- "Sensing and Opportunistic Delivery of Ubiquitous Video in Health Monitoring, On-Campus and Social Network Applications," Workshop on Mobile Video Delivery (MoViD), Chapel Hill North Carolina, USA, February 2012.

- "Medium Access in New Contexts: Reinventing the Wheel?," USC Invited Workshop on Theory and Practice in Wireless Networks, Los Angeles, California, USA, May 2008.

- "The Wild, Wild West: Wireless Networks Need a New Sheriff," University of Florida CISE Department Lecture Series, Gainesville, Florida, USA, February 2008.

- "Distinguishing Between Connectivity, Intermittent Connectivity, and Intermittent Disconnectivity," Keynote at the ACM MobiCom Workshop on Challenged Networks (CHANTS), Montreal, CANADA, September 2007.

- "The Three Ghosts of Multicast: Past, Present, and Future," Keynote at the Trans-European Research and Education Networking Association (TERENA) Networking Conference, Lynby, DENMARK, May 2007.

- "Multicast Help Wanted: From Where and How Much?," Keynote at the Workshop on Peer-to-Peer Multicasting (P2PM), Las Vegas, Nevada, USA, January 2007.

- "The Confluence of Wi-Fi and Apps: What to Expect Next," Engineering Insights, UC-Santa Barbara, Santa Barbara, California, USA, October 2006.

- "Challenges, Opportunities, and Implications for the Future Internet," University of Minnesota Digital Technology Center, Minneapolis, Minnesota, USA, September 2006.

- "Wireless Technology as a Catalyst: Possibilities for Next-Generation Interaction," Santa Barbara Forum on Digital Transitions, Santa Barbara, California, USA, April 2006.

- "Challenges and Opportunities in an Internet with Pervasive Wireless Access," University of Texas--Dallas Computer Science Colloquium, Dallas, Texas, USA, March 2006.

- "Challenges and Opportunities with Pervasive Wireless in the Internet," Duke University Computer Science Colloquium, Durham, North Carolina, USA, February 2006.

- "The Span From Wireless Protocols to Social Applications," Intel Research Labs, Cambridge, United Kingdom, December 2005.

- "The Internet Dot.Com Bomb and Beyond the Dot.Com Calm," CSE IGERT and Cal Poly Lecture Series, San Luis Obispo, California, USA, October 2005.

- "Panel: Directions in Networking Research," IEEE Computer Communications Workshop (CCW), Irvine, California, USA, October 2005.

- "Economic Incentives for Ad Hoc Networks," KAIST New Applications Seminar, Seoul, South Korea, March 2004.

- "New Applications for the Next Generation Internet," Citrix Systems, Santa Barbara, California, USA, March 2004.

- "PI: The Imperfect Pursuit of Pure Pattern," CITS Visions in Technology Series, Santa Barbara,

California, USA, January 2004.

- "Panel: Core Networking Issues and Protocols for the Internet," National Science Foundation (NSF) Division of Advanced Networking Infrastructure and Research (ANIR) Principal Investigators Workshop, Washington DC, USA, March 2003.
- "Panel: Pricing for Content in the Internet," SPIE ITCom Internet Performance and Control of Network Systems, Boston, Massachusetts, USA, July 2002.
- "The Technology Behind Wireless LANs," Central Coast MIT Enterprise Forum, Santa Barbara, California, USA, March 2002.
- "Lessons Learned in the Digital Classroom," Center for Information and Technology Brown Bag Symposium, Santa Barbara, California, USA, March 2002.
- "The Evolution of Advanced Networking Services: From the ARPAnet to Internet2," California State University--San Luis Obispo CS Centennial Colloquium Series, San Luis Obispo, California, USA, February 2002.
- "Deployment of IP Multicast in Campus Infrastructures," Internet2 Campus Deployment Workshop, Atlanta, Georgia, USA, May 2001.
- "Multicast: Is There Anything Else to Do?," Sprint Research Retreat, Miami, Florida, USA, May 2001.
- "The Evolution of Next-Generation Internet Services and Applications," Government Technology Conference 2001 (GTC) for the Western Region, Sacramento, California, USA, May 2001.
- "I2 Multicast: Not WIDE-scale Deployment, FULL-scale Deployment," Closing Plenary, Internet2 Member Meetings, Washington, D.C., USA, March 2001.
- "Panel: Beyond IP Multicast," Content Delivery Networks (CDN), New York, New York, USA, February 2001.
- "Viable Multicast Pricing & Business Models for Wider-Scale Deployment," Content Delivery Networks (CDN), New York, New York, USA, February 2001.
- "IP Multicast: Modern Protocols, Deployment, and Management," Content Delivery Networks (CDN), New York, New York, USA, February 2001 & San Jose, California, USA, December 2001.
- "Under the Hood of the Internet," Technology 101: Technology for Investors, Center for Entrepreneurship & Engineering Management, November 2000.
- "Understanding Multicast Traffic in the Internet," (1) University of Virginia, (2) University of Maryland, and (3) Columbia University, September 2000.
- "The Bad, The Ugly, and The Good: The Past, Present, and Future of Multicast," Digital Fountain, San Francisco, California, USA, August 2000.
- "Implications of Source-Specific Multicast (SSM) on the Future of Internet Content Delivery," Occam Networks, Santa Barbara, California, USA, August 2000.
- "Introduction to Multicast Routing Protocols," UC-Berkeley Open Mash Multicast Workshop, Berkeley, California, USA, July 2000.

- "Efforts to Understand Traffic and Tree Characteristics," University of Massachusetts--Amherst Colloquia, Amherst, Massachusetts, USA, May 2000.
- "Monitoring Multicast Traffic," Sprint Research Retreat, Half Moon Bay, California, USA, April 2000.
- "What is the Next Generation of Multicast in the Internet?," HRL Laboratories, Malibu, California, USA, January 2000.
- "Mission and Status of the Center for Information Technology and Society (CITS)," Intel Research Council, Portland, Oregon, USA, September 1999.
- "Multicast at a Crossroads," IP Multicast Initiative Summits and Bandwidth Management Workshops, San Francisco, CA, USA, (1) October 1999; (2) February 2000; and (3) June 2000.
- "IP Multicast: Modern Protocols, Deployment, and Management," Networld+Interop: (1) Las Vegas, Nevada, USA--May 2000; (2) Tokyo, JAPAN--June 2000; (3) Atlanta, Georgia, USA--September 2000; (4) Las Vegas, Nevada, USA--May 2001; (5) Las Vegas, Nevada, USA--May 2002.
- "IP Multicast: Practice and Theory" (w/ Steve Deering), Networld+Interop: (1) Las Vegas, Nevada, USA--May 1999; (2) Tokyo, JAPAN--June 1999; and (3) Atlanta, Georgia, USA--September 1999.
- "Internet2 Multicast Testbeds and Applications," Workshop on Protocols for High Speed Networks (PfHSN), Salem, Massachusetts, USA, August 1999.
- "IP Multicast: Protocols for the Intra- and Inter-Domain," Lucent Technologies, Westford, Massachusetts, USA, August 1999.
- "Internet2 Multicast Testbeds and Applications," NASA Workshop: Bridging the Gap, Moffett Field, California, USA, August 1999.
- "The Evolution of Next-Generation Services and Applications in the Internet," Tektronix Distinguished Lecture Series, Portland, Oregon, USA, May 1999.
- "Multicast Applications and Infrastructure in the Next Generation Internet," CENIC 99 Workshop on Achieving Critical Mass for Advanced Applications, Monterey, California, USA, May 1999.
- "Multicast Traffic Monitoring and Analysis Work at UCSB" (w/ P. Rajvaidya), Workshop on Internet Statistics and Metrics Analysis (ISMA), San Diego, California, USA, April 1999.
- "How the Internet Works: Following Bits Around the World," Science Lite, Santa Barbara General Affiliates and Office of Community Relations, California, USA, February 1999.
- "Managing Multicast: Challenges, Tools, and the Future," IP Multicast Initiative Summit, San Jose, California, USA, February 1999.
- "The Future of Multicast Communication and Protocols," Internet Bandwidth Management Summit (iBAND), San Jose, California, USA, November 1998.
- "An Overview of IP Multicast: Applications and Deployment," (1) Workshop on Evaluating IP Multicast as the Solution for Webcasting Real-Time Networked Multimedia Applications, New York, New York, USA, July 1998; and (2) Satellites and the Internet Conference, Washington, D.C., USA, July 1998.

- "IETF Developments in IP Multicast," IP Multicast Initiative Summit, San Jose, California, USA, February 1998.

- "An Introduction to IP Multicast and the Multicast Backbone (MBone)" vBNS Technical Meeting sponsored by the National Center for Network Engineering (NLANR), San Diego, California, USA, February 1998.

- "Using Multicast Communication to Deliver WWW Pages" Computer Communications Workshop (CCW '97), Phoenix, Arizona, USA, September 1997.

G. Research Funding

- K. Almeroth, "Packet Scheduling Using IP Embedded Transport Instrumentation," Cisco Systems Inc., $100,000, 3/1/13-8/31/14.

- K. Almeroth, E. Belding and S.J. Lee, "GOALI: Maximizing Available Bandwidth in Next Generation WLANs", National Science Foundation (NSF), $101,088, 10/1/13-9/30/14.

- K. Almeroth and E. Belding, "GOALI: Intelligent Channel Management in 802.11n Networks," National Science Foundation (NSF), $51,000, 10/1/10-9/30/11.

- B. Zhao, K. Almeroth, H. Zheng, and E. Belding, "NeTS: Medium: Airlab: Distributed Infrastructure for Wireless Measurements," National Science Foundation (NSF), $700,000, 9/1/09-8/13/13.

- K. Almeroth, E. Belding and T. Hollerer, "NeTS-WN: Wireless Network Health: Real-Time Diagnosis, Adaptation, and Management," National Science Foundation (NSF), $600,000, 10/1/07-9/30/10.

- K. Almeroth, "Next-Generation Service Engineering in Internet2," University Consortium for Advanced Internet Development (UCAID), $1,254,000, 7/1/04-6/30/09 (reviewed and renewed each year).

- B. Manjunath, K. Almeroth, F. Bullo, J. Hespanha, T. Hollerer, C. Krintz, U. Madhow, K. Rose, A. Singh, and M. Turk, "Large-Scale Multimodal Wireless Sensor Network," Office of Naval Research Defense University Research Instrumentation Program (DURIP), $655,174, 4/14/08-4/14/09.

- K. Almeroth and E. Belding, "Improving Robustness in Evolving Wireless Infrastructures," Intel Corporation, $135,000, 7/1/06-6/30/09 (reviewed and renewed for second and third year).

- K. Almeroth and K. Sarac, "Bridging Support in Mixed Deployment Multicast Environments," Cisco Systems Inc., $100,000, 9/1/07-8/31/08.

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- E. Belding, K. Almeroth and J. Gibson, "Real-Time Communication Support in a Ubiquitous Next-Generation Internet," National Science Foundation (NSF), $900,000, 10/1/04-9/30/07.

- K. Almeroth and K. Sarac, "Improving the Robustness of Multicast in the Internet," Cisco Systems Inc., $80,000, 9/1/04-8/31/05.

- R. Mayer, B. Bimber, K. Almeroth and D. Chun, "Assessing the Pedagogical Implications of Technology in College Courses," Mellon Foundation, $350,000, 7/1/04-6/30/07.

- B. Bimber, A. Flanagin and C. Stol, "Technological Change and Collective Association: Changing Relationships Among Technology, Organizations, Society and the Citizenry," National Science Foundation (NSF), $329,175, 7/1/04-6/30/07.

- K. Almeroth and B. Bimber, "Plagiarism Detection Techniques and Software," UCSB Instructional Development, $22,000, 7/1/04-6/30/05.

- K. Almeroth, "Student Travel Support for the 14th International Workshop on Network and Operating Systems Support for Digital Audio and Video (NOSSDAV)," National Science Foundation (NSF), $10,000, 5/1/04-8/31/04.

- K. Almeroth, "An Automated Indexing System for Remote, Archived Presentations," QAD Inc., $25,000, 5/1/04-6/30/05.

- K. Almeroth and M. Turk, "A Remote Teaching Assistant Support System," Microsoft, $40,000, 1/1/04-6/30/05.

- K. Almeroth, "Supporting Multicast Service Functionality in Helix," Real Networks, $30,000, 9/1/03-6/30/04.

- K. Almeroth and E. Belding, "Service Discovery in Mobile Networks," Nokia Summer Research Grant (U. Mohan), $10,240, 7/1/03-9/30/03.

- K. Almeroth, D. Zappala, "Building a Global Multicast Service," Cisco Systems Inc., $100,000, 1/1/03-6/30/04.

- K. Almeroth, "Developing A Dynamic Protocol for Candidate Access Router Discovery," Nokia Graduate Student Fellowship (R. Chalmers), $26,110, 9/01/02-6/30/03.

- B. Bimber and K. Almeroth, "The Role of Collaborative Groupware in Organizations," Toole Family Foundation, $182,500 ($20,000 cash plus $162,500 in software), 9/1/02-8/30/07.

- B. Manjunath, et al., "Digital Multimedia: Graduate Training Program in Interactive Digital Multimedia," National Science Foundation (NSF), $2,629,373, 4/1/02-3/31/07.

- J. Green, K. Almeroth, et al., "Inquiry in the Online Context: Learning from the Past, Informing the Future," UCSB Research Across Disciplines, $10,000, 9/1/01-8/31/02.

- K. Almeroth, "Monitoring and Maintaining the Global Multicast Infrastructure," Cisco Systems Inc., $54,600, 7/1/01-6/30/02.

- R. Kemmerer, K. Almeroth, et al., "Hi-DRA High-speed, Wide-area Network Detection, Response, and Analysis," Department of Defense (DoD), $4,283,500, 5/1/01-4/30/06.

- A. Singh, K. Almeroth, et al., "Digital Campus: Scalable Information Services on a Campus-wide Wireless Network," National Science Foundation (NSF), 1,450,000, 9/15/00-12/31/04.

- K. Almeroth, "Visualizing the Global Multicast Infrastructure," UC MICRO w/ Cisco Systems Inc., $85,438, 7/1/00-6/30/02.

- H. Lee, K. Almeroth, et al., "Dynamic Sensing Systems," International Telemetering Foundation, $260,000, 07/01/00-06/30/04.

- B. Bimber and K. Almeroth, "Funding for the Center on Information Technology and Society," $250,000 from Dialogic (an Intel Company) and $250,000 from Canadian Pacific.

- K. Almeroth, "CAREER: From Protocol Support to Applications: Elevating Multicast to a Ubiquitous Network Service," National Science Foundation (NSF), $200,000, 9/1/00-8/31/04.

- K. Almeroth, "Characterizing Multicast Use and Efficiency in the Inter-Domain," Sprint Advanced Technology Laboratories, $62,500, 3/1/00-6/30/01.

- K. Almeroth, "Producing the Next Generation of Multicast Monitoring and Management Protocols and Tools," UC MICRO w/ Cisco Systems Inc., $124,500, 7/1/99 - 6/30/01.

- K. Almeroth, "Utilizing Satellite Links in the Provision of an Inter-Wide Multicast Service," HRL Laboratories, $20,000, 7/1/99 - 6/30/00.

- T. Smith, K. Almeroth, et al., "Alexandria Digital Earth Prototype," National Science Foundation, $5,400,000, 4/1/99-3/31/04.

- V. Vesna, K. Almeroth, et al., "Online Public Spaces: Multidisciplinary Explorations in Multi-User Environments (OPS:MEME), Phase II," UCSB Research Across Disciplines, $50,000, 9/1/98-8/31/99.

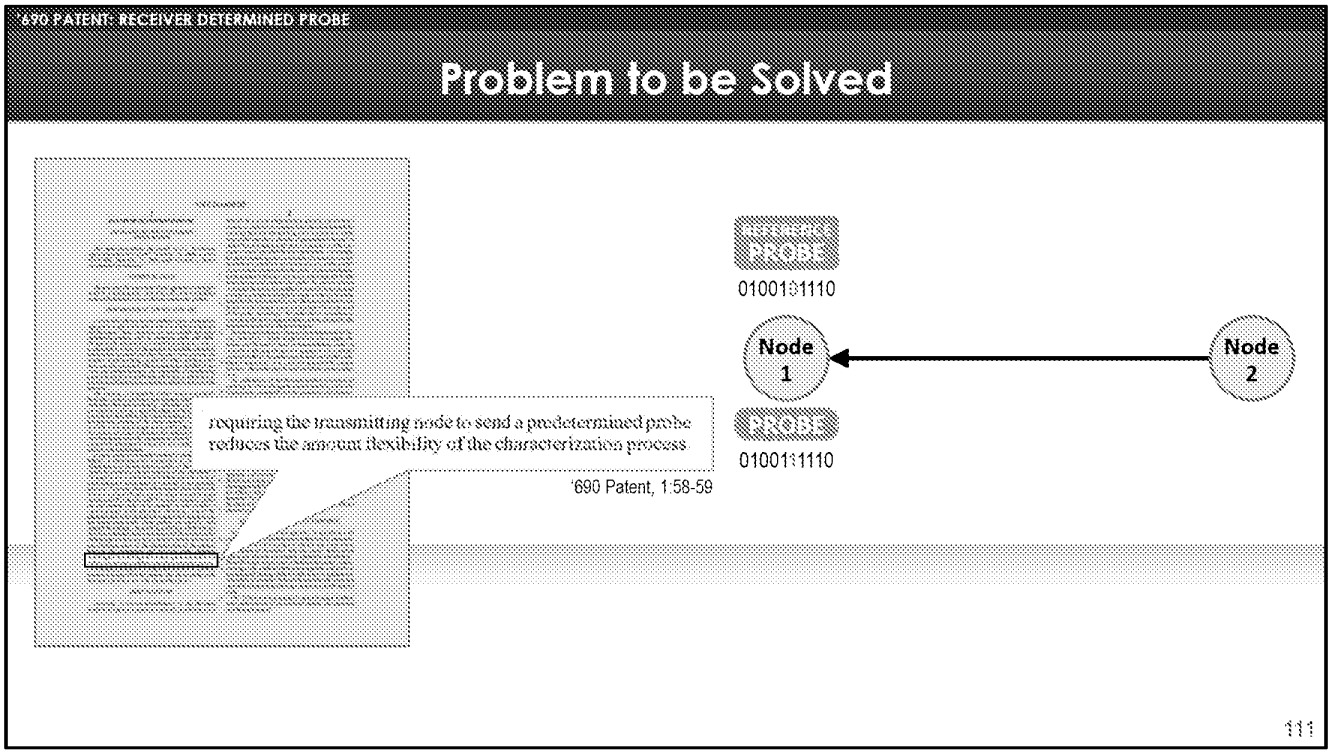
- K. Almeroth, "Techniques and Analysis for the Provision of Multicast Route Management," UC MICRO w/ Cisco Systems Inc., $97,610, 7/1/98 - 6/30/00.

- K. Almeroth, "Capturing and Modeling Multicast Group Membership in the Multicast Backbone (MBone)," UC MICRO w/ Hughes Research Labs, $19,146, 7/1/98 - 12/31/99.

- K. Almeroth, "Building a Content Server for the Next Generation Digital Classroom," UCSB Faculty Research Grant, $5,000, 7/1/98-6/31/99.

H. Research Honors and Awards

- IEEE Fellow Status, 2013
- Finalist for Best Paper Award, IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON), June 2008
- Best Paper Award, Passive and Active Measurement (PAM) Conference, April 2007
- Outstanding Paper Award, World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA), June 2006
- IEEE Senior Member Status, 2003
- Finalist for Best Student Paper Award, ACM Multimedia, December 2002
- Outstanding Paper Award, World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA), June 2002
- Computing Research Association (CRA) Digital Government Fellowship, 2001
- National Science Foundation CAREER Award, 2000
- Best Paper Award, 7th International World Wide Web Conference, April 1998



According to the specification, however, the requirement that the probes be predefined limits the ability of the receiving node to determine characteristics of the channel.

Receiver Determined Probe

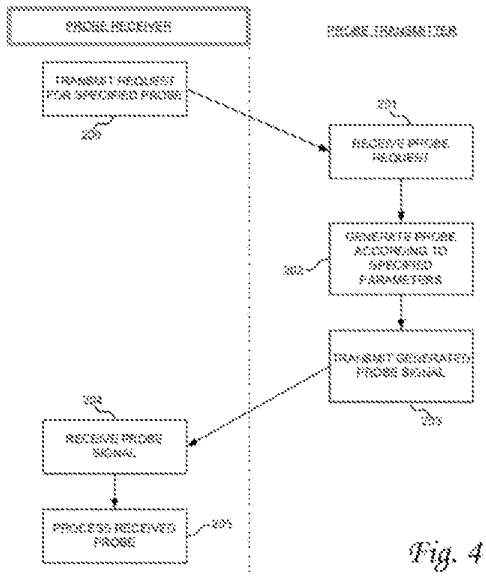


Fig. 4

112

That's where the alleged invention of the 690 patent comes in. The patent is directed to a receiver determined probe, whereby the node that will receive the probe determines what the form of the probe will be.

The patent explains this with respect to Figure 4, where the node that will receive the probe is called the probe receiver.

'670 PATENT: RECEIVER DETERMINED PROBE

Receiver Determined Probe

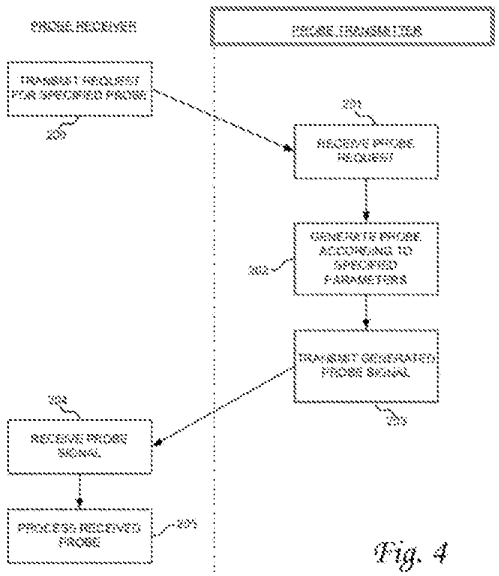


Fig. 4

113

And the node that will generate and transmit the probe is called the probe transmitter.

'690 PATENT: RECEIVER DETERMINED PROBE

Receiver Determined Probe

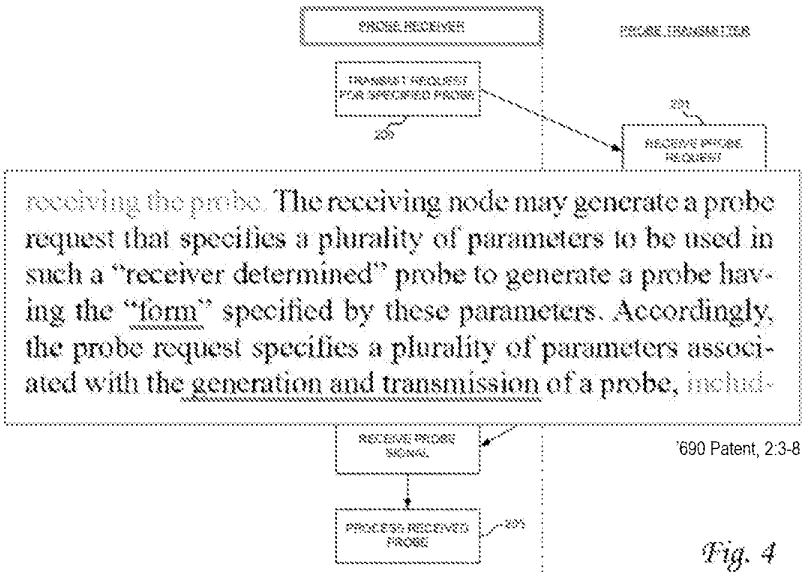


Fig. 4

114

According to the specification, the probe receiver specifies parameters that dictate the "form" of the probe it wants to receive. Those parameters dictate how the probe will be generated and transmitted by the probe transmitter.

'690 PATENT: RECEIVER DETERMINED PROBE

Probe Request

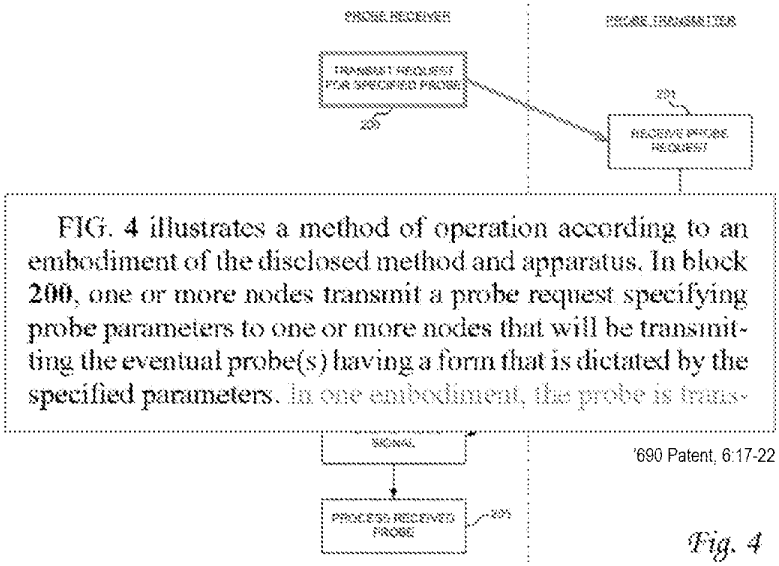


FIG. 4 illustrates a method of operation according to an embodiment of the disclosed method and apparatus. In block **200**, one or more nodes transmit a probe request specifying probe parameters to one or more nodes that will be transmitting the eventual probe(s) having a form that is dictated by the specified parameters. In one embodiment, the probe is trans-

'690 Patent, 6:17-22

Fig. 4

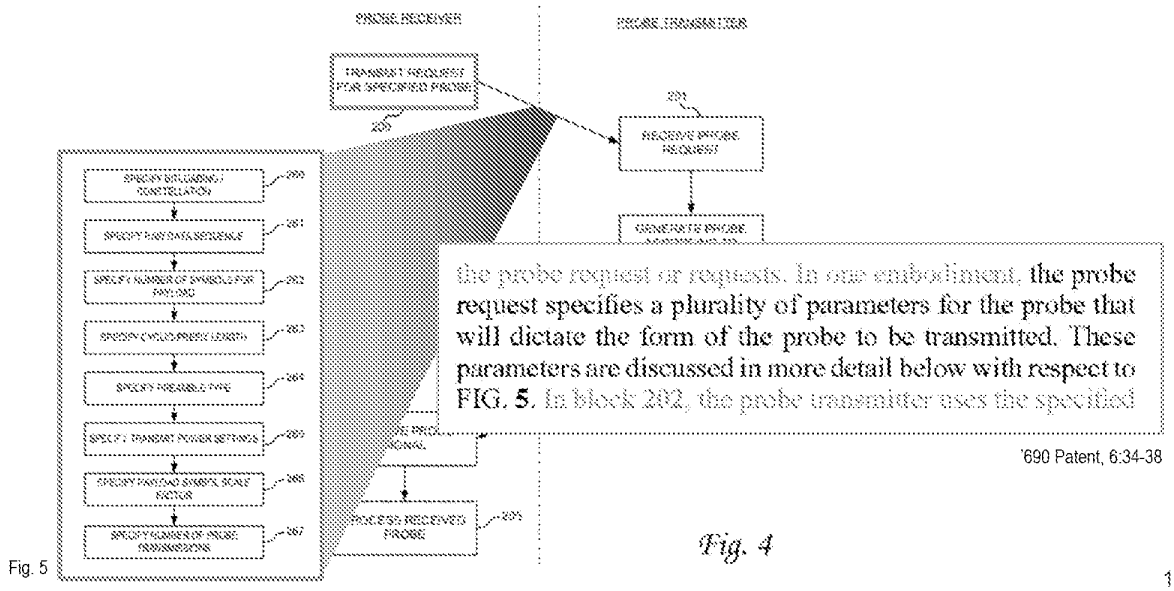
115

So let's review how this works with reference to Figure 4

First, at block 200, the Probe receiver transmits a probe request to the probe transmitter. The probe request contains parameters that dictate the form of the probe to be generated and transmitted by the probe transmitter.

'690 PATENT: RECEIVER DETERMINED PROBE

Probe Request Parameters



The parameters contained in the probe request which dictate the form of the probe are said to be depicted in figure 5.

'670 PATENT: RECEIVER DETERMINED PROBE

Probe Transmitter

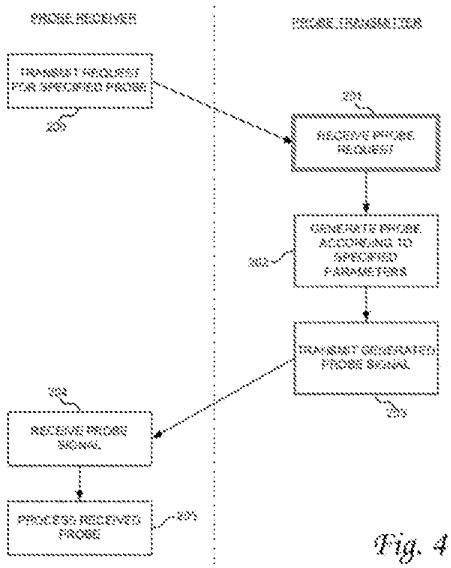


Fig. 4

117

The probe transmitter receives the probe request in block 201.

'690 PATENT: RECEIVER DETERMINED PROBE

Probe Transmitter

FIG. 8. In block **202**, the probe transmitter uses the specified probe parameters to generate a probe having a form that complies with the specified parameters. In block 203, the

'690 Patent, 6:38-40

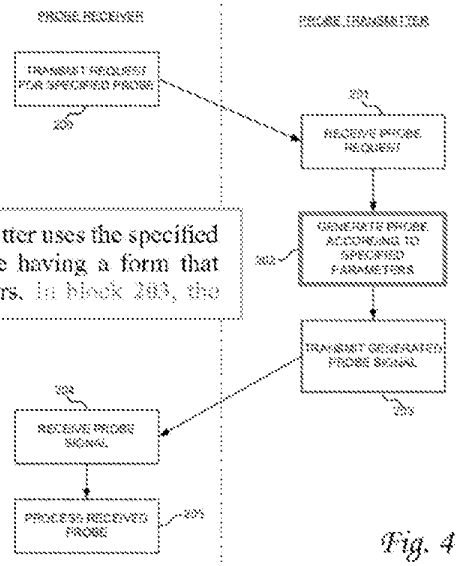


Fig. 4

118

And in block 202, it generates the probe in accordance with the parameters it received in the probe request.

'670 PATENT: RECEIVER DETERMINED PROBE

Probe Transmitter

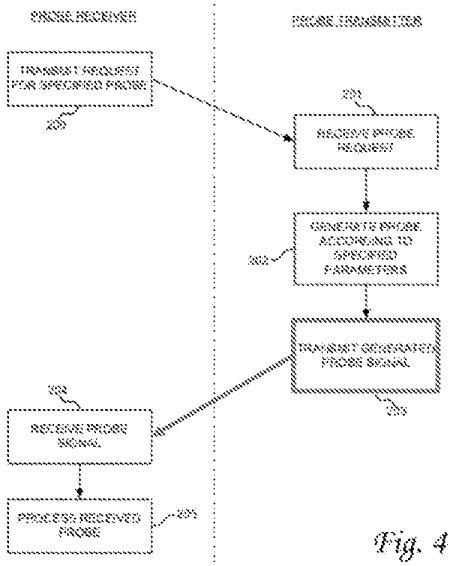


Fig. 4

119

It then transmits the probe it generated to the probe receiver

'690 PATENT: RECEIVER DETERMINED PROBE

Probe Receiver

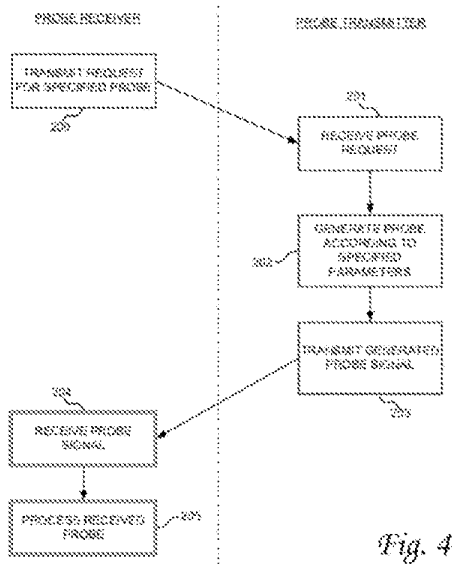
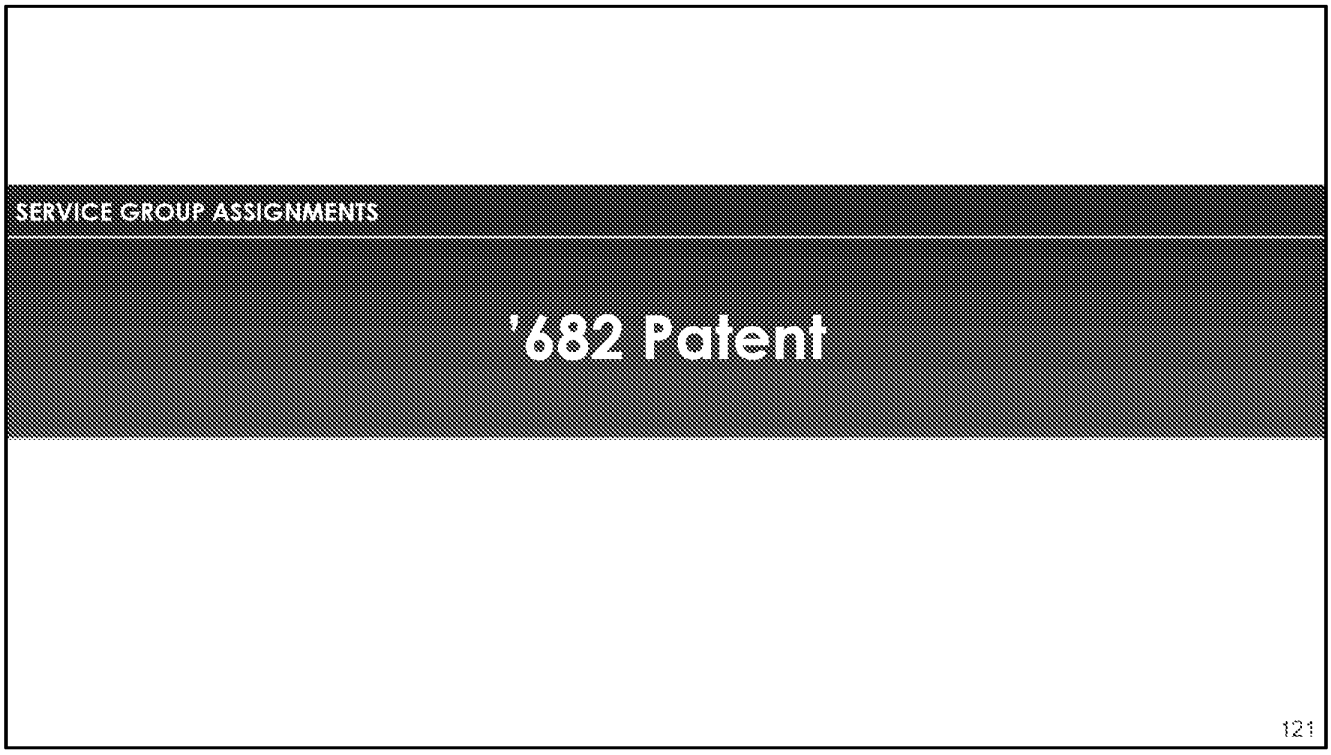


Fig. 4

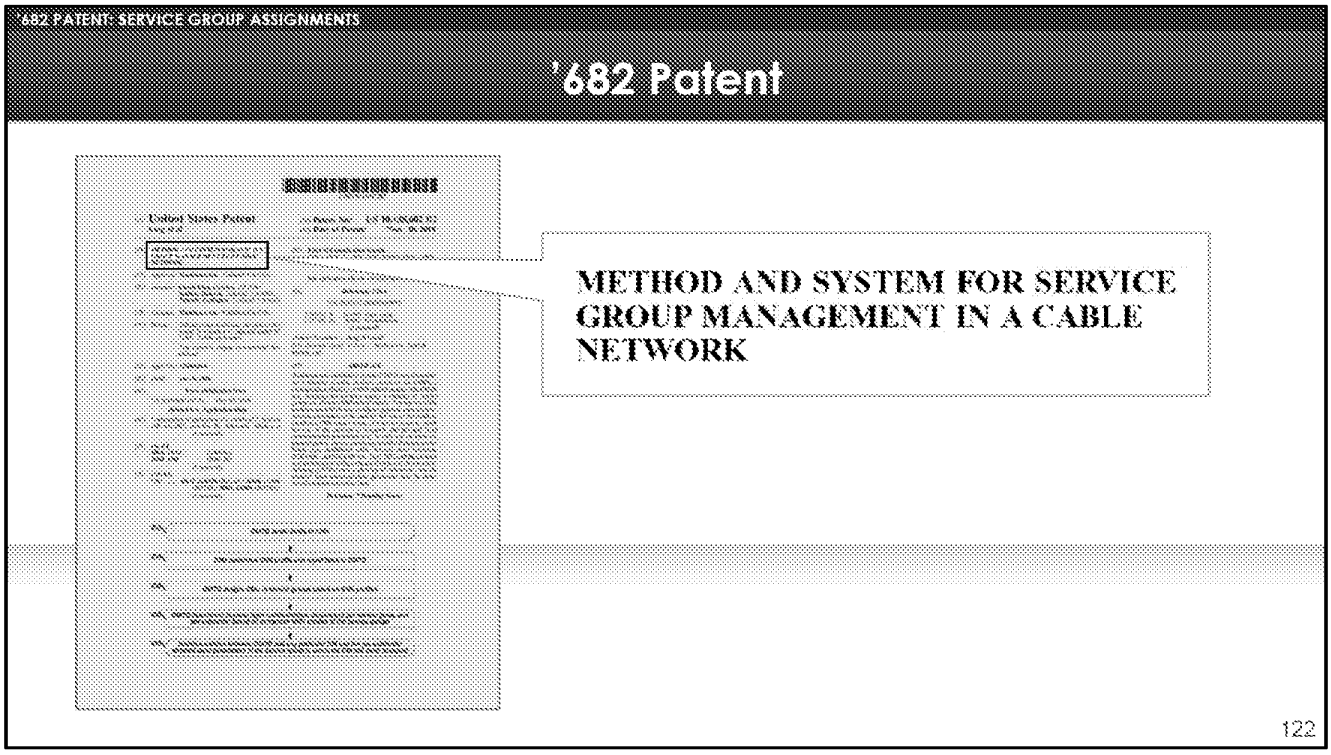
120

After which the probe receiver receives and processes the probe in blocks 204 and 205.

That concludes our discussion of the 690 patent. Again, we will not address the claims of the 690 patent because Charter contends those claims are indefinite and that it is not possible to understand what those claims cover.

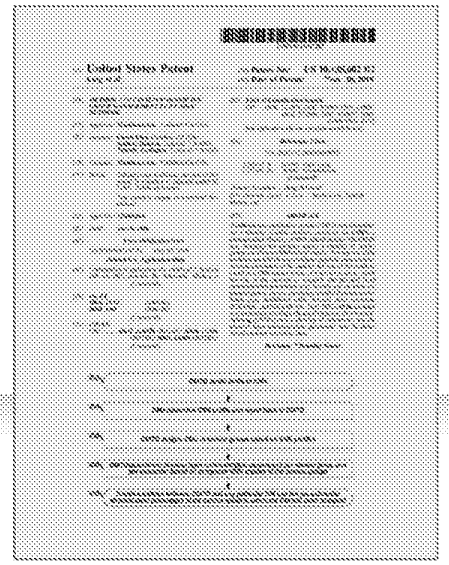


Finally, the last of the asserted patents is the 682 patent.



As the title suggests, this patent discloses an allegedly novel way of assigning cable modems to service groups.

Problem To Be Solved



BACKGROUND OF THE INVENTION

Convention cable television networks can be inefficient and have insufficient capacity. Further limitations and disadvantages of conventional and traditional approaches will become apparent to one of skill in the art, through comparison of such systems with some aspects of the present invention as set forth in the remainder of the present application with reference to the drawings.

BRIEF SUMMARY OF THE INVENTION

A system and/or method is provided for service group management in a cable television network, substantially as

'682, Patent 1:56-67

123

According to the specification, existing cable networks are inefficient and have insufficient capacity. The disclosed system and method for assigning cable modems to service groups is said to address these issues.

'682 PATENT: SERVICE GROUP ASSIGNMENTS

DOCSIS Cable Network

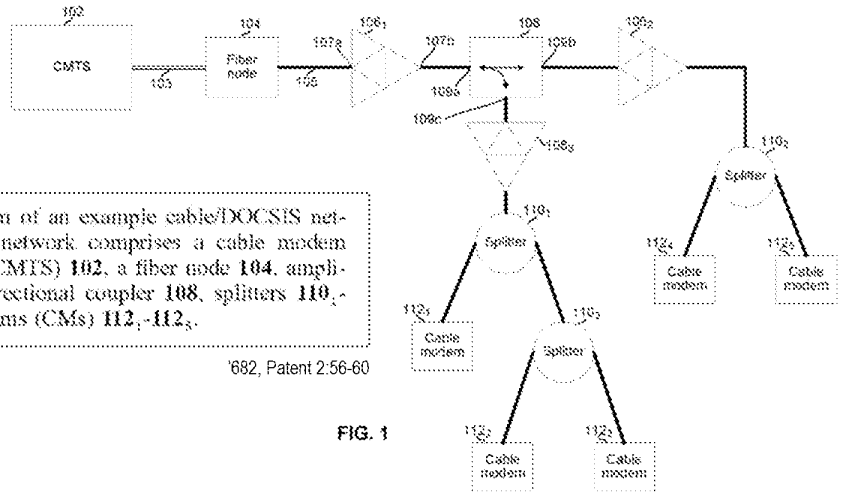


FIG. 1 is a diagram of an example cable/DOCSIS network. The example network comprises a cable modem termination system (CMTS) **102**, a fiber node **104**, amplifiers $\mathbf{106_1}$-$\mathbf{106_3}$, a directional coupler **108**, splitters $\mathbf{110_1}$-$\mathbf{110_3}$, and cable modems (CMs) $\mathbf{112_1}$-$\mathbf{112_5}$.

'682, Patent 2:56-60

FIG. 1

124

An exemplary DOCSIS cable network showing cable modems to be assigned to service groups is depicted in Figure 1.

'632 PATENT: SERVICE GROUP ASSIGNMENTS

DOCSIS Cable Network

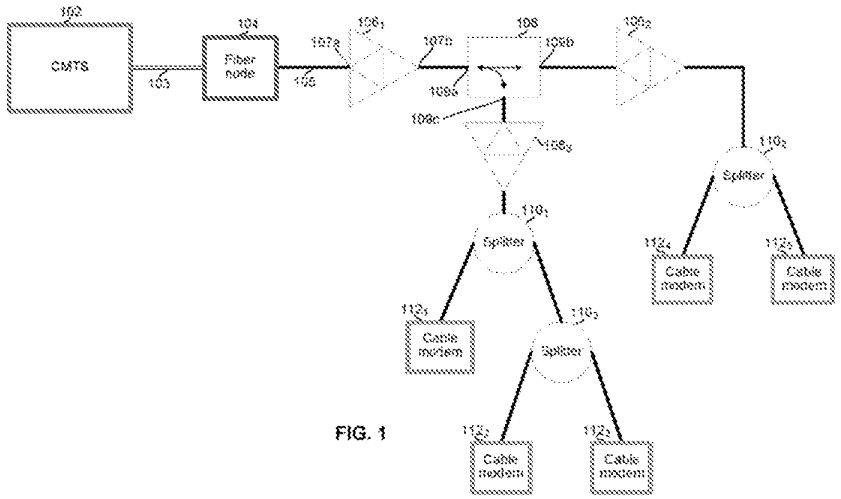
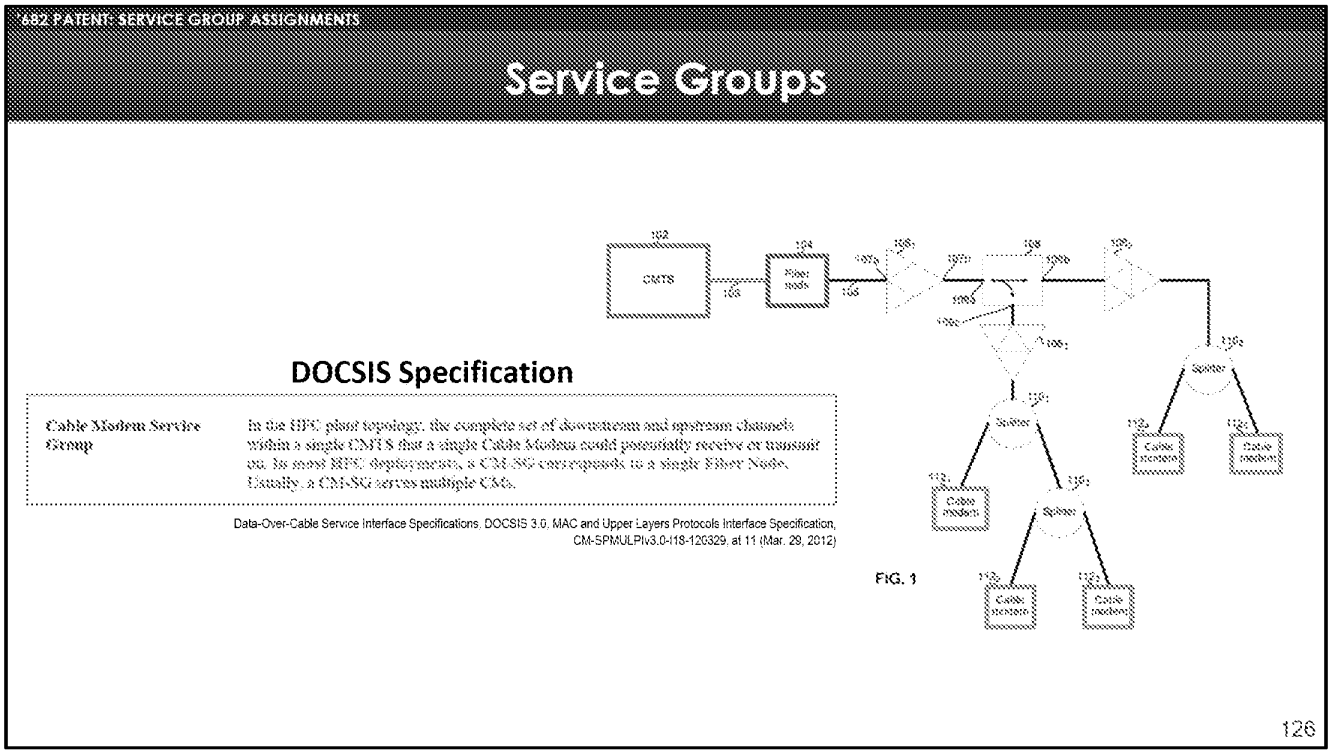


FIG. 1

125

The cable modems are annotated in green. In addition, we've annotated the CMTS in red, and a device called a fiber node in blue.



Now before we explain the disclosed method of assigning cable modems to service groups, we have to fist explain what a service group is. The term service group has a well-understood plain and ordinary meaning in the cable television art. In fact, the DOCSIS specification itself provides that definition. We have put that definition on the slide.

A cable modem service group is the complete set of downstream and upstream channels within a single CMTS that a single Cable Modem could potentially receive or transmit on. As the text in red indicates, in most but not all instances, a cable modem service group includes all of the cable modems which correspond to the same fiber node. In figure 1 of the 682 patent, that would be all of the cable modems annotated in green.

As we will see, the alleged invention purports to allow the creation of service groups whereby cable modems corresponding to the same fiber node can be in different service groups

Assigning Cable Modems To Service Groups

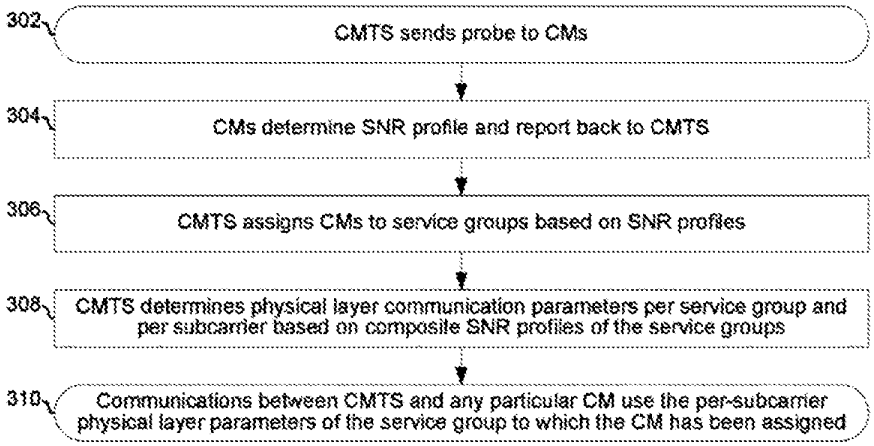


FIG. 3A

127

So now I'll explain the disclosed method of assigning cable modems to service groups. Figure 3A of the patent depicts that method.

'632 PATENT: SERVICE GROUP ASSIGNMENTS

Assigning Cable Modems To Service Groups

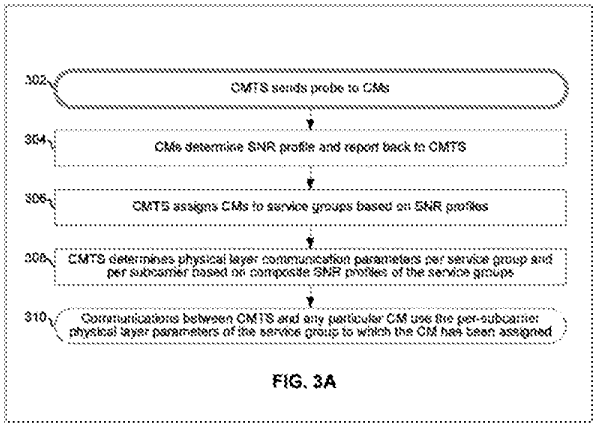


FIG. 3A

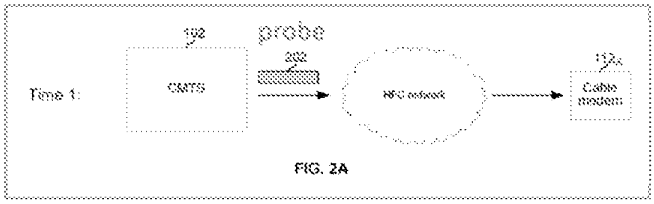


FIG. 2A

128

First, the CMTS sends probes to the cable modems. This is depicted graphically in Figure 2A of the patent.

'682 PATENT: SERVICE GROUP ASSIGNMENTS

SNR Profile

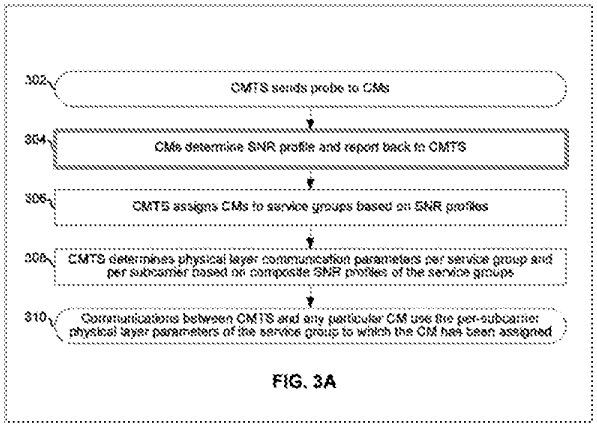


FIG. 3A

129

Each cable modem then uses the probe to determine its SNR profile.

SNR Profile

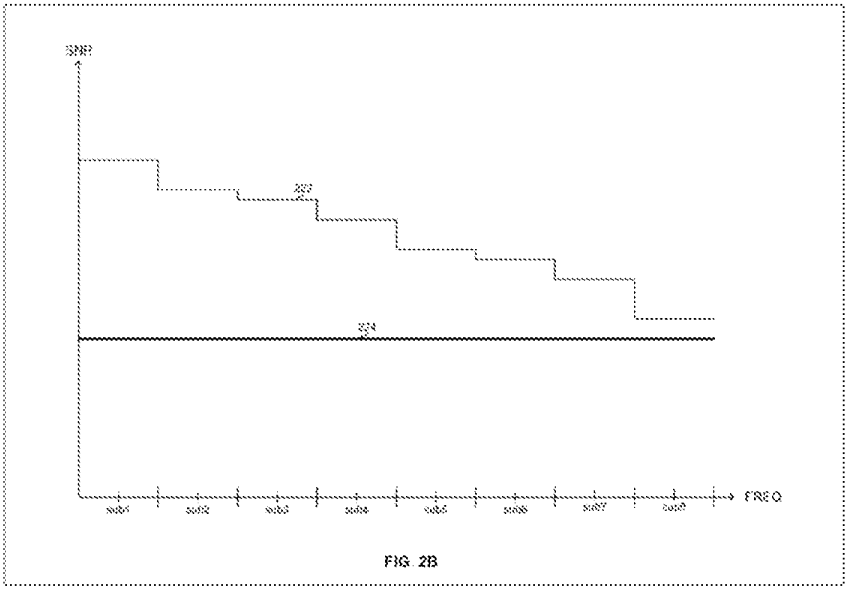
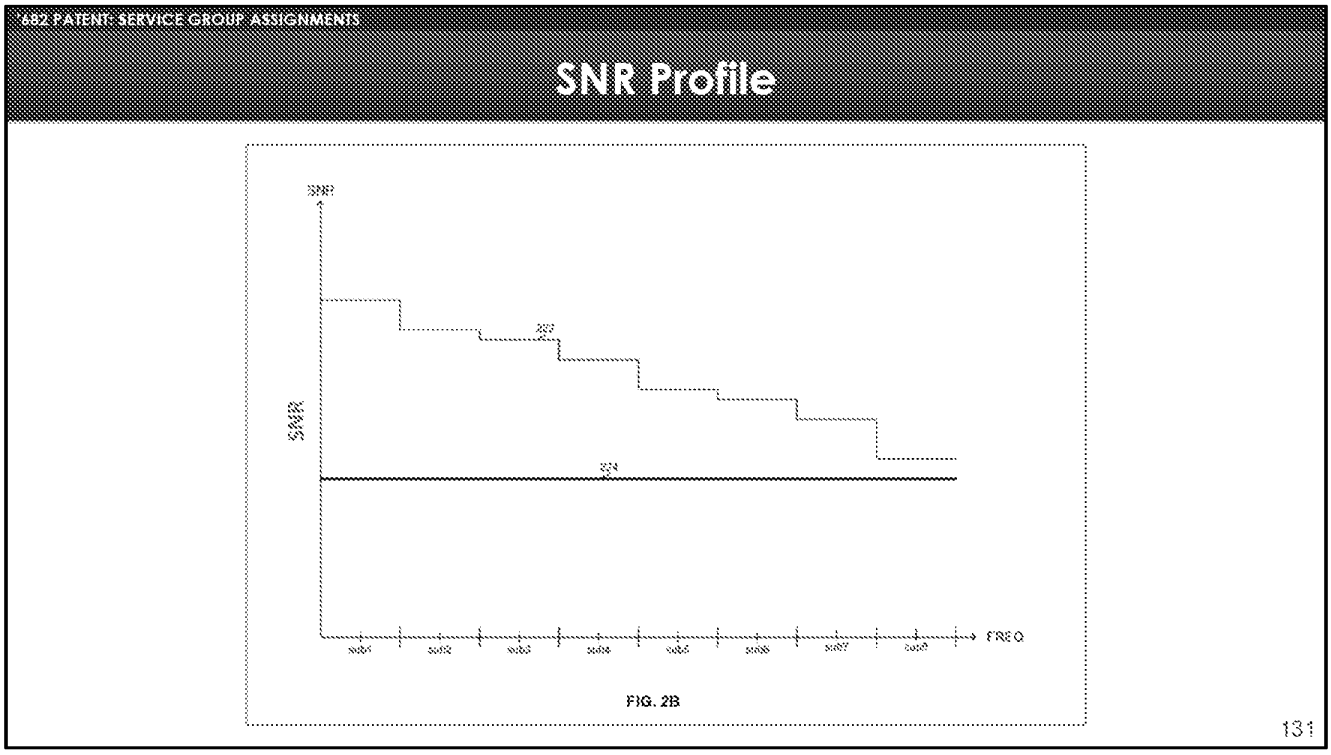


FIG. 2B

130

We'll explain what an SNR profile is with reference to Figure 2B.



The y-axis on Figure 2B is the SNR. SNR stands for signal to noise ratio. A signal to noise ratio is the ratio of the signal level to the noise level. The higher the SNR the greater the ratio of signal to noise. Greater signal and less noise is better, as noise interferes with the ability to understand or properly interpret the signal that is received.

SNR Profile

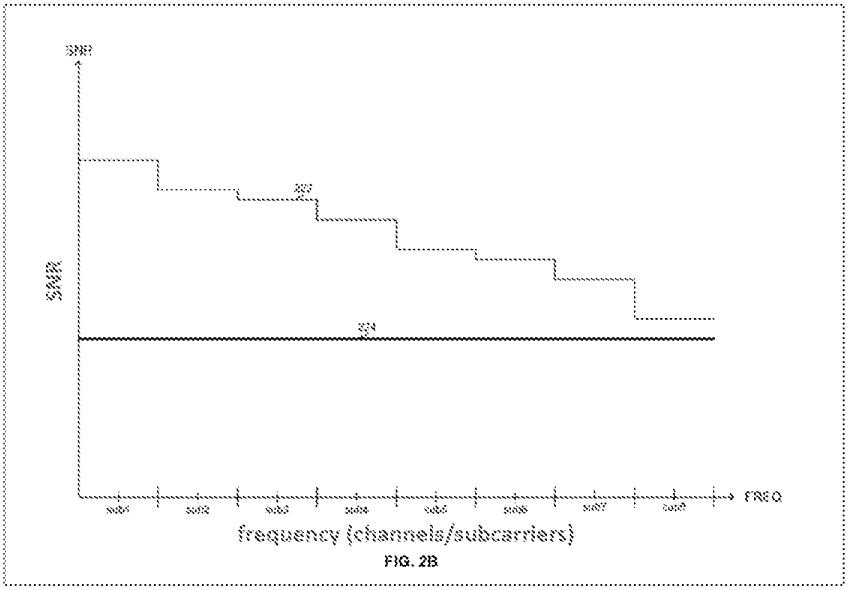


FIG. 2B

132

The x axis is frequency. Figure 2B depicts different subcarriers on the x axis which are at different frequencies. In the example of figure 2B, eight subcarriers are used which are denoted sub 1 through sub 8.

SNR Profile

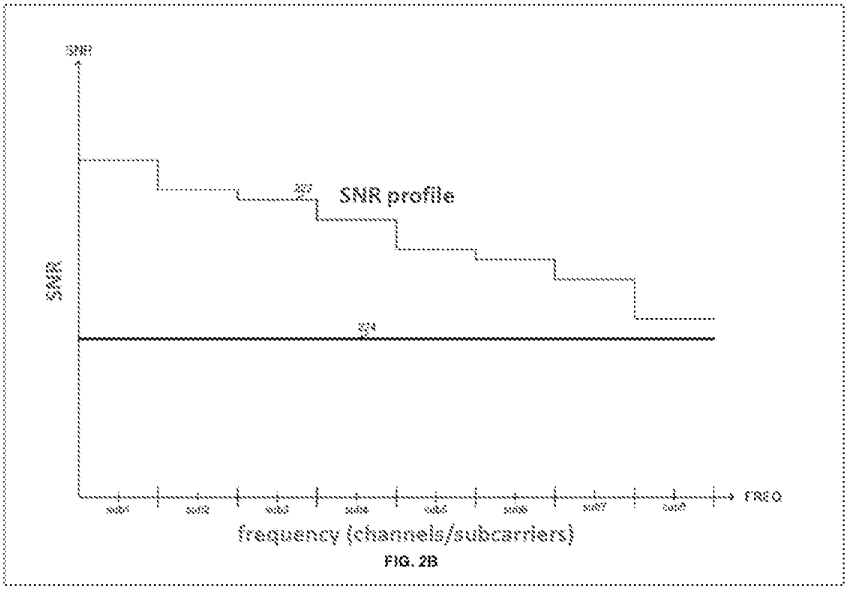


FIG. 2B

133

The line labeled 222 represents the SNR at each of the subcarriers.

When a cable modem is returning its SNR profile to the CMTS, line 222 would represent the SNR of that particular cable modem at each subcarrier.

SNR Profile

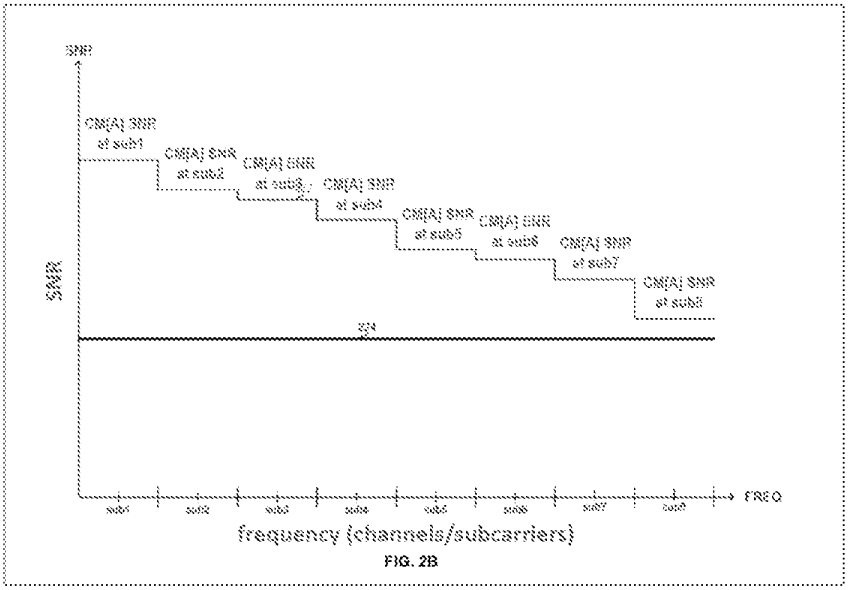
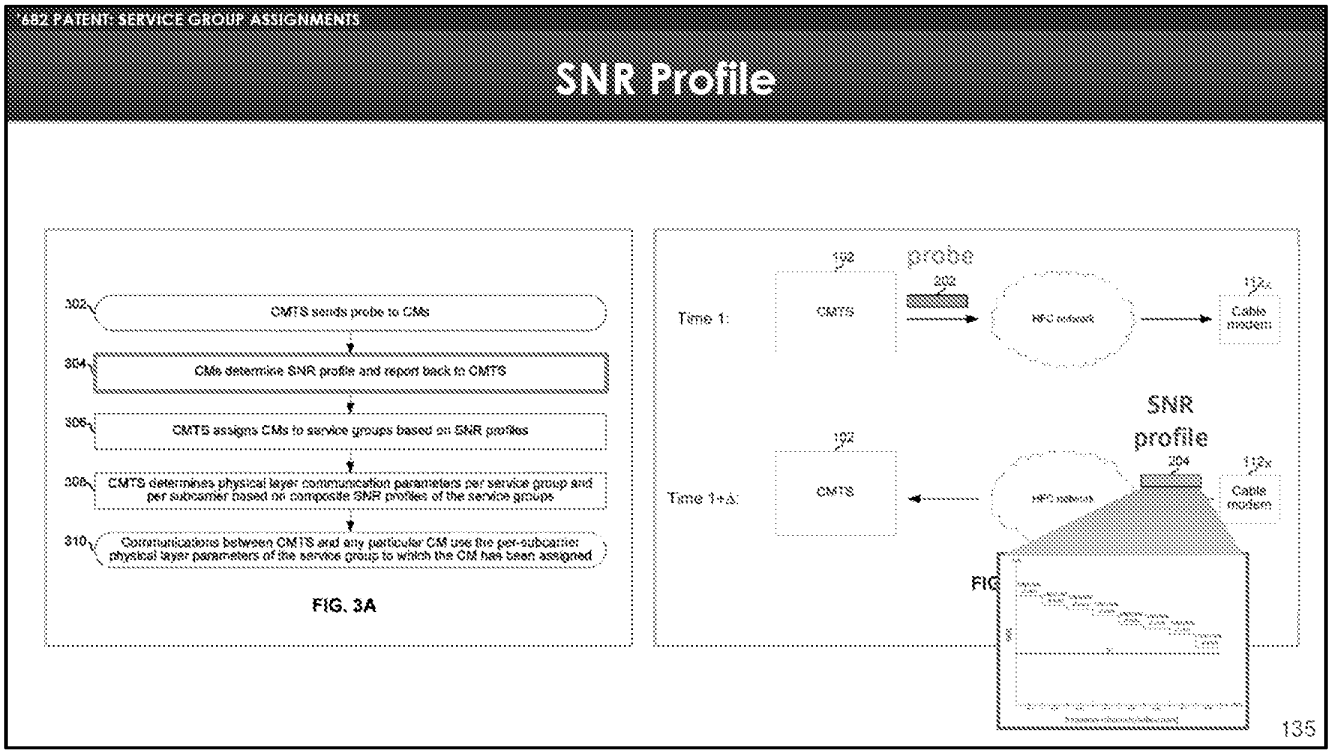


FIG. 2B

134

Thus, if a hypothetical cable modem A was returning its SNR profile to the CMTS, each step in line 222 would be the SNR of cable modem A at one of the subcarriers.

In this illustration, cable modem A is designated as C M followed by the letter A in brackets.



Next, in step 306, the CMTS uses the SNR profiles it received from all the cable modems to assign the cable modems to service groups.

Service Group Assignments

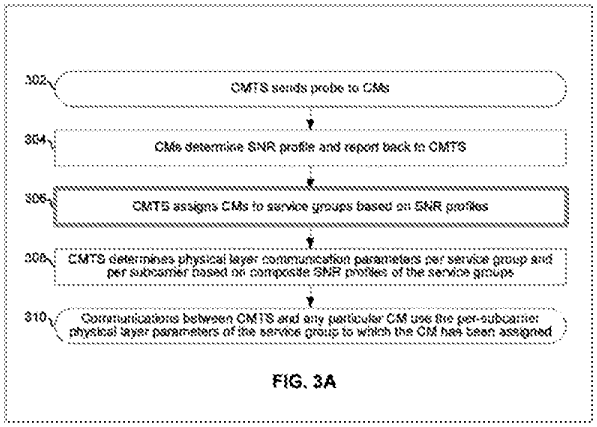


FIG. 3A

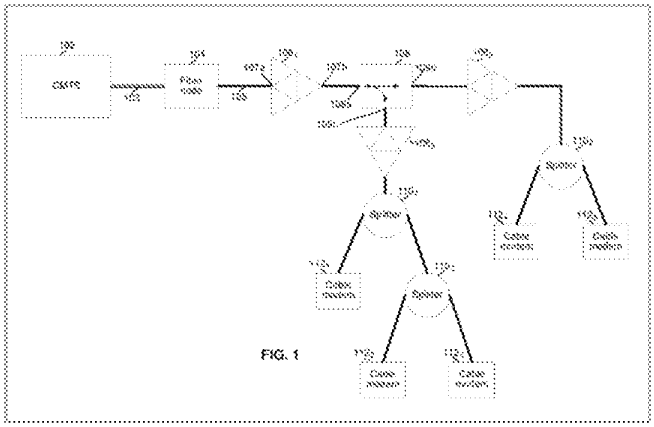


FIG. 1

136

Next, in step 306, the CMTS uses the SNR profiles it received from all the cable modems to assign the cable modems to service groups.

'682 PATENT: SERVICE GROUP ASSIGNMENTS

Service Group Assignments

16-QAM on channel z. Conversely, if 112_1, 112_4, and 112_5 are assigned to a first service group and 112_2 and 112_3 are assigned to a second service group, then the first service

'682 Patent, 5:64-66

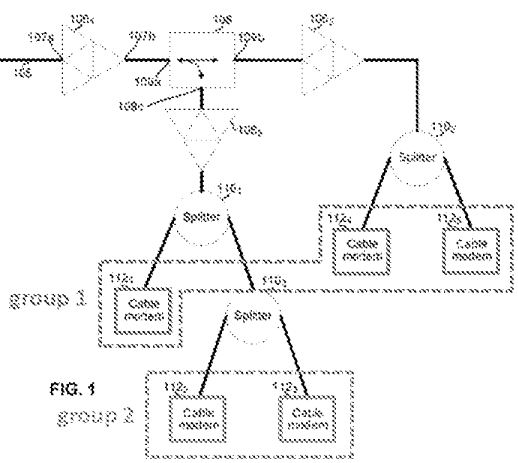


FIG. 1

137

In the example disclosed in the specification, the CMTS assigns the three cable modems annotated in red to service group 1, and the two cable modems annotated in green to service group 2.

'682 PATENT: SERVICE GROUP ASSIGNMENTS

Service Group Assignments

16-QAM on channel z. Conversely, if 112_1, 112_4, and 112_5 are assigned to a first service group and 112_2 and 112_3 are assigned to a second service group, then the first service

'682 Patent, 5:64-66

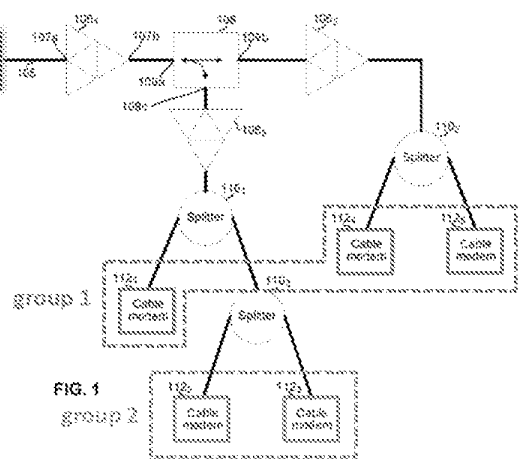


FIG. 1

138

Notice that both the red and the green cable modems correspond to the same fiber node 104. Thus, the alleged invention seemingly has the capability of creating service groups whereby cable modems which correspond to the same fiber node can be in different service groups.

'682 PATENT: SERVICE GROUP ASSIGNMENTS

Composite Worst Case SNR Profile

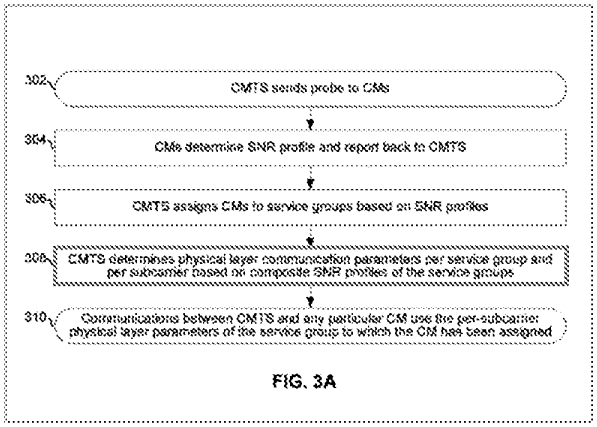


FIG. 3A

In block **308**, physical layer communication parameters are determined per service group and per channel/subcarrier. For example, for any particular service group, the modulation order and FEC code rate to be used on a particular subcarrier may be determined based on the worst case SNR for that subcarrier among the CMs in that particular service group. Thus, it can be seen that grouping CMs based on SNR

'682 Patent, 5:40-46

139

Next, once the cable modems have been assigned to service groups, the CMTS determines parameters for communicating with each different service group in step 308. It does that by using a composite worst-case SNR profile for each service group.

As the specification explains in the excerpt on the slide now, a composite worst case SNR profile for a service group is the worst case SNR at each subcarrier among the cable modems in the service group.

'632 PATENT: SERVICE GROUP ASSIGNMENTS

Composite Worst Case SNR Profile

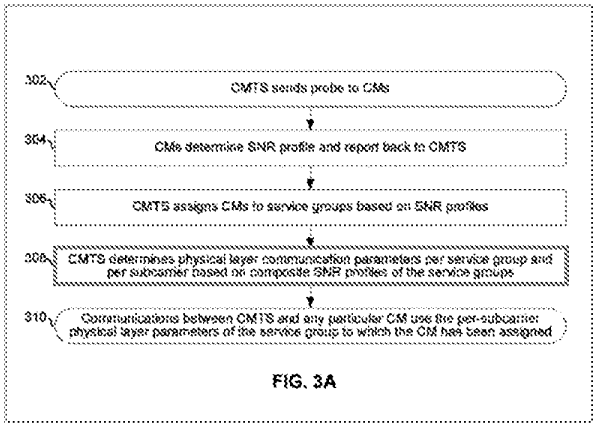


FIG. 3A

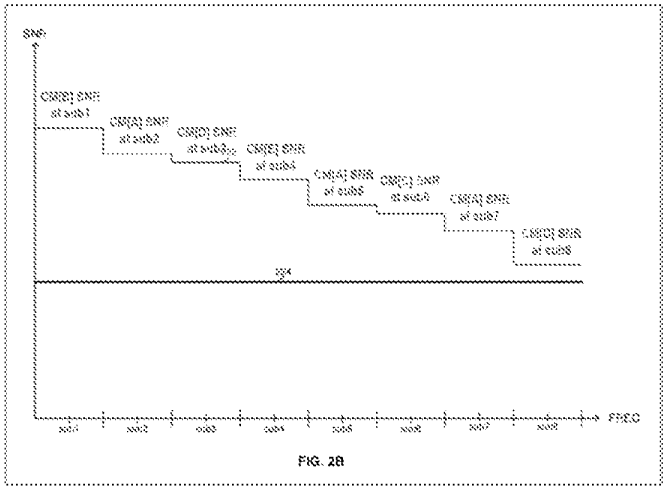


FIG. 2B

140

Thus, if a hypothetical service group had five cable modem in it, called cable modems A, B, C, D and E, the composite worst case SNR profile for that service group might look like our annotation of Figure 2B depicted on the right.

Composite Worst Case SNR Profile

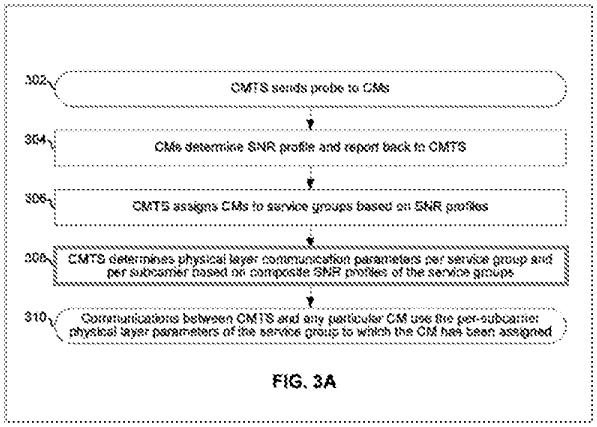


FIG. 3A

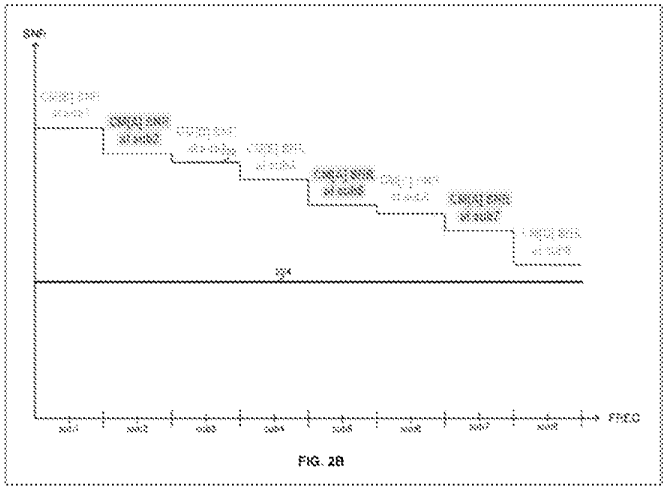


FIG. 2B

141

In this example, cable modem A has the worst SNR at subcarriers 2, 5 and 7.

Composite Worst Case SNR Profile

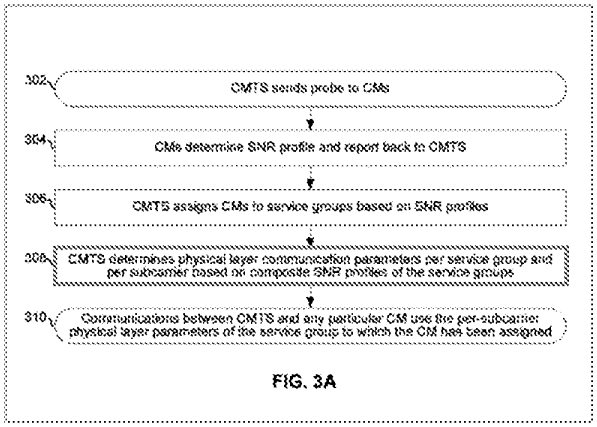


FIG. 3A

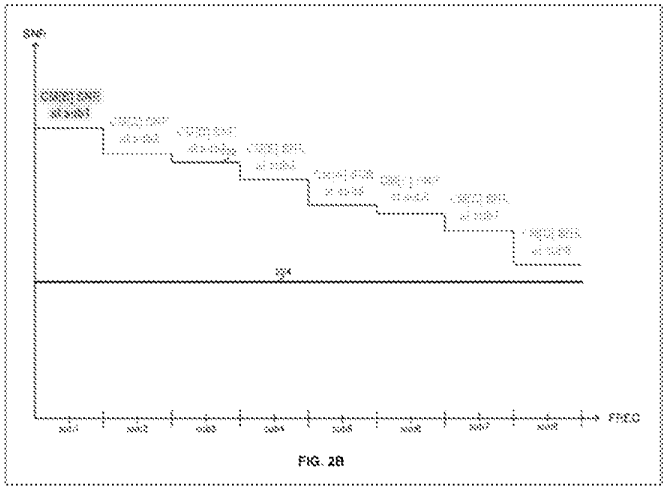


FIG. 2B

142

Cable modem B has the worst SNR at subcarrier 1.

'682 PATENT: SERVICE GROUP ASSIGNMENTS

Composite Worst Case SNR Profile

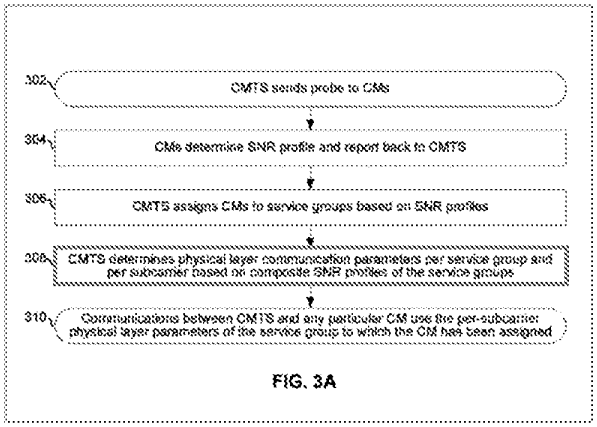


FIG. 3A

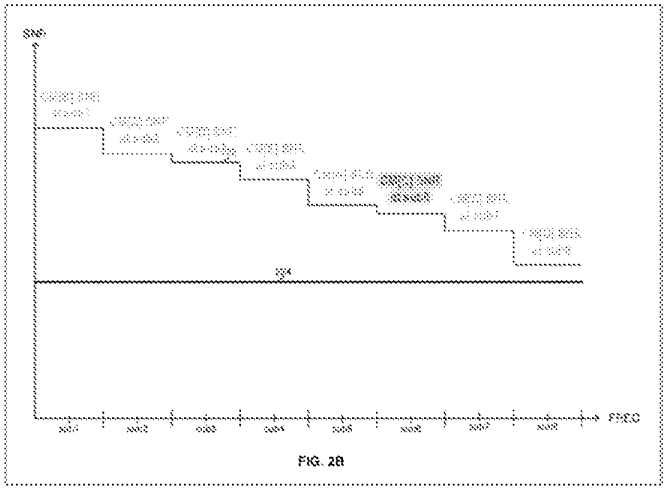


FIG. 2B

143

Cable modem C has the worst SNR at subcarrier 6.

Composite Worst Case SNR Profile

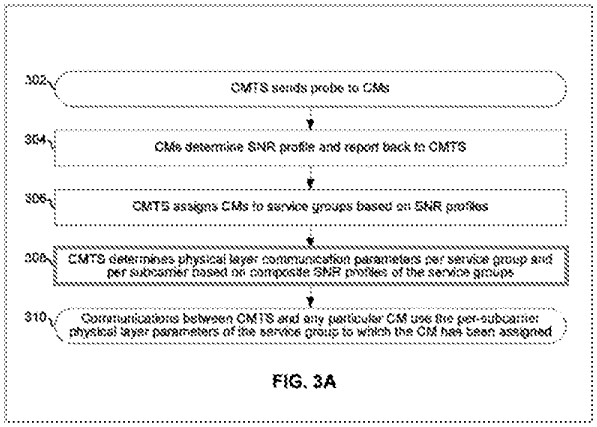


FIG. 3A

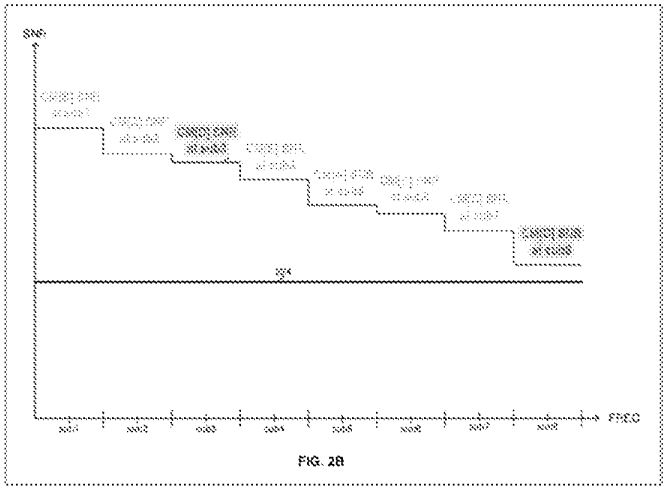


FIG. 2B

144

cable modem D has the worst SNR at subcarriers 3 and 8.

Composite Worst Case SNR Profile

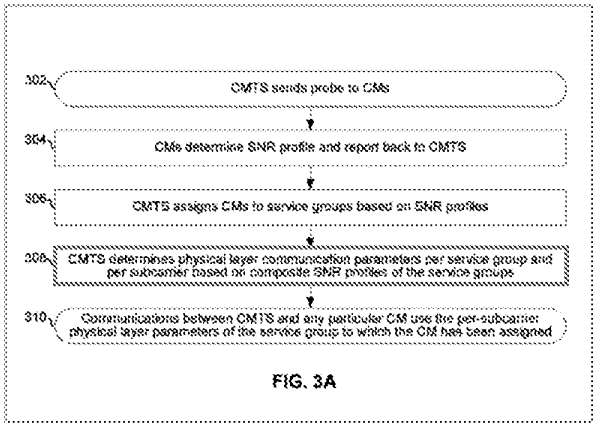


FIG. 3A

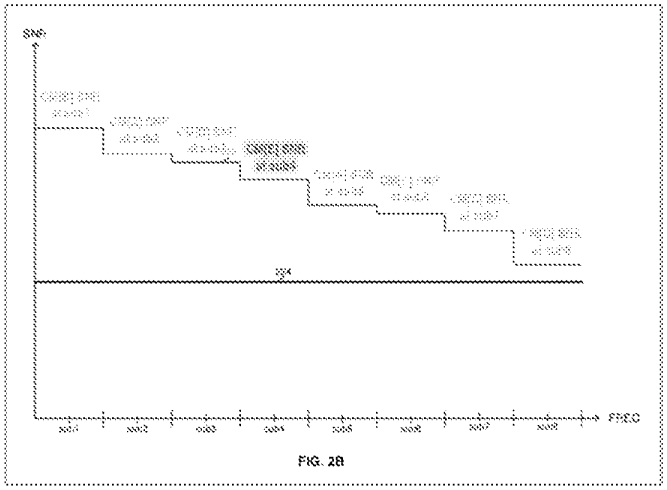


FIG. 2B

145

And cable modem E has the worst SNR at subcarrier 4.

Communications with Cable Modems

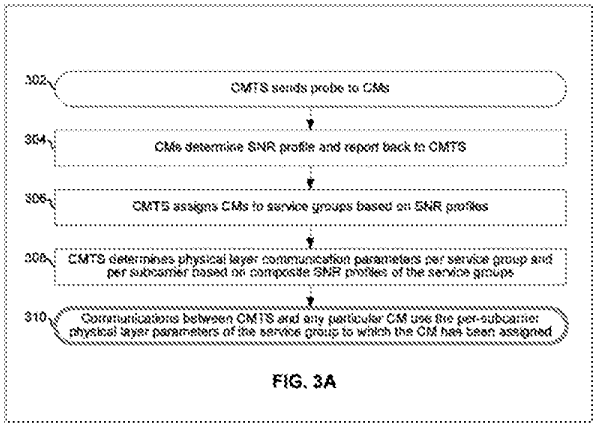


FIG. 3A

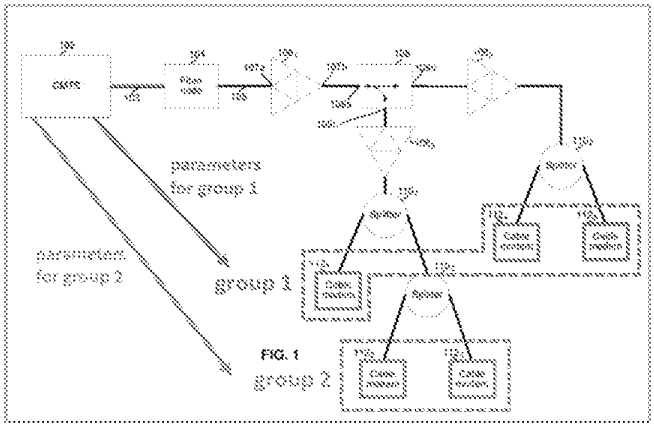
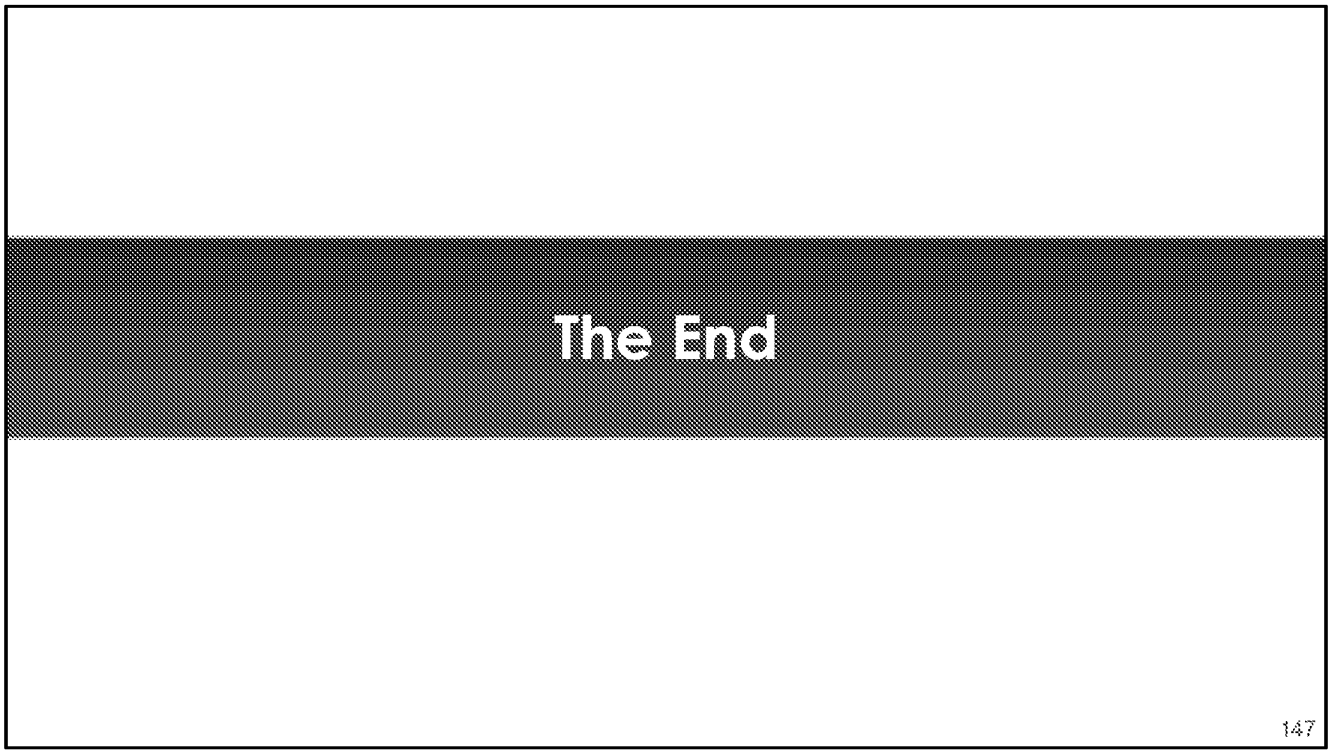


FIG. 1

146

Finally, in step 310 of Figure 3A, the CMTS communicates with the cable modems in a service group using the parameters it determined in step 308.

That concludes our discussion of the 682 patent. Again, we will not address the claims of the 682 patent because Charter contends that those claims are indefinite and that it is not possible to understand what those claims cover.



And that also concludes Charter's technology tutorial. Thank you Your Honor for the opportunity to present it.

EXHIBIT 2

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ENTROPIC COMMUNICATIONS, LLC,	)	
Plaintiff,	)	
vs.	)	Civil No.
	)	2:22-CV-00125-JRG
CHARTER COMMUNICATIONS, INC., CHARTER SPECTRUM ADVANCED SERVICES, LLC and SPECTRUM MANAGEMENT HOLDING COMPANY, LLC,	)	
Defendants.	)	

The Zoom video deposition of RICHARD KRAMER, Ph.D., taken before Richard Derrick Ehrlich, Registered Merit Reporter, Certified Realtime Reporter, taken pursuant to the Federal Rules of Civil Procedure, commencing at 10:00 a.m., on the 4th day of May, 2023.

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Videographer:
Tim Tupiak

INDEX

	Page
Exam by David Benyacar	5
Exam by Katherine Allor	277
Exam by David Benyacar	279

EXHIBITS

	Page
Exhibit No. 1 -	6
Exhibit No. 2 -	39
Exhibit No. 3 -	58
Exhibit No. 4 -	89
Exhibit No. 5 -	125
Exhibit No. 6 -	209
Exhibit No. 7 -	247

VIDEOGRAPHER: Good morning. We are going on the record. The time is 10:09 a.m. Central time on May the 4th, 2023.

Quality of recording depends on quality of camera and Internet connection participants. What is heard from the witness and seen on the screen is what will be recorded.

Audio and video recording will continue to take place unless all parties agree to go off the record.

This is Media Unit Number 1 of the video recorded deposition of Dr. Richard Kramer taken in the matter of Entropic Communications, LLC, vs. Charter Communications, Inc., filed in the United States District Court for the Eastern District of Texas, Marshall Division, Case No. 2:22-CV-00125.

My name is Tim Tupiak, and I'm the videographer. The court reporter is Richard Ehrlich. We are both with the firm Veritext Legal Solutions.

I'm not related to any party in this action, nor am I financially interested in the outcome.

Counsel will state their appearances and affiliations for the record beginning with the noticing attorney after which the reporter will administer the oath.

MR. BENYACAR: My name is David Benyacar with the law firm of Arnold & Porter representing Charter Communications.

MS. ALLOR: Katy Allor from K & L Gates on behalf of Entropic Communications, LLC. With me is my colleague Jason Engel. And I'm also here on behalf of the witness, Dr. Richard Kramer.

RICHARD KRAMER, DEPONENT, SWORN

EXAMINATION

BY MR. BENYACAR:

Q Good morning, Dr. Kramer.

A Good morning.

Q Let me see if I can use this fancy Exhibit Share technology.

Katy, is it okay if we call these exhibits Kramer Exhibit X?

MS. ALLOR: Sorry. Your audio is a little quiet compared to everyone else's.

THE DEPONENT: Yeah. I'm having a hard time hearing you.

Page 122

A So it can be considered a combination of electrical components interconnected to perform a particular task or function, yes.
Q And that's what an integrated circuit is?
I just want to make sure we're using --
A A circuit. So --
Q What about an integrated circuit?
I'm trying to figure out what -- like, integrated circuit, is that some particular type of circuit? What makes it integrated?
A Usually it means it's within a chip, in general.
Q Does that mean it's its own chip?
A It can -- again, the umbrella being, like, for instance, an ASIC. And I'm speaking in general terms, an ASIC is an application specific IC. And within that, you know, we're talking -- there's SoCs as -- umbrella can be power supply, custom power supply chip, custom communications chip. So there's subsets. Not all integrated application specific ICs are SoCs. But within an SoC, as an example, or whatever, and there's no hard, fast, you know, terminology memorized dictionary version. I'm just trying to explain an SoC, as an example, can be considered to have

Page 123

within it separate, integrated circuits. Integrated being integrated. I mean, that's what the word means.
We're kind of switching back and forth between chips. I'm just trying to be clear. We're switching -- there's a form factor and then there's what's inside the chip. Sometimes those terms are interchangeably loosely used. But, you know, how I look at it is an ASIC is application specific within there, there's a subset, and it's me personally, generally speaking, without asked to give a formal definition, there's an SoC. An SoC can have separate, integrated circuits inside the chip. Inside there's a physical chip.
Q And so the different integrated circuits, you know what they are because they're components that perform one function or a different function; is that right? Or is there some physical manifestation of the fact that there are separate, integrated circuits?
MS. ALLOR: Object to the form.
THE DEPONENT: So I don't know what you mean by -- so they can be defined functionally.

Page 124

That's what -- you know, like I said, I don't disagree with the first part of the definition, A combination of electrical components interconnected to perform a particular task, as long as that task is known and there's a function that's assigned to that task.
Like I said, the wireless, you know, circuit that I had described, that telecommunication circuit that I described.
BY MR. BENYACAR:
Q Yes, and I understand that. What I'm trying to figure out is if I were to look inside the SoC that you had worked on that you were testifying about, and I saw all the components inside but I didn't know what each component did, would I be able to tell one integrated circuit from another integrated circuit?
A I don't know. You know, because then you're asking me if you could see the die and what was on the die and how it was laid out on the die, and I believe we laid the circuits out separately in their own, you know, quadrants or whatever, you know, areas. You're asking me to speculate on something.

Page 125

But I think, you know, clearly we designed the circuits that were collections of components that were, you know, logically grouped for the function that they performed. And I believe physically you could probably look at the die and at least at a high level identify where those were located.
Q Okay. And would you agree with me that a System on Chip is itself a circuit?
A Outside the context of the patent, I've not been asked to consider all different possibilities. In general, and speculatively, it could be considered a separate circuit outside of the scope of the patents.
Q So let me just -- I'm going to introduce what I'm marking as Kramer Exhibit 5.
(Exhibit No. 5 marked.)
BY MR. BENYACAR:
Q Let me know when you -- when that pops up for you, Dr. Kramer.
This is the excerpt from Newton's Telecom Dictionary, Copyright 2001.
Let me know when you have that open.
A I clicked on it. It showed up. I'm still

Page 126

waiting for it.
Q Okay. Let me know when you see it.
A I see it. And can you tell me, just so I can follow you with hard copy, or I can just look.
Q You don't have the hard copy of this one, so unfortunately you're going to have to go -- it's very short. It's on the third of three pages of the PDF.
A Okay.
Q And on the left, you will see that there is a definition of System on a Chip. Let me know if you see that?
A Okay. I just have to read it.
MS. ALLOR: You should be able to zoom in if you hover near the bottom of the page.
THE DEPONENT: Yeah, that's what I'm trying to figure out.
BY MR. BENYACAR:
Q Just let me know when you're ready, Doctor.
A I'm reading. There's a lot to unpack here, so just bear with me. I'm just trying to read through this.
Q Well, I'll just ask you my question, and you can read whatever you think you need to read. But

Page 127

my question is simply: Do you see the definition begins, SoC, System on Chip, a silicon integrated circuit?
I'm just asking about that. Do you see that?
A I see that.
Q You don't disagree with that, do you?
A I would like to have the benefit of reading the whole thing.
Q Let me know when you're done.
A Thank you.
So your question again, please?
Q You don't agree with the statement -- you don't disagree with the statement that says that a System on a Chip is a silicon integrated circuit, do you?
A It is -- I don't disagree with that. Some of the characterizations and implementation details I think are a bit different than having experienced. But, in general, you can consider as one definition, a System on a Chip can be considered an integrated circuit.
So the characterization that's given -- and, again, this is one definition -- are a bit

Page 128

odd, you know.
Q Okay. Well, when you say it's a bit odd, you don't think it's odd that it would be called an integrated circuit, right?
A It's just a fact that -- it's not odd that it's called an integrated circuit. System on a Chip, as I had explained in the example, the System on a Chip that I explained to you, we had separate, integrated circuits. They had defined functions; for instance, for the radio and for the telecommunications. And so to that -- you know, so there were separate, integrated circuits within the SoC. That's why it's called a System on a Chip. And they talk about that. It's rather quirky and they say, Well, you know, you can kind of implement this by, you know, predefined components, and they kind of parallel it with circuit boards.
So we had -- and one would understand circuits in the context of design. When people had specific roles, they designed a particular circuit for a particular function. It doesn't really make that clear in this definition. That's the quirky part.

Page 129

Q So you don't disagree that you can have circuits within circuits, right?
A There can be circuits within circuits if we ignore the claims and just speculate. In general, there can be subcircuits.
Q Now, the specification of the '775 patent does not use the word "circuit," does it?
And, again, just to be clear, by the specification, I'm excluding the claims.
A One skilled in the art in reviewing this specification would understand "circuit." But if you do -- and, in fact, it talks about a chip at least twice. Implementation on a chip, so it's clear.
But if I were to do a search outside of the claims, claims fully inform me, but I don't think the word "circuit" would show up on that search, but I'm not sure.
Q Okay. Let me just make sure I understand your answer. You said that the specification does talk about a chip.
Are you saying that chip and circuit are synonymous?
A One skilled in the art would understand it.

blocks but the CME blocks that are identified as part of the DOCSIS controller would be implemented -- or could be implemented in portions of another processor or the same processor. I've not gone through that analysis.

BY MR. BENYACAR:

Q So as you sit here today, you can't answer my question because you haven't done that analysis; is that right?

A That's correct.

MR. BENYACAR: Okay. I have nothing else. Thank you.

THE DEPONENT: Thank you.

MS. ALLOR: Thanks.

VIDEOGRAPHER: Are we ready to go off the record?

MR. BENYACAR: Yes.

MS. ALLOR: Yep.

THE DEPONENT: Yeah. If you have questions for me --

VIDEOGRAPHER: We are going off the record. The time is 7:11 p.m. This concludes today's testimony.

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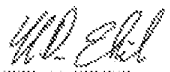
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katy.allor@kigates.com
May 8, 2023
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EXHIBIT 3

NEWTON's TELECOM DICTIONARY



The Official Dictionary of Telecommunications
Networking and Internet

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Kramer 0005

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Snuggling Snuggling is a method used by operators of surveillance equipment. A surveillance equipment operator, when building radio transmitters, will select a transmitter frequency close to that of a nearby high powered transmitter, usually, a commercial radio station. Most ordinary radio gear will automatically tune into the stronger of the two signals. The operator must use a specially modified receiver capable of detecting and isolating the weaker signal. "Snuggling" will be difficult to detect by low quality RF receivers when making a countermeasure sweep.

SO Serving Office. Central office where IXC (InterexXchange Carrier) has POP (Point Of Presence).

Soak A means of uncovering problems in software and hardware by running them under operating conditions while they are closely supervised by their developers.

Soap Simple Object Access Protocol (SOAP) is new "open" software developed by Microsoft for exchanging information over the Web based on a standard call the Extensible Markup Language (XML). SOAP will be open if it's ever adopted by a standards body or sufficient number of programmers program to it and it becomes a defacto standard. SOAP is actually a network protocol that lets software objects developed using different languages communicate with each other. Microsoft sees it as leveling the playing field between Windows and development strategies based on Java. Instead of being forced to chose one model, companies will be free to select whichever is best suited to solving the problem at hand, Microsoft argues.

At issue is the slugfest between Microsoft and its competitors over the programming models software developers use. Microsoft has its own programming model based on the Windows operating system, called the Component Object Model (COM). Its competitors support Enterprise JavaBeans (EJBs) and Common Object Request Broker Architecture (CORBA), two programming models that are tightly integrated with each other.

SOAP would replace Microsoft's current proprietary protocol called DCOM for communication over the Internet. Because SOAP is based on XML, it's compatible with all programming models and allows businesses to exchange data with each other over the Internet.

SOC System-On-a-Chip. A silicon integrated circuit which combines generic functions (e.g., microcontrollers, UARTs, memory, FIFOs, and other analog and digital logic functions) with custom design elements to create a device that contains all major elements of a system on one integrated chip. This is one method of increasing design productivity. The SOC designer collects and integrates pre-defined (and pre-tested) components similar to the way hardware designers collect and interconnect integrated circuits on a circuit board design. The final implementation of an SOC may be in an ASIC or FPGA. Also see ASIC and FPGA. Thanks to Ken Coffman for this definition.

Social Computing A term that emerged in the summer of 1993. Defined by Peter Lewis in the New York Times of September 19, 1993, social computing is a "communications-rich brew," which is "expected to create new ways for businesses and their customers to communicate, over new types of wireless as well as wired pathways, using new types of computers called personal communicators." According to Peter Lewis, "The rise of social computing is expected to shift the emphasis of computing devices away from simple number crunching and data base management to wider-ranging forms of business communications...Where client server broke away from mainframe-based systems and distributed computing power to everyone in the organization, social computing goes the next step and extends the distribution of computing power to a company's customers."

Social Contract An arrangement between the local telephone company and its local regulatory authority whereby the telephone company's services are detariffed, but cannot be priced at less than cost. Quality of service standards apply.

Social Engineering Gaining privileged information about a computer system (such as a password) by skillful lying — usually via a phone call. Often done by impersonating an authorized user.

Socket 1. A synonym for a port.

2. A technology that serves as the endpoint when computers communicate with each other.

3. The socket in a PC which is responsible for accepting a PCMCIA Card and mapping the host's internal bus signals to the PCMCIA interface signals.

4. An operating system abstraction which provides the capability for application programs to automatically access communications protocols. Developed as part of the early work on TCP/IP.

Socket Interface The Sockets Interface, introduced in the early 1980s with the release of Berkeley UNIX, was the first consistent and well-defined application programming interface (API). It is used at the transport layer between Transmission Control Protocol (TCP) or User Datagram Protocol (UDP) and the applications on a system. Since 1980, sockets have been implemented on virtually every platform.

Socket Number In TCP/IP, the socket number is the joining of the sender's (
receiver's) IP address and the port numbers for the service being used. These two toget
er uniquely identifies the connection in the Internet.

Socket Services The software layer directly above the hardware that provides
standardized interface to manipulate PCMCIA Cards, sockets and adapters. Socket Servic
is a BIOS level software interface that provides a method for accessing the PCMCIA slots
a computer, desktop or laptop (but most typically a laptop). Ideally, socket services so
ware should be integrated into the notebook's BIOS, but few manufacturers have done
to date. For PCMCIA cards to operate correctly you also need Card Services, which is (n
are) a software management interface that allows the allocation of system resources (su
as memory and interrupts) automatically once the Socket Services detects that a PC Ca
has been inserted. You can, however, happily operate PCMCIA cards in your laptop wi
out using socket and card services. You simply load the correct device drivers for tha
cards. Such drivers always come with PCMCIA cards when you buy the cards. You will, ha
ever, have to load new drivers every time you change cards and allocate the correct me
ory exclusions. You will have to reboot if you disconnect your network card. Theoretical
with socket and card services loaded, you do not have to reboot every time you chan
cards. My experience is that this works, except with network cards, which cannot
hotswapped. See PCMCIA.

Sockets An application program interface (API) for communications between a u
application program and TCP/IP. See Socket and Socket Number.

SOCKS A circuit-level security technology developed by David Koblas in 1990 and su
made publicly available by the IETF (Internet Engineering Task Force. SOCKSv5, the c
rent version, provides security in a client/server environment, running at the Session Lay
Layer 5 of the OSI Reference Model. SOCKSv5 supports multiple means of authenticati
negotiated between client and server over a virtual circuit, and on a session-by-sess
basis. SOCKSv5 also supports the transfer of UDP data as a stream, avoiding the need
treat each packet of UDP data as an independent message. SOCKSv5 also allows proto
filtering, which offers enhanced access control on a protocol-specific basis. For example
network administrator can add a SMTP (Simple Mail Transfer Protocol) filter command
prevent hackers from extracting from a mail message information such as a mail al
Reference implementations exist for most UNIX platforms, as well as Windows NT.
cross-platform nature of SOCKS offers portability to Macintosh and other operating syste
and browsers. According to Network World Magazine, September 27, 1999, "the la
version of SOCKSv5 offers network managers an easier way to run videoconferencing
video and audio streaming through firewalls, which has been difficult and time-consum
Socksv5 does this by providing a single and powerful method of authenticating users
managing security policies for all Internet applications, including multimedia." SOCK
also interoperates on top of IPv4, IPsec, PPTP, L2TP and other lower-level protocols.

SOF Start Of File

Soft Copy 1. A copy of a file or program which resides on magnetic medium, suc
a floppy disk, or any form that is not a hard copy — which is paper.

2. Old legacy systems term reapplied to distributed computing in which reports are c
ed on-screen from data residing within different applications.

Soft Decision See SISO.

Soft Ferrite Ferrite that is magnetized only while exposed to a magnetic field.
to make cores for inductors, transformers, and other electronic components. See Ba
Ferrite, Ferrite and Hard Ferrite.

Soft Font A font,usually provided by a font vendor, that must be installed on your
puter and sent to the printer before text formatted in that font can be printed. Also kn
as downloadable font.

Soft Handoff 1. A cellular radio term. A soft handoff is a handoff between cell sites
involves first making the connection with the new cell site before breaking the connection
the previous cell site. A hard handoff, or "break and make" handoff, is not noticeable in a
conversation, but has disastrous impact on a data communication. See also Hard Hando

2. A satellite term. The process of transferring a circuit from one beam or satellite to a
er without interruption of the call.

Soft Input-Soft Output See SISO.

Soft Key There are three types of keys on a telephone: hard, programmable and
HARD keys are those which do one thing and one thing only, e.g. the touchtone bu
1, 2, 3, * and # etc. PROGRAMMABLE keys are those which you can program to d
duce a bunch of tones. Those tones might be "dial mother." They might be "transfe

EXHIBIT 4

Data-Over-Cable Service Interface Specifications DOCSIS® 3.1

MAC and Upper Layer Protocols Interface Specification

CM-SP-MULPIv3.1-I03-140610

ISSUED

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1.2.2 DOCSIS Network and System Architecture

The elements that participate in the provisioning of DOCSIS services are shown in Figure 1-1.

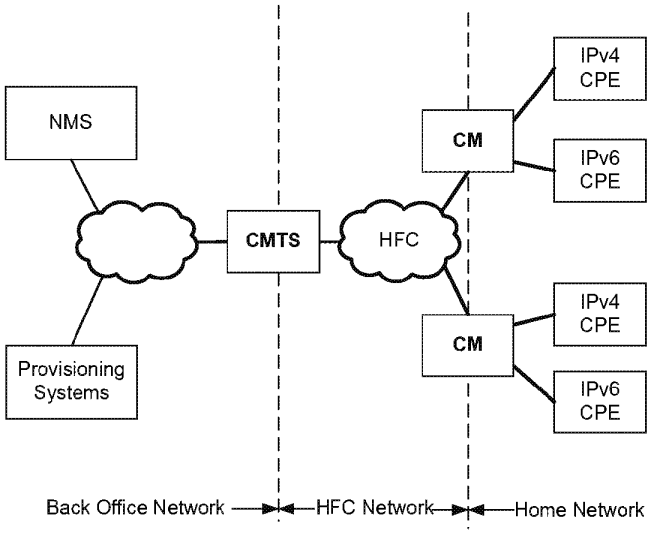


Figure 1-1 - The DOCSIS Network

The CM connects to the operator's HFC network and to a home network, bridging packets between them. Many CPE devices can connect to the CM's LAN interfaces, can be embedded with the CM in a single device, or they can be separate standalone devices (as shown in Figure 1-1). CPE devices may use IPv4, IPv6 or both forms of IP addressing. Examples of typical CPE devices are home routers, set-top devices, personal computers, etc.

The CMTS connects the operator's back office and core network with the HFC network. Its main function is to forward packets between these two domains, and optionally forward packets between upstream and downstream channels on the HFC network. The CMTS performs this forwarding with any combination of link-layer (bridging) and network-layer (routing) semantics.

Various applications are used to provide back office configuration and other support to the devices on the DOCSIS network. These applications use IPv4 and/or IPv6 as appropriate to the particular operator's deployment. The following applications include:

Provisioning Systems:

- The DHCP servers provide the CM with initial configuration information, including the device IP address(es), when the CM boots.
- The Configuration File server is used to download configuration files to CMs when they boot. Configuration files are in binary format and permit the configuration of the CM's parameters.
- The Software Download server is used to download software upgrades to the CM.
- The Time Protocol server provides Time Protocol clients, typically CMs, with the current time of day.
- Certificate Revocation server provides certificate status.

Network Management System (NMS):

- The SNMP Manager allows the operator to configure and monitor SNMP Agents, typically the CM and the CMTS.
- The syslog server collects messages pertaining to the operation of devices.
- The IPDR Collector server allows the operator to collect bulk statistics in an efficient manner.

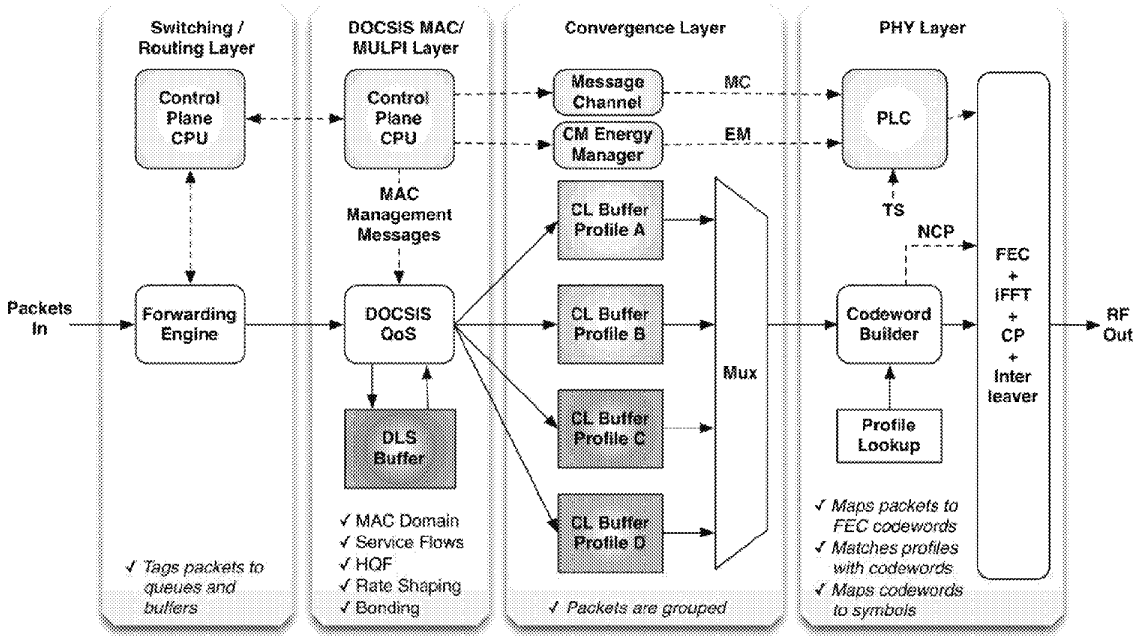


Figure 5-5 - Downstream Convergence Layer Block Diagram

5.2.3 OFDMA Upstream

OFDMA is a new type of upstream channel for DOCSIS 3.1. OFDMA upstream channels can span more spectrum than TDMA or S-CDMA upstream channels. OFDMA upstream channels use LDPC for Forward Error Correction and have other attributes specific to Orthogonal Frequency Division Multiplexing technology. OFDMA channels utilize a framing structure consisting of a number of symbols in time and a number of subcarriers in frequency. Some of the subcarriers are excluded and never used on the channel. Other subcarriers are not used for transporting MAC-layer data but are used for physical layer monitoring. Subcarriers used for transporting MAC-layer data are grouped in sets of 8 (50 kHz subcarrier spacing) or 16 (25 kHz subcarrier spacing) contiguous subcarriers in the frequency dimension and K symbols in the time dimension to create minislots in a frame structure.

On TDMA and S-CDMA upstream channels with Multiple Transmit Channel Mode, the CMTS can create 5 profiles that are used for data transmissions. These profiles define the modulation rate and Reed-Solomon codeword size to be used any time a transmission is made with that profile. With OFDMA upstream channels, the LDPC codeword sizes are fixed. For OFDMA channels, the number of data profiles is expanded to 7 and the profile describes the modulation rate and pilot pattern on a minislot by minislot basis for a frame. Thus, a single OFDMA data profile can use different modulation rates for different minislots within a frame.

For TDMA and S-CDMA upstream channels, a ranging burst uses all of the spectrum defined for the channel and is used to adjust a CM's transmit timing, power, and pre-equalization. With OFDMA upstream channels, ranging uses a subset of the spectrum defined for the channel. In order to properly adjust the CM's transmit pre-equalizer for every non-excluded subcarrier, the CMTS needs to receive a transmission with a known pattern on every non-excluded subcarrier. For OFDMA upstream channels, this known pattern is provided by probing. A probe is a wide-band physical-layer signal that the CM sends in response to a special probe bandwidth allocation. Probing is used whenever the CMTS needs to evaluate the CM's transmit pre-equalization.

5.2.4 QoS

This section provides an overview of the QoS protocol mechanisms and their part in providing end-to-end QoS.

Some of the Quality of Service related features described in this specification include:

- Packet Classification and Flow Identification

EXHIBIT 5

Superseded by a later version of this document.

Data-Over-Cable Service Interface Specifications DOCSIS 3.0

MAC and Upper Layer Protocols Interface Specification

CM-SP-MULPIv3.0-I18-120329

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3 TERMS AND DEFINITIONS[9]

This specification uses the following terms:

Active Codes	The set of spreading codes which carry information in an S-CDMA upstream. The complementary set, the unused codes, are idle and are not transmitted. Reducing the number of active codes below the maximum value of 128 may provide advantages including more robust operation in the presence of colored noise.
Address Resolution Protocol	A protocol of the IETF for converting network addresses to 48-bit Ethernet addresses.
Advanced Time Division Multiple Access	DOCSIS 3.0 TDMA mode (as distinguished from DOCSIS 1.x TDMA).
Allocation	A group of contiguous mini-slots in a MAP which constitute a single transmit opportunity.
American National Standards Institute	A U.S. standards body.
Bandwidth Allocation Map	The MAC Management Message that the CMTS uses to allocate transmission opportunities to CMs.
BITS Encoding	An octet string using a BITS encoding represents a zero-indexed linear array of 8*N bits, with the most significant bit of each byte representing the lowest-indexed bit. Bit positions increase from left to right. For example, bit position 0 is the most significant bit of the most significant (leftmost) byte, encoded as hex 0x80. Unspecified bit positions are assumed as zero. Unimplemented bit positions are ignored.
Bonded Channel Set	An identified set of upstream or downstream channels among which a stream of packets is distributed.
Bonding Group	A list of channels providing a means to identify the specific channels bonded together.
Border Gateway Protocol	An inter-autonomous system routing protocol.
Bridged Network	A set of IEEE 802 LANs interconnected by IEEE 802.1D MAC bridges.
Bridging CMTS	A CMTS that makes traffic forwarding decisions between its Network System Interfaces and MAC Domain Interfaces based upon the Layer 2 Ethernet MAC address of a data frame.
Burst	A single continuous RF signal from the upstream transmitter, from transmitter on to transmitter off.
Byte	A contiguous sequence of eight bits. An octet.
Cable Modem	A modulator-demodulator at subscriber locations intended for use in conveying data communications on a cable television system.
Cable Modem Service Group	In the HFC plant topology, the complete set of downstream and upstream channels within a single CMTS that a single Cable Modem could potentially receive or transmit on. In most HFC deployments, a CM-SG corresponds to a single Fiber Node. Usually, a CM-SG serves multiple CMs.

[9] Revised per MULPIv3.0-N-06.0297-1, MULPIv3.0-N-06.0313-5 by GO on 10/13/06 and 11/21/06, per MULPIv3.0-N-0489-2, on 7/11/07, MULPIv3.0-N-07.0492-4 on 7/12/07, MULPIv3.0-N-07.0544-2 on 10/31/07, and MULPIv3.0-N-08.0622-3 on 4/9/08 by KN. Revised per MULPIv3.0-N-10.0973-2 on 1/17/2011 by JB.

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Substitute for Form PTO-875

Application or Docket Number: 10/625,566

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	x 25 =		OR	x 50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	x 105 =			x 210 =	
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $260 ($130 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))			185			370	
			TOTAL			TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED – PART II

5-19-09

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 1	x 25 =		OR	x 50 =	
Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	=	x 105 =		OR	x 210 =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					185		OR	370 N/A	
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x 25 =		OR	x 50 =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x 105 =		OR	x 210 =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					185		OR	370 N/A	
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D	9980

65913 7590 09/03/2009

NXP, B.V.
NXP INTELLECTUAL PROPERTY & LICENSING
M/S41-SJ
1109 MCKAY DRIVE
SAN JOSE, CA 95131

EXAMINER	
HOSSAIN, TANIM M	
ART UNIT	**PAPER NUMBER**
2445	

NOTIFICATION DATE	DELIVERY MODE
09/03/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ip.department.us@nxp.com

Office Action Summary	Application No.	Applicant(s)	
	10/675,566	LI ET AL.	
	Examiner	Art Unit	
	Tanim Hossain	2445	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 1 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *5/19/09*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) _____ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-16* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-11 and 16, drawn to computer software upgrading, classified in class 717, subclass 168.

II. Claims 12-15, drawn to network protocol implementation, classified in class 709, subclass 230.

Inventions I and II are related as subcombinations as usable together in a single combination. The subcombinations are distinct from each other if they are shown to be separately usable. In the instant case, Invention I discloses the upgrading of software for the system in an independent fashion. This specific upgrading concept is classified in class 717, subclass 168. On the other hand, Invention II includes the implementation and use of various protocols to employ different network functionalities, and is thus classified accordingly, in class 709, subclass 230. Both inventions may be implemented separately from one another.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classifications, restriction for examination purposes as indicated is proper.

Applicant is advised that the reply to this requirement to be complete must include an election of the invention to be examined even though the requirement be traversed (37 CFR 1.143).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tanim Hossain whose telephone number is (571)272-3881. The examiner can normally be reached on 8:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vivek Srivastava can be reached on 571/272-7304. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Tanim Hossain
Patent Examiner
Art Unit 2445

/VIVEK SRIVASTAVA/

Supervisory Patent Examiner, Art Unit 2445

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10675566	LI ET AL.
	Examiner	**Art Unit**
	Tanim Hossain	2445

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/16/2009	08/24/2009							
	1	✓	÷							
	2	✓	÷							
	3	✓	÷							
	4	✓	÷							
	5	✓	÷							
	6	✓	÷							
	7	✓	÷							
	8	✓	÷							
	9	✓	÷							
	10	✓	÷							
	11	✓	÷							
	12	✓	÷							
	13	✓	÷							
	14	✓	÷							
	15	✓	÷							
	16		÷							

To: ip.department.us@nxp.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 65913

Sep 03, 2009 05:45:53 AM

Dear PAIR Customer:

NXP, B.V.
NXP INTELLECTUAL PROPERTY & LICENSING
M/S41-SJ
1109 MCKAY DRIVE
SAN JOSE, CA 95131
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 65913 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:
The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
10675566	CTRS	09/03/2009	81373818US01-02CXT0070D

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Confirmation No. 9980

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	LI *et al.*	Examiner:	Hossain, Tanim
Serial No.:	10/675,566	Group Art Unit:	2445
Filed:	September 30, 2003	Docket No.:	81373818US01 (NXPS.615PA)
Title:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM		

RESPONSE TO ELECTION/RESTRICTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Customer No.
65913

Dear Sir:

This communication is in reply to the Office Action dated September 3, 2009 in which a restriction/election requirement was presented.

A complete listing of the Claims, to include any amendments thereto, and the Remarks follow.

In the Claims:

1. (Previously presented) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable mode engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and

a data bus that connects the data networking engine to the cable modem engine,

wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

2. (Original) A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. (Original) A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. (Previously presented) A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine configured to perform all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem engine.

5. (Previously presented) A cable modem system as claimed in claim 1, wherein the cable modem engine includes:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller, and

wherein the at least one processor of the data networking engine is a RISC processor.

6. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer includes a hardware transmitter and receiver.

7. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor is configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. (Original) A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. (Original) A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine is configured to perform all data networking processing including advanced multi-port bridging routing with NAT/firewall and VPN, and home networking applications.

11. (Original) A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. (Currently amended) A cable modem <u>system as claimed in claim 5, wherein the</u> ~~architecture comprising: a~~ cable modem engine ~~that~~ includes:

the [[a]] DOCSIS PHY layer includes ~~comprising~~ a transmitter and receiver;

the [[a]] DOCSIS MAC processor is configured to implement real-time ~~critical~~ MAC functions for both upstream and downstream communications; and

the [[a]] DOCSIS controller is configured to implement VoIP functionality; and wherein

the [[a]] data networking engine ~~that~~ includes a RISC processor configured to implement substantially all data networking processing and home networking applications~~, wherein the implementation of the data networking processing and home networking applications by the data networking engine is completely~~ decoupled from the implementation of the MAC functions and the VoIP functionality of ~~by~~ the cable modem engine.

13. (Previously presented) A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, wherein the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. (Original) A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. (Original) A method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VoIP functionality in a cable modem engine; and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

16. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

Remarks

In the Office Action dated September 3, 2009, a Restriction/Election was made, requesting that Applicant elect either Group I (consisting of claims 1-11 and 16) or Group II (consisting of claims 12-15). Applicant elects the claims identified under Group I (claims 1-11, 12-14 as amended and 16) with traverse. Applicant respectfully submits that the rationale used in support of the restrictions does not comply with the rules and guidelines set forth in the M.P.E.P. Applicant submits that the restrictions should be withdrawn.

The Office Action asserts that the inventions of Groups I and II are related as subcombinations as usable together in a single combination and that both inventions may be implemented separately from one another. Specifically, the Office Action asserts that the invention of Group I "discloses the upgrading of software for the system in an independent fashion" and the invention of Group II "includes the implementation and use of various protocols to employ different network functionalities."

Applicant traverses for lack of compliance with the restriction guidelines in the M.P.E.P. and because no basis has been provided to support the separate use conclusion in the Office Action.

Notwithstanding, Applicant has amended claim 12 to comport to the scope presented in the Office Action.

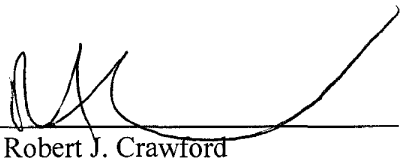
Accordingly, Applicants respectfully requests that the Examiner withdraw the present restriction requirement(s) for examination of all the claims.

In view of the above, Applicant believes that each of the rejections is improper and should be withdrawn and that the application is in condition for allowance. Should there be any remaining issues that could be readily addressed over the telephone, the Examiner is asked to contact the agent overseeing the application file, Peter Zawilski, of NXP Corporation at (408) 474-9063 (or the undersigned).

Please direct all correspondence to:

Corporate Patent Counsel
NXP Intellectual Property & Standards
1109 McKay Drive; Mail Stop SJ41
San Jose, CA 95131

CUSTOMER NO. 65913

By: 
Name: Robert J. Crawford
Reg. No.: 32,122
651-686-6633
(NXPS.615PA)

Electronic Acknowledgement Receipt

EFS ID:	6202616
Application Number:	10675566
International Application Number:	
Confirmation Number:	9980
Title of Invention:	Architecture for a flexible and high-performance gateway cable modem
First Named Inventor/Applicant Name:	Gordon Y. Li
Customer Number:	65913
Filer:	Robert J. Crawford/Kelly Davis
Filer Authorized By:	Robert J. Crawford
Attorney Docket Number:	81373818US01-02CXT0070D
Receipt Date:	05-OCT-2009
Filing Date:	30-SEP-2003
Time Stamp:	15:37:03
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		81373818US01_response.pdf	261101 e4476c5e6f4367403a4b9650ed67b626d69c90fc	yes	7

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Response to Election / Restriction Filed	1	1
Claims	2	5
Applicant Arguments/Remarks Made in an Amendment	6	7

Warnings:	
Information:	
Total Files Size (in bytes):	261101

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 10/675,566	Filing Date 09/30/2003	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
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☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
AMENDMENT	10/05/2009	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 0	X $ =		OR	X $52=	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $ =		OR	X $220=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)					
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/CATHERINE d. SMITH/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D	9980

65913 7590 02/05/2010

NXP, B.V.
NXP INTELLECTUAL PROPERTY & LICENSING
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EXAMINER	
HOSSAIN, TANIM M	
ART UNIT	**PAPER NUMBER**
2445	

NOTIFICATION DATE	DELIVERY MODE
02/05/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ip.department.us@nxp.com

Office Action Summary	Application No.	Applicant(s)	
	10/675,566	LI ET AL.	
	Examiner	Art Unit	
	Tanim Hossain	2445	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 October 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

Claim 1 is objected to because of the following informalities: The term, "the cable mode engine" in line 9 appears to be a typographical error. Appropriate correction is required.

Election/Restriction

The restriction requirement filed on September 3, 2009 is hereby withdrawn.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 12 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 12 discloses that the data networking engine includes a RISC processor, which is not supported by the specification.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 12 -14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 12 contains the term "substantially" The term is not defined in the specification rendering the claim indefinite. Other claims are dependent from claim 12.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-16 are rejected under 35 U.S.C. 102(e) as being anticipated by Brooks (U.S. 2001/0039600).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

As per claim 1, Brooks teaches a cable modem system comprising: a data networking engine implemented in a first circuit that includes at least one processor (Figure 2), the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment (Abstract; paragraphs 0014, 0026, 0037, 0066-0068); a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine (paragraphs 0026, 0037, 0042-0046, 0050-0052); a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine (0042-0046).

As per claim 2, Brooks teaches a cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine (0024-0026).

As per claim 3, Brooks teaches a cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine (0024-0026).

As per claim 4, Brooks teaches a cable modem system as claimed in claim 1, and further comprising an advanced crypto engine that performs all crypto functions (0013).

As per claim 5, Brooks teaches a cable modem system as claimed in claim 1, wherein the cable modem engine comprises: a DOCSIS PHY layer (0024-0026); a DOCSIS MAC processor (0024-0026); and a DOCSIS controller (0024-0026).

As per claim 6, Brooks teaches a cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer comprises a hardware transmitter and receiver (0013, 0024-0026).

As per claim 7, Brooks teaches a cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor processes downstream PDU packets and forwards the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput (0024-0026, 0028).

As per claim 8, Brooks teaches a cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller (0024-0026).

As per claim 9, Brooks teaches a cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification (0024-0026).

As per claim 10, Brooks teaches a cable modem system as claimed in claim 5, wherein the data networking engine is responsible for all data networking processing including advanced

multi-port bridging/routing with NAT/firewall and VPN, and home networking applications (0024-0026, 0030).

As per claim 11, Brooks teaches a cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification (0024-0026).

As per claim 12, Brooks teaches a cable modem as claimed in claim 5, wherein the cable modem engine includes: the DOCSIS PHY layer includes a transmitter and receiver (0030); the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications (0053-0054); the DOCSIS controller is configured to implement VoIP functionality (0025); and wherein the data networking engine includes a RISC processor configured to implement all data networking processing and home networking applications, decoupled from the implementation of the MAC functions and the VoIP functionality of the cable modem engine (0037, 0043-0045).

As per claim 13, Brooks teaches a cable modem architecture as claimed in claim 12, wherein the DOCSIS controller provides VoIP functionality in accordance with the PacketCable specification, and wherein the data networking engine provides the embedded portal services functionality of the CableHome specification, wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine (0013-0016, 0024-0026).

As per claim 14, Brooks teaches a cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor (0013-0016, 0024-0026, 0037).

As per claim 15, Brooks teaches a method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VoIP functionality in a cable modem engine (0013-0016, 0024-0026); and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality (0013-0016, 0024-0026).

As per claim 16, Brooks teaches a cable modem system as claimed in claim 5, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine (0044-0045).

Response to Remarks

Applicant's remarks filed on May 19, 2009 have fully been considered.

The data networking engine and cable modem engines are represented in figures 1 and 2 of the Brooks reference, including buses carrying out separate networking functions. For example, the data networking engine interfaces with the peripheral devices and employs operating system functions, and the cable modem engine implements DOCSIS functionality. These entities are completely partitioned from each other, as discussed in the cited sections.

Paragraphs 0036-0042 discuss the transfer of packets between the cable modem and data networking engines. Therefore, examiner respectfully disagrees with the assertion that there is no data networking engine, and it is respectfully submitted that the Brooks invention fully teaches the limitations of claim 7. Further, paragraph 0010 discusses the inclusion of various CableLabs standards. Because PacketCable and CableHome specifications constitute these standards, Brooks fully teaches the claim limitations.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tanim Hossain whose telephone number is (571)272-3881. The examiner can normally be reached on 8:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vivek Srivastava can be reached on 571/272-7304. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Tanim Hossain
Patent Examiner
Art Unit 2445

/Nabil El-Hady/
Supervisory Patent Examiner, Art Unit 4191

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10675566	LI ET AL.
	Examiner	**Art Unit**
	Tanim Hossain	2445

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/16/2009	08/24/2009	01/30/2010						
	1	✓	÷	✓						
	2	✓	÷	✓						
	3	✓	÷	✓						
	4	✓	÷	✓						
	5	✓	÷	✓						
	6	✓	÷	✓						
	7	✓	÷	✓						
	8	✓	÷	✓						
	9	✓	÷	✓						
	10	✓	÷	✓						
	11	✓	÷	✓						
	12	✓	÷	✓						
	13	✓	÷	✓						
	14	✓	÷	✓						
	15	✓	÷	✓						
	16		÷	✓						

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10675566	LI ET AL.
	Examiner	Art Unit
	Tanim Hossain	2445

SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
EAST	2/16/09	TH
EAST	1/30/10	TH

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	3981	docsis	US-PGPUB; USPAT	OR	OFF	2010/01/30 19:52
L2	3546	docsis and modem$4	US-PGPUB; USPAT	OR	OFF	2010/01/30 19:52
L3	505	docsis and modem$4 and partition$4	US-PGPUB; USPAT	OR	OFF	2010/01/30 19:52
L4	518	docsis and modem$4 and (partition$4 or bifurcat$)	US-PGPUB; USPAT	OR	OFF	2010/01/30 19:52
L5	184	docsis and modem$4 and ((partition$4 or bifurcat$) same function $7)	US-PGPUB; USPAT	OR	OFF	2010/01/30 19:53
L6	52	docsis and modem$4 and ((partition$4 or bifurcat$) same function $7) and risc	US-PGPUB; USPAT	OR	OFF	2010/01/30 19:53
S1	28271	cable$4 near2 modem$4	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:09
S2	2625	(cable$4 near2 modem $4) and docsis	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:09
S3	482	(cable$4 near2 modem $4).ab. and docsis	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:10

ENTROPIC_CHARTER_0005548

S4	91	(cable$4 near2 modem $4).ab. and docsis and ((integrat$4 with (function $4 or service $4) same modem$4))	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:12
S5	21	(cable$4 near2 modem $4).ab. and docsis and ((integrat$4 with (function $4 or service $4) same modem$4)) and partition $4	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:12
S6	13	(cable$4 near2 modem $4).ab. and docsis and ((integrat$4 with (function $4 or service $4) same modem$4)) and partition $4 and voip$4	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:12
S7	230	(cable$4 near2 modem $4).ab. and docsis and ((integrat$4 or multipl$4 or pluralit$4) with (function $4 or service $4) same modem$4)	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:25

ENTROPIC_CHARTER_0005549

S8	35	(cable$4 near2 modem $4).ti. and docsis and ((integrat$4 with (function $4 or service $4) same modem$4))	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:26
S9	94	(cable$4 near2 modem $4).ti. and docsis and ((integrat$4 or multipl$4 or pluralit$4) with (function $4 or service $4) same modem$4)	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:27

1/30/10 7:58:05 PM
C:\Documents and Settings\thossain\My Documents\EAST\Workspaces\10675566 Li - Multiple Function Cable Modem.wsp

ENTROPIC_CHARTER_0005550

To: ip.department.us@nxp.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 65913

Feb 05, 2010 05:44:51 AM

Dear PAIR Customer:

NXP, B.V.
NXP INTELLECTUAL PROPERTY & LICENSING
M/S41-SJ
1109 MCKAY DRIVE
SAN JOSE, CA 95131
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 65913 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:
The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
10675566	CTFR	02/05/2010	81373818US01-02CXT0070D

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Reply under 37 C.F.R. 1.116
Expedited Procedure
Technology Center 2445

Confirmation No. 9980

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	LI *et al.*	Examiner:	Hossain, Tanim
Serial No.:	10/675,566	Group Art Unit:	2445
Filed:	September 30, 2003	Docket No.:	81373818US01 (NXPS.615PA)
Title:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM		

REQUEST TO WITHDRAW FINALITY AND RESPONSE TO FINAL OFFICE ACTION

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Customer No. 65913

Dear Sir:

In acknowledgement of the Final Office Action dated February 5, 2010, please reconsider the application in view of the following amendments and remarks.

A complete listing of the claims, including any amendments, and Remarks/Arguments follow.

Authorization is given to charge/credit **Deposit Account 50-4019 (81373818US01)** all required fees/overages to enter this paper.

In the Claims:

1. (Currently amended) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem ~~mode~~ engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and

a data bus that connects the data networking engine to the cable modem engine,

wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

2. (Original) A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. (Original) A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. (Previously presented) A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine configured to perform all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem engine.

5. (Previously presented) A cable modem system as claimed in claim 1, wherein the cable modem engine includes:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller, and

wherein the at least one processor of the data networking engine is a RISC processor.

6. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer includes a hardware transmitter and receiver.

7. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor is configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. (Original) A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. (Original) A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine is configured to perform all data networking processing including advanced multi-port bridging routing with NAT/firewall and VPN, and home networking applications.

11. (Original) A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. (Currently Amended) A cable modem system as claimed in claim 5, wherein the cable modem engine includes:

the DOCSIS PHY layer includes a transmitter and receiver;

the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications; and

the DOCSIS controller is configured to implement VoIP functionality; and wherein

the data networking engine ~~that~~ includes a RISC processor configured to implement ~~substantially all~~ a majority of data networking processing and home networking applications decoupled from the implementation of the MAC functions and the VoIP functionality of the cable modem engine.

13. (Previously presented) A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, wherein the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. (Original) A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. (Original) A method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VoIP functionality in a cable modem engine; and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

16. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

Remarks

In the non-final Office Action dated February 5, 2010, the following grounds of rejection are presented: claim 1 is objected to as to informalities; claim 12 is rejected under 35 U.S.C § 112, first paragraph as failing to comply with the written description requirement; claims 12-14 are rejected under 35 U.S.C § 112, second paragraph as being indefinite; claims 1-16 stand rejected under 35 U.S.C. § 102(e) over Brooks (U.S. Patent Pub. 2001/0039600). In the following discussion, Applicant does not acquiesce in any regard to averments in this Office Action (unless Applicant expressly indicates otherwise).

Applicant has amended claim 1 to correct a typographical error, and requests that the objection be removed.

Applicant respectfully traverses the § 102(e) rejection of claims 1-16 because the cited portions of the '600 reference do not correspond to aspects of the claimed invention. For example, Applicant is uncertain how the '600 reference discloses aspects of the claimed invention directed to data networking functions performed by a data networking engine being completely partitioned/decoupled from the other cable modem functions performed by a cable modem engine. The Examiner has repeatedly failed to identify elements of the '600 reference corresponding to these aspects as requested. In contrast, the Office Action make the conclusion statement that "the data networking engine and cable modem engines are represented in Figures 1 and 2 of the ['600] reference" (*see, e.g.*, p. 8 of the Office Action). However, Applicant is uncertain how any reasonable interpretation of these Figures can provide correspondence. For example, Figure 2 of the '600 reference discloses only two processors, each of which, therefore, must correspond to the claimed data-networking and cable-modem engines. However, the discussion of Figure 2 makes clear that the cable modem functions are performed by CMAC unit 224 (*see, e.g.*, paragraph 0042). Therefore, in order for the cable modem engine to contain a processor and perform the CMAC functions as claimed, the cited cable modem engine must include circuitry to connect the processors with the CMAC unit. Because available connecting circuitry would be shared with the other processor, Applicant is uncertain how the asserted cable modem engine and home networking engine can be completely

partitioned as claimed. Because the Office Action has not identified these claimed aspects in the '600 reference, a *prima facie* case has not been presented and Applicant requests that the rejection of claims 1-16 be withdrawn.

Applicant submits that the Examiner's failure to identify corresponding elements as requested in Applicant's response constitutes an incomplete answer under M.P.E.P. § 707.07 and, therefore, makes the finality of the Office Action improper. In order to comply with 35 U.S.C. § 132, sufficient detail must be provided by the Examiner regarding the alleged correspondence between the claimed invention and the cited reference to enable Applicant to adequately respond to the rejections. *See, also,* 37 CFR 1.104 ("The pertinence of each reference, if not apparent, must be clearly explained and each rejected claim specified.") and M.P.E.P. § 706.02(j), ("It is important for an Examiner to properly communicate the basis for a rejection so that the issues can be identified early and the applicant can be given fair opportunity to reply."). Because the Examiner has repeatedly failed to identify specific elements of the '600 reference which provide correspondence (as requested in the previous response), Applicant submits that the Office Action is unresponsive to Applicant's arguments and Applicant requests the finality of the Office Action be withdrawn.

Applicant respectfully traverses the § 112(1) rejection of claim 12 because aspects of the claim directed to a RISC processor are fully supported by Applicant's specification in compliance with the written description requirement. As shown in Figure 1 and related discussion at paragraph 0028 of Applicant's published specification, "the functions of the cable modem and data networking are rationally distributed among three different processors: DOCSIS MAC processor 114 (ARM #2); DOCSIS controller 116 (ARM #1); and data networking engine 120 (ARM #3)." Applicant submits that ARM, as commonly used in the art, refers to the Advanced RISC Machine (ARM). ARM is a 32-bit reduced instruction set computer (RISC) instruction set architecture developed by ARM Holding. Applicant submits that word-for-word correspondence is not required by the M.P.E.P. or relevant law, and maintains that the figures, together with the aforementioned discussion in the specification, fully support the claim limitations. *See, e.g., Union Oil Co. of California v. Atlantic Richfield Co.*, 208 F.3d 989 (Fed. Cir. 2000), *cert. denied*, 69 U.S.L.W. 3165 (Feb. 20, 2001) (No. 00-249) (quoting *In re Gosteli*, 872

F.2d 1008, 1012, 10 U.S.P.Q.2d 1614, 1618 (Fed. Cir. 1989) ("The written description requirement does not require the applicant "to describe exactly the subject matter claimed, [instead] the description must clearly allow persons of ordinary skill in the art to recognize that [he or she] invented what is claimed. "). Accordingly the 112(1) rejection is improper and should be withdrawn.

Applicant respectfully traverses the § 112(2) rejection of claims 12-14. While the Office Action erroneously suggests that "substantially" must be defined in the specification. Consistent with § 112(2), Applicant submits that, as used, the phase "substantially all" would be understood by one of ordinary skill in the art in light of the specification and in the context of decoupling performance of data networking and home networking applications from the implementation of the MAC and VoIP functionality. *See, Andrew Corp. v. Gabriel Electronics*, 847 F.2d 819 (Fed. Cir. 1988). Accordingly, the §112(2) rejection of claims 12-14 fails. Notwithstanding the above, Applicant has amended the claims for clarity and to better reflect the original intent of the claims. The §112(2) rejection is believe to no longer apply.

In view of the above, Applicant believes that each of the rejections is improper and should be withdrawn and that the application is in condition for allowance. Should there be any remaining issues that could be readily addressed over the telephone, the Examiner is asked to contact the agent overseeing the application file, Peter Zawilski, of NXP Corporation at (408) 474-9063 (or the undersigned).

Please direct all correspondence to:

Corporate Patent Counsel
NXP Intellectual Property & Standards
1109 McKay Drive; Mail Stop SJ41
San Jose, CA 95131

CUSTOMER NO. 65913

By: _____
Name: Robert J. Crawford
Reg. No.: 32,122
651-686-6633
(NXPS.615PA)

Electronic Acknowledgement Receipt

EFS ID:	7353649
Application Number:	10675566
International Application Number:	
Confirmation Number:	9980
Title of Invention:	Architecture for a flexible and high-performance gateway cable modem
First Named Inventor/Applicant Name:	Gordon Y. Li
Customer Number:	65913
Filer:	Robert J. Crawford/Kelly Davis
Filer Authorized By:	Robert J. Crawford
Attorney Docket Number:	81373818US01-02CXT0070D
Receipt Date:	05-APR-2010
Filing Date:	30-SEP-2003
Time Stamp:	17:28:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		81373818US01_response.pdf	379587 3fd06cee436ac96c2743e668df9e17153ed69a54	yes	8

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Amendment After Final	1	1
Claims	2	5
Applicant Arguments/Remarks Made in an Amendment	6	8

Warnings:	
Information:	
Total Files Size (in bytes):	379587

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Attorney Docket No.: 348162-982350

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: G. Li

Serial No: 10/675,566

Filed: September 30, 2003

Title: Architecture For A Flexible And High-Performance Gateway Cable Modem

Docket No.: 348162-982350

Customer No.: 94518

Certificate of Transmission Under 37 CFR 1.8

I hereby certify that this correspondence is being transmitted via electronic submission, Commissioner for Patents, Alexandria, VA 22313-1450 on:

April 5, 2010 /Susan Pingue/

Date *Susan Pingue*

***

COMMUNICATION

Assistant Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313

Sir:

Attached herewith are copies of the Power of Attorney Form (SB/80) and Statement Under 37 CFR 3.73(b) (SB/96) signed by David L. Teichmann, Secretary and Director of Trident Microsystems (Far East) Ltd. in connection with the above-referenced US patent application.

Please note that the new Attorney Docket Number is 348162-982350.

The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 07-1896 referencing our Docket No. 348162-982350.

Respectfully submitted,

DLA PIPER LLP US

Dated: April 5, 2010

By /David L. Alberti/
David L. Alberti
Reg. No. 43,465
Attorney for Applicants

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2000 University Avenue
East Palo Alto, CA 94303
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Facsimile : (650) 833-2001

CUSTOMER NO. 94518

/SCP

WEST\21929924.1

PTO/SB/96 (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: NXP

Application No./Patent No.: 10/675,566 Filed/Issue Date: Sep. 30, 2003

Entitled:

Trident Microsystems (Far East) Ltd., a Corporation
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. ☒ the assignee of the entire right, title, and interest in;
2. ☐ an assignee of less than the entire right, title and interest in (The extent (by percentage) of its ownership interest is _____%); or
3. ☐ the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

in the patent application/patent identified above by virtue of either:

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 023998, Frame 0552, or for which a copy thereof is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____
   The document was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.
2. From: _____ To: _____
   The document was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.
3. From: _____ To: _____
   The document was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature	Feb. 19, 2010 Date
David L. Teichmann, Printed or Typed Name	Secretary and Director Trident Microsystems (Far East) Ltd. Title

American LegalNet, Inc.
www.FormsWorkFlow.com

PTO/SB/80 (11-08)
Approved for use through 11/30/2011. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:

☑ Practitioners associated with the Customer Number: 94518

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:

☑ The address associated with Customer Number: 94518

OR

☐ Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address:

Trident Microsystems (Far East) Ltd.
Ugland House, South Church Street
Grand Cayman, Cayman Islands

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	Feb. 19 2010
Name	David L. Teichmann	Telephone	408/764-8808
Title	Secretary and Director, Trident Microsystems (Far East) Ltd.		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Electronic Acknowledgement Receipt

EFS ID:	7356207
Application Number:	10675566
International Application Number:	
Confirmation Number:	9980
Title of Invention:	Architecture for a flexible and high-performance gateway cable modem
First Named Inventor/Applicant Name:	Gordon Y. Li
Customer Number:	65913
Filer:	David L. Alberti/Susan Pingue
Filer Authorized By:	David L. Alberti
Attorney Docket Number:	81373818US01-02CXT0070D
Receipt Date:	06-APR-2010
Filing Date:	30-SEP-2003
Time Stamp:	00:58:42
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		982350Documents.pdf	110392 15c4e60163b42cc7843deb01c0d9d2c2f38c78ed	yes	4

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Miscellaneous Incoming Letter	1	2
Assignee showing of ownership per 37 CFR 3.73(b).	3	3
Power of Attorney	4	4

Warnings:	
Information:	
Total Files Size (in bytes):	110392

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 10/675,566	Filing Date 09/30/2003	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
AMENDMENT	**04/05/2010**	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 0	X $ =		OR	X $52=	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $ =		OR	X $220=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)					
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/VIOLA ROGERS/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PTO/SB/06 (07-06)
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U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 10/675,566	Filing Date 09/30/2003	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
AMENDMENT	**04/05/2010**	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 0	X $ =		OR	X $52=	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $ =		OR	X $220=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)					
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/VIOLA ROGERS/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D	9980

94518 7590 05/11/2010
DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303

EXAMINER	
HOSSAIN, TANIM M	
ART UNIT	PAPER NUMBER
2445	

MAIL DATE	DELIVERY MODE
05/11/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Advisory Action Before the Filing of an Appeal Brief	**Application No.**	**Applicant(s)**	
	10/675,566	LI ET AL.	
	Examiner	**Art Unit**	
	Tanim Hossain	2445	

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 05 April 2010 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

1. ☒ The reply was filed after a final rejection, but prior to or on the same day as filing a Notice of Appeal. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114. The reply must be filed within one of the following time periods:
   a) ☐ The period for reply expires _____months from the mailing date of the final rejection.
   b) ☒ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

   Examiner Note: If box 1 is checked, check either box (a) or (b). ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☐ The proposed amendment(s) filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   (a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below);
   (b) ☐ They raise the issue of new matter (see NOTE below);
   (c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   (d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

   NOTE: _____. (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☒ For purposes of appeal, the proposed amendment(s): a) ☐ will not be entered, or b) ☒ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.

   The status of the claim(s) is (or will be) as follows:
   Claim(s) allowed: _____.
   Claim(s) objected to: _____.
   Claim(s) rejected: *1-16*.
   Claim(s) withdrawn from consideration: _____.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ The affidavit or other evidence filed after a final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

11. ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: See Continuation Sheet.
12. ☐ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). _____
13. ☐ Other: _____.

/VIVEK SRIVASTAVA/
Supervisory Patent Examiner, Art Unit 2445

Continuation of 11. does NOT place the application in condition for allowance because: Brooks' abstract, for example, discloses bifurcated processing architecture. The first processor processes information flowing to and from cable media interface circuitry. This constitutes the data networking engine, which performs the interacting with equipment, as claimed. The second processor performs the management of some message processing and scheduling, which constitutes cable modem functions other than those of the data networking engine (please see paragraph 0026). This then constitutes the cable modem engine, as claimed. Claim 9 of the Brooks reference further teaches partitioned processors, where the co-processor supports the processing of cable media and performs data transfer, and the first processor performs a plurality of other processing functions.

The 112 rejections are hereby withdrawn.

Finality of the previous office action is proper, given that the cited paragraphs point to the birfurcated nature of the cable modem, where each of the processors perform different functions. This is sufficient to equate the corresponding processor to the data networking engine (the processor that handles the data flow), and the other to the cable modem engine (the processor that performs other functions).

Reply under 37 C.F.R. 1.116
Expedited Procedure
Technology Center 2445

Confirmation No. 9980

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	LI *et al.*	Examiner:	Hossain, Tanim
Serial No.:	10/675,566	Group Art Unit:	2445
Filed:	September 30, 2003	Docket No.:	81373818US01 (NXPS.615PA)
Title:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM		

REQUEST TO WITHDRAW FINALITY AND RESPONSE TO FINAL OFFICE ACTION

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Customer No.
65913

Okay to enter amendments.
Thanks, TH

Dear Sir:

In acknowledgement of the Final Office Action dated February 5, 2010, please reconsider the application in view of the following amendments and remarks.

A complete listing of the claims, including any amendments, and Remarks/Arguments follow.

Authorization is given to charge/credit **Deposit Account 50-4019 (81373818US01)** all required fees/overages to enter this paper.

PTO/SB/30 (09-08)
Approved for use through 10/31/2008. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Request for Continued Examination (RCE) Transmittal

Address to:
Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Application Number	10/675,566
Filing Date	September 30, 2003
First Named Inventor	Gordon Y. Li
Art Unit	2445
Examiner Name	Tanim M. Hossain
Attorney Docket Number	348162-982350 [81373818US01]

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. Submission required under 37 CFR 1.114 Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

   a. ☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

      i. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

      ii. ☐ Other _____

   b. ☑ Enclosed

      i. ☑ Amendment/Reply

      ii. ☐ Affidavit(s)/ Declaration(s)

      iii. ☐ Information Disclosure Statement (IDS)

      iv. ☐ Other _____

2. Miscellaneous

   a. ☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

   b. ☐ Other _____

3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

   a. ☑ The Director is hereby authorized to charge the following fees, any underpayment of fees, or credit any overpayments, to Deposit Account No. 07-1896.

      i. ☑ RCE fee required under 37 CFR 1.17(e)

      ii. ☑ Extension of time fee (37 CFR 1.136 and 1.17)

      iii. ☐ Other _____

   b. ☐ Check in the amount of $ _____ enclosed

   c. ☐ Payment by credit card (Form PTO-2038 enclosed)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Signature	/Gerald T. Sekimura/	Date	June 7, 2010
Name (Print/Type)	Gerald T. Sekimura	Registration No.	30,103

CERTIFICATE OF MAILING OR ELECTRONIC TRANSMISSION

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450 or electronically transmitted to the U.S. Patent and Trademark Office on the date shown below.

Signature	/Ta-Tanisha L. Henry/		
Name (Print/Type)	Ta-Tanisha L. Henry	Date	June 7, 2010

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Appl. No.	:	10/675,566	Confirmation No. 9980
Applicants	:	Gordon Y. Li, et al.	
Filed	:	September 30, 2003	
TC/A.U.	:	2445	
Examiner	:	Tanim M. Hossain	
Docket No.	:	348162-982350 [81373818US01]	
Customer No.	:	94518	

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

AMENDMENT

Sir:

In connection with the Request for Continued Examination, filed herewith, please amend the subject application as follows:

Any Amendments to the Claims are reflected in the listing of claims which begins on page **2** of this paper.

Remarks/Arguments begin on page 6 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and

a data bus that connects the data networking engine to the cable modem engine,

wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

2. (Original) A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. (Original) A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. (Previously presented) A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine configured to perform all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem engine.

5. (Previously presented) A cable modem system as claimed in claim 1, wherein the cable modem engine includes:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller, and

wherein the at least one processor of the data networking engine is a RISC processor.

6. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer includes a hardware transmitter and receiver.

7. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor is configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. (Original) A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. (Original) A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine is configured to perform all data networking processing including advanced multi-port bridging routing with NAT/firewall and VPN, and home networking applications.

11. (Original) A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. (Previously presented) A cable modem system as claimed in claim 5, wherein the cable modem engine includes:

the DOCSIS PHY layer includes a transmitter and receiver;

the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications; and

the DOCSIS controller is configured to implement VoIP functionality; and wherein

the data networking engine includes a RISC processor configured to implement a majority of data networking processing and home networking applications decoupled from the implementation of the MAC functions and the VoIP functionality of the cable modem engine.

13. (Previously presented) A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, wherein the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. (Original) A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. (Original) A method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VoIP functionality in a cable modem engine; and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

16. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

REMARKS/ARGUMENTS

Reconsideration of the subject application, as amended, is respectfully requested.

Claims 1-16 are pending in the subject application. Claim 1 has been amended to recite that the cable modem functions include interfacing with cable media. Support for this amendment is found in the implementation examples of Figures 1 and 2, and the illustrated interfaces to the HFC or RF external sources.

In the February 5, 2010 Office Action, made final, the Examiner rejected claims 1-16 under 35 USC 102(e) as being anticipated by Brooks (U.S. 2001/0039600) ("Brooks '600"). (See, Office Action, p. 3.) Claim 12 was rejected under 35 USC 112, first paragraph, as failing to comply with the written description. Claims 12-14 were rejected under 35 USC 112, second paragraph, as indefinite.

A Request to Withdraw Finality and Response to Final Office Action was filed on April 5, 2010 in which claims 1 and 12 were amended to address the Examiner's section 112 rejections, and it was pointed out that there was continued uncertainty as to how the Examiner was interpreting and applying the disclosures of Brooks '600 to the claims at issue. More specifically, it was pointed out that in Brooks '600, only two processors were disclosed. Therefore, from the Examiner's position that "the data networking engine and cable modem engines are represented in figures 1 and 2" (Office Action, p. 8), it would follow that one of the two processors corresponded to the networking engine, and the other of the two processors corresponded to the cable modem engine. It was further pointed out that while the discussion concerning Figure 2 in Brooks '600 paragraph 0042 makes clear that cable modem functions are performed by CMAC unit 224, if the cable modem engine is to contain a processor and perform CMAC functions as claimed, the cited cable modem engine must include circuitry

to connect one of the processors with the CMAC unit. It was noted, however, that because available connecting circuitry would be shared by both the one processor and the other processor, the asserted cable modem engine and home networking engine could not be completely partitioned as claimed.

In the Examiner's Advisory Action (notification date May 11, 2010) the Examiner withdrew the section 112 rejections, continued the finality of the 102(e) rejection, and provided a limited further explanation of his view of how the disclosure of Brooks '600 applies to the pending claims. However, despite this further explanation, it is still not clear as to what the Examiner considers to be the cable modem engine and the data networking engine in Brooks '600.

The Examiner explained that:

> Brooks' abstract, for example, discloses bifurcated processing architecture. The first processor processes information flowing to and from cable media interface circuitry. This constitutes the data networking engine, which performs the interacting with equipment, as claimed. The second processor performs the management of some message processing and scheduling, which constitutes cable modem functions other than those of the data networking engine (please see paragraph 0026). This the constitutes the cable modem engine, as claimed. Claim 9 of the Brooks reference further teaches partitioned processors, where the co-processor supports the processing of cable media and performs data transfer, and the first processor performs a plurality of other processing functions.

(Advisory Action Before Filing of an Appeal Brief, sheet 3.)

First of all, the Examiner's assertion that "[t]his constitutes the data networking engine, which performs the interacting with equipment, as claimed" appears to equate the "cable media interface circuitry" with the "customer provided equipment" of, for example, claim 1. Presumably, the Examiner is referring to the CMAC/CPHY block (114, 118, 224 and 228) of Fig. 2 as the cable media interface circuitry. However, Brooks '600 does not describe such blocks as customer provided equipment. Thus, it is not clear what the Examiner considers to correspond to "customer provided equipment" in Brooks '600.

Further, from the above explanation, it appears that the Examiner may be asserting that the cable modem engine includes second processor 104, that the data networking engine is first processor 102 (see Fig. 2), and that the CMAC/CPHY block (114, 118, 224 and 228) is also a part of the cable modem engine. However, processor 102 handles many cable modem functions (see Fig. 4, paragraphs 0053 to 0062), and is explicitly described as "programmed to implement the desired MAC functionality" (paragraph 0026). Paragraph 0025 states "[i]n the case of DOCSIS, typical MAC functionality includes MPEG and MCNS decoding and frame synchronization." On the other hand, processor 104 is described only as providing operating system support and that it "may manage some message processing and scheduling" (paragraph 0026, emphasis added). Thus, the Examiner's designation of the first processor as the "data networking engine" is at odds with the Brooks '600 description of processor 102 as being "programmed to implement the desired MAC functionality."

The Examiner's apparent designation of the first processor 102 in Brooks '600 as the "data networking engine," and the second processor 104 and the CMAC/CPHY block (114, 118, 224 and 228) as the "cable modem engine," further does not square with the claim 1 feature that "the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine," and the claim 15 feature of "partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VOIP functionality." This is because the CMAC/CPHY block (114, 118, 224 and 228) communicates with both the processors 102 and 104 by sharing the same data paths and sharing the same direct memory access controller. (See peripheral bus 112 – bridge 110 – system bus 108 in Fig. 1 and APB 214 – DMA Controller/ASB-APB Bridge 212 – ASB 210 in Fig. 2, and paragraphs 0034 and 0035).

Further, accepting the Examiner's assertion that first processor 102 handles data networking functionality, and considering the description of paragraphs 0025 and 0026 that processor 102 is programmed to implement the desired MAC functionality (which would include typical DOCSIS MAC functionality), leads to a conclusion that the Brooks '600 processor 102 does not implement a complete partitioning or a completely decoupled arrangement of the data networking engine from the cable modem engine.

Thus, Brooks '600 does not provide the complete partitioning or completely decoupled arrangement of the data networking engine from the cable modem engine that the Examiner apparently asserts it does.

For at least the above reasons, it is respectfully submitted that Brooks '600 does not teach or make obvious the claimed subject matter.

The Examiner also asserts that claim 9 of the Brooks reference:

> further teaches partitioned processors, where the co-processor supports the processing of cable media and performs data transfer, and the first processor performs a plurality of other processing functions.

(Advisory Action Before Filing of an Appeal Brief, sheet 3.)

It is respectfully submitted that the description that the "co-processor supports the processing of cable media and performs data transfer" (emphasis added) indicates that there is no partitioning of cable modem functionality from data networking functionality in the co-processor, but instead a combining of the same. Thus, claim 9 of Brooks '600 does not support the Examiner's rejection of the claims of the subject application.

In view of the above, it is respectfully submitted that the application is now in condition for allowance. The Examiner's reconsideration and further examination are respectfully requested.

The undersigned attorney would welcome an opportunity to discuss the claims as amended and Brooks '600 with the Examiner in order to better understand the Examiner's interpretation of the same, and to advance the subject application toward allowance.

Respectfully submitted,

DLA Piper LLP (US)

Dated: June 7, 2010

By: /Gerald T. Sekimura/
Gerald T. Sekimura
Reg. No. 30,103
Tel.: (415) 836-2500

Attn.: Patent Department
DLA Piper LLP (US)
555 Mission Street, Suite 2400
San Francisco, CA 94105-2933

PTO/SB/22 (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a) **FY 2009** ***(Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).)***	Docket Number (Optional) 348162-982350 [81373818US01]
Application Number 10/675,566	Filed September 30, 2003
For Architecture for a Flexible and High-Performance Gateway Cable Modem	
Art Unit 2445	Examiner Tanim M. Hossain

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

		Fee	Small Entity Fee	
☒	One month (37 CFR 1.17(a)(1))	$130	$65	$ 130.00
☐	Two months (37 CFR 1.17(a)(2))	$490	$245	$
☐	Three months (37 CFR 1.17(a)(3))	$1110	$555	$
☐	Four months (37 CFR 1.17(a)(4))	$1730	$865	$
☐	Five months (37 CFR 1.17(a)(5))	$2350	$1175	$

☐ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 07-1896.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant/inventor.

☐ assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed (Form PTO/SB/96).

☒ attorney or agent of record. Registration Number 30,103

☐ attorney or agent under 37 CFR 1.34. Registration number if acting under 37 CFR 1.34 _____

/Gerald T. Sekimura/ — Signature

June 7, 2010 — Date

Gerald T. Sekimura — Typed or printed name

(415) 836-2500 — Telephone Number

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

☒ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS, **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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Electronic Patent Application Fee Transmittal

Application Number:	10675566
Filing Date:	30-Sep-2003
Title of Invention:	Architecture for a flexible and high-performance gateway cable modem
First Named Inventor/Applicant Name:	Gordon Y. Li
Filer:	Gerald T. Sekimura./Ta-Tanisha Henry
Attorney Docket Number:	81373818US01-02CXT0070D

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 1 month with $0 paid	1251	1	130	130

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for continued examination	1801	1	810	810
		Total in USD ($)		**940**

Electronic Acknowledgement Receipt

EFS ID:	7760990
Application Number:	10675566
International Application Number:	
Confirmation Number:	9980
Title of Invention:	Architecture for a flexible and high-performance gateway cable modem
First Named Inventor/Applicant Name:	Gordon Y. Li
Customer Number:	94518
Filer:	Gerald T. Sekimura./Ta-Tanisha Henry
Filer Authorized By:	Gerald T. Sekimura.
Attorney Docket Number:	81373818US01-02CXT0070D
Receipt Date:	07-JUN-2010
Filing Date:	30-SEP-2003
Time Stamp:	16:27:16
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$940
RAM confirmation Number	3079
Deposit Account	071896
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	RCE.pdf	48886 c85fe713393b1f9cd3dc1fcdfa6d70fc5f758569	no	1
Warnings:					
This is not a USPTO supplied RCE SB30 form.					
Information:					
2	Amendment Submitted/Entered with Filing of CPA/RCE	AMDWRCE.pdf	264973 d3563b1c983ce99c9eb55bee255fa27eb3825d4b	no	10
Warnings:					
Information:					
3	Extension of Time	EXTOFTIME.pdf	39944 85fc5cbe6b09b83b3da5b23062dedb695b72ca68	no	1
Warnings:					
Information:					
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D

CONFIRMATION NO. 9980

65913
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POWER OF ATTORNEY NOTICE

OC000000041004721

Date Mailed: 06/18/2010

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/06/2010.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/cdsmith/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D

CONFIRMATION NO. 9980

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POA ACCEPTANCE LETTER

OC000000041004759

Date Mailed: 06/18/2010

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/06/2010.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/cdsmith/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

> The data networking engine and cable modem engines are represented in figures 1 and 2 of the Brooks reference, including buses carrying out separate networking functions. For example, the data networking engine interfaces with the peripheral devices and employs operating system functions, and the cable modem engine implements DOCSIS functionality. These entities are completely partitioned from each other, as discussed in the cited sections.
>
> Paragraphs 0036-0042 discuss the transfer of packets between the cable modem and data networking engines. Therefore, examiner respectfully disagrees with the assertion that there is no data networking engine, and it is respectfully submitted that the Brooks invention fully teaches the limitations of claim 7. Further, paragraph 0010 discusses the inclusion of various CableLabs standards. Because PacketCable and CableHome specifications constitute these standards, Brooks fully teaches the claim limitations.

Id. at ENTROPIC_CHARTER_0005544.

69. On April 5, 2010, the Applicant responded to the February 5 office action. The Applicant again traversed the rejection and explained the Applicant's continued uncertainty as to how the Examiner was interpreting and applying the disclosures of Brooks to the claims at issue. Specifically, the Applicant stated the following:

> For example, ***Applicant is uncertain how [Brooks] discloses aspects of the claimed invention directed to data networking functions performed by a data networking engine being completely partitioned/decoupled from the other cable modem functions performed by a cable modem engine.*** The Examiner has repeatedly failed to identify elements of [Brooks] corresponding to these aspects as requested. In contrast, the Office Action make the conclusion statement [sic] that "the data networking engine and the cable modem engines are represented in Figures 1 and 2 of [Brooks]" (*see, e.g.*, p. 8 of the Office action). However, Applicant is uncertain how any reasonable interpretation of these Figures can provide correspondence. For example, ***Figure 2 of [Brooks] discloses only two processors, each of which, therefore, must correspond to the claimed data-networking and cable-modem engines. However, the discussion of Figure 2 makes clear that the cable modem functions are performed by CMAC unit 224*** (*see, e.g.*, paragraph 0042). Therefore, in order for the cable modem engine to contain a processor and perform the CMAC functions as claimed, the cited cable modem engine must include circuitry to connect the processors with the CMAC unit. Because available connecting circuitry would be shared with the other processor, Applicant is uncertain how the asserted

> cable modem engine and home networking engine can be completely partitioned as claimed. Because the Office Action has not identified these clamed aspects in [Brooks], a *prime facie* case has not been presented and Applicant requests that the rejection of claims 1-16 be withdrawn.

Id. at ENTROPIC_CHARTER_0005557–0005558 (emphasis added).

70. The Applicant further confirmed its uncertainty of the Examiner's application of Brooks by stating, for example: "Applicant submits that the Examiner's failure to identify corresponding elements as requested in Applicant's response constitutes an incomplete answer under M.P.E.P. § 707.07 and, therefore, makes the finality of the Office Action improper." *Id.* at ENTROPIC_CHARTER_0005558. The Applicant further explained, "[i]n order to comply with 35 U.S.C. § 132, sufficient detail must be provided by the Examiner regarding the alleged correspondence between the claimed invention and the cited reference to enable Applicant to adequately respond to the rejections." *Id.*

71. On May 11, 2010, the Examiner issued an Advisory Action, in which the Examiner withdrew some rejections but continued the finality of the rejection of Claims 1–16 associated with the Brooks '006 disclosure. The Examiner explained the following:

> Brooks' abstract, for example, discloses bifurcated processing architecture. The first processor processes information flowing to and from cable media interface circuitry. This constitutes the data networking engine, which performs the interacting with equipment as claimed. The second processor performs the management of some message processing and scheduling, which constitutes cable modem functions other than those of the data networking engine (please see paragraph 0026). This then constitutes the cable modem engine, as claimed. Claim 9 of the Brooks reference further teaches partitioned processors, where the co-processor supports the processing of cable media and performs data transfer, and the first processor performs a plurality of other processing functions.

Id. at ENTROPIC_CHARTER_0005572.

72. On June 7, 2010, the Applicant submitted a request for continued examination along with an amendment to the claims and remarks. Among other things, the Applicant explained its continued requests for the Examiner to explain the application of the Brooks reference because

"it was pointed out that there was continued uncertainty as to how the Examiner was interpreting and applying the disclosures of Brooks '600 to the claims at issue." *Id.* at ENTROPIC_CHARTER_0005580. In particular, the Applicant explained the continued uncertainty as follows:

> [I]t was pointed out that in Brooks '600, only two processors were disclosed. Therefore, from the Examiner's position that "the data networking engine and cable modem engines are represented in figures 1 and 2" (Office Action, p. 8), it would follow that one of the two processors corresponded to the networking engine, and the other of the two processors corresponded to the cable modem engine. ***It was further pointed out that while the discussion concerning Figure 2 in Brooks '600 paragraph 0042 makes clear that cable modem functions are performed by CMAC unit 224***, if the cable modem engine is to contain a processor and perform CMAC functions as claimed, the cited cable modem engine must include circuitry to connect one of the processors with the CMAC unit. It was noted, however, that because available connecting circuitry would be shared by both the one processor and the other processor, the asserted cable modem engine and home networking engine could not be completely partitioned as claimed.

Id. at ENTROPIC_CHARTER_0005580–0005581 (emphasis added).

73. In other words, as the Applicant explained, processor 102, which the Examiner had designated as the data networking engine, handles many cable modem functions:

> [I]t appears that the Examiner may be asserting that the cable modem processor includes second processor 104, that the data networking engine is first processor 102 (see Fig. 2), and that the CMAC/CPHY block (114, 118, 224 and 228) is also a part of the cable modem engine. However, processor 102 handles many cable modem functions (see Fig. 4, paragraphs 0053 to 0062), and is explicitly described as "programmed to implement the desired MAC functionality" (paragraph 0026). Paragraph 0025 states "in the case of DOCSIS, typical MAC functionality includes MPEG and MCNS decoding and frame synchronization." On the other hand, processor 104 is described only as providing operating system support and that it "may manage some message processing and scheduling" (paragraph 0026, emphasis added). Thus, the Examiner's designation of the first processor as the "data networking engine" is at odds with the Brooks '600 description of processor 102 as being "programmed to implement the desired MAC functionality."

Id. at ENTROPIC_CHARTER_0005582 (emphasis in original).

74. The Applicant further explained that the specific architecture of Brooks, in which the CMAC/CPHY block (114, 118, 224, and 228) communicates with both processors 102 and

104 by sharing the same data paths and sharing the same direct memory access controller, did not "square" with certain features in Claim 1 and Claim 15:

> The Examiner's apparent designation of the first processor 102 in Brooks '600 as the "data networking engine," and the second processor 104 and the CMAC/CPHY block (114, 118, 224 and 228) as the "cable modem engine," further does not square with the claim 1 feature that "the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine," and the claim 15 feature of "partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VOIP functionality." This is because the CMAC/CPHY block (114, 118, 224 and 228) communicates with both the processors 102 and 104 by sharing the same data paths and sharing the same direct memory access controller. (See peripheral bus 112 – bridge 110 – system bus 108 in Fig. 1 and APB 214 – DMA Controller/ASB-APB Bridge 212 – ASB 210 in Fig. 2, and paragraphs 0034 and 0035.)

Id. at ENTROPIC_CHARTER_0005582.

75. On September 2, 2011, the Examiner issued a non-final rejection for Claims 1–16. The Examiner did not include Brooks as a basis for the rejection. *See id.* at ENTROPIC_CHARTER_0005592–0005602.

76. On March 2, 2012, the Applicant amended the claims and added the now-asserted Claim 18 (as Claim 20). Claim 20 is reproduced below:

20. **(New)** A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a DOCSIS controller and a DOCSIS MAC processor, the DOCSIS MAC processor configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput; and

a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

Id. at ENTROPIC_CHARTER_0005619.

77. On March 19, 2012, the Examiner allowed the claims. *See id.* at ENTROPIC_CHARTER_0005628–0005632. Claim 20 was unchanged and issued as Claim 18.

C. Disputed Terms of the '775 Patent

78. I understand that there is a dispute over five (5) claim terms within Claim 18 of the '775 Patent. Below I have reproduced Claim 18 of the '775 Patent in its entirety and have emphasized the terms that are in dispute.

18. A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when

executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a ***DOCSIS controller*** and a ***DOCSIS MAC processor***, the ***DOCSIS MAC processor*** configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the ***DOCSIS controller*** in order to boost downstream throughput; and

a ***data bus*** that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

'775 Patent, Claim 18.

79. Dr. Almeroth concludes that these terms are indefinite;[2] however, his analysis is flawed on numerous levels. For the reasons I outline below, a POSITA would not interpret the claims as Dr. Almeroth does and would not find Claim 18 indefinite.

1. "a data networking engine implemented in a first circuit . . ." and "a cable modem engine implemented in a second circuit . . ." (Claim 18)

a. Among other things, Dr. Almeroth's opinions assume a POSITA would ignore "circuit" as used in the plain claim language

80. I understand that the dispute centers around the following claim language:[3]

[2] Including "indefinite" for claim terms "DOCSIS MAC processor" and "DOCSIS controller" if not interpreted as Dr. Almeroth requires (*i.e.*, "[i]f … does not mean …"). Almeroth Decl. ¶ 29.

[3] I note that I have done my analysis considering not only the below claim language but also the claim terms as a whole and Claim 18 as a whole.

- "a data networking engine implemented in a first circuit that includes at least one processor" (Claim 18)
- "a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit" (Claim 18)

81. Dr. Almeroth opines that these terms are ambiguous because:

> [T]here is no way to determine what "circuit" means in the claims or how many circuits a particular cable modem contains. Nor is there a way to determine where one circuit begins and another ends. It is therefore impossible to determine if any particular cable modem contains "a first circuit" and "a second circuit' as claimed, or if the "second circuit" is "separate from the first circuit."

Almeroth Decl. ¶ 29; *see also id.* at ¶¶ 64–75.

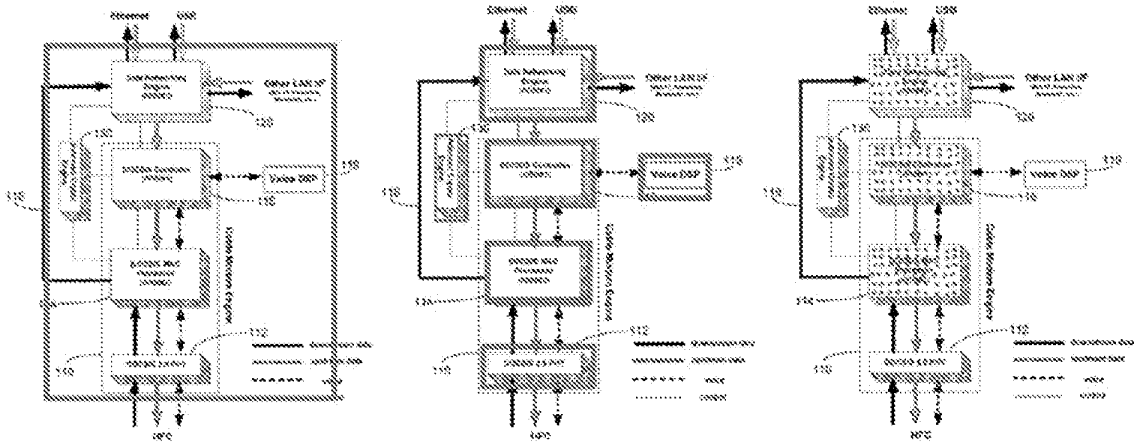
82. I disagree. The '775 Patent does not claim a first and second "circuit" in a vacuum. Rather, Claim 18 recites "a data networking engine implemented in a first circuit that includes at least one processor" and "a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit."

83. A POSITA has no difficulty understanding that circuits, such as those of the data networking engine, are delineated from other circuits, such as those of the cable modem engine. This is extremely common. The definition of "circuit" Dr. Almeroth cites confirms this point: "circuit" "A combination of electrical components interconnected to perform a particular task. At one level a computer consists of a single circuit; at another, it consists of hundreds of interconnected circuits." Almeroth Decl. ¶ 65 (citing Appx. C, at 99).

84. This is further true of the specific context of the '775 Patent. As of the priority date, a POSITA would have been familiar with systems-on-a-chip (SoCs) and application-specific integrated circuits (ASICs) (*i.e.*, a "chip"). *See, e.g.*, '775 Patent, 4:58–62. Furthermore, a POSITA would have been familiar with data networking functions (*e.g.*, web server, CableHome, etc.) and cable modem functions (*e.g.*, DOCSIS). *See, e.g., id.* at Abstract. Therefore, a POSITA would

readily appreciate that Claim 18 claims separate data networking and cable modem engines, wherein each is implemented on a circuit that includes at least one processor.

85. Dr. Almeroth attempts to create ambiguity by looking at circuits in the abstract while ignoring the plain language of Claim 18, the specification, and the embodiments depicted in Figures 1 and 2. Dr. Almeroth draws boxes around the physical parts depicted in Figure 1:



Almeroth Decl. ¶¶ 67, 69, 71.

86. Dr. Almeroth concludes that the claim is indefinite because none of the above illustrations show "[a] data networking engine implemented in a first circuit [and] a cable modem engine implemented in a second circuit." *See id.* at ¶¶ 67–72.

87. Dr. Almeroth's physical boxes ignore that the specification describes these components as the portions of physical circuits that embody the functionalities of the cable modem shown:

> System 100 comprises three major ***subsystems***: ***cable modem engine 110; data networking engine 120***; and advanced crypto engine 130. The ***functional sub-components*** of these three-subsystems are illustrated in greater detail in FIG. 2.

'775 Patent, 2: 50–54 (emphasis added).

88. This is consistent with Dr. Almeroth's dictionary definition, which speaks in terms of division based on function: "[a] combination of electrical components interconnected to perform

a particular task." Almeroth Decl. ¶ 65 (citing Appx. C at 99). A POSITA would have recognized at the time, as I experienced firsthand, the combination of electrical components interconnected to perform a particular task included integrated circuits, wherein an SoC comprised one or more integrated circuits. *See* '775 Patent, 4:25–28; *see also id.* at 4:58–62.

89. The specification provides an exemplary embodiment where the data networking engine and cable modem engine may be implemented on a single chip having two processors, *i.e.*, one for the data networking engine and one for the cable modem engine. *See* '775 Patent, 4:58–62 ("***A chip*** implementing cable modem system 100 will have only a small incremental hardware cost/functional increase over current stand-alone cable modem chips. The major cost difference relative to current chips is the addition of another ARM940-type processor to the chip."). In such an embodiment, the cable modem engine and data networking engine would be implemented on the same circuit board (if not the same die).

90. A POSITA would therefore not discard their prior experience and plain understanding of separate circuits where the separation is in terms of function. Thus, a POSITA would not understand "separate" to mean "separate circuit boards."

2. "DOCSIS MAC processor" / "DOCSIS controller" (Claim 18)

a. A POSITA would understand the meaning of "DOCSIS MAC processor" and "DOCSIS controller"

91. Dr. Almeroth opines that the term DOCSIS MAC processor must mean "the DOCSIS MAC processor as described in the patent specification (*see, e.g.*, '775 Patent, 3:1–20; 4:41–54; *id.* at Figures 1 & 2)." Almeroth Decl. ¶ 29; *see also id.* ¶¶ 76–77. Dr. Almeroth also opines that the term DOCSIS controller must "mean the DOCSIS controller as described in the patent specification (*see, e.g.*, '775 Patent, 3:21–48; 4:41–57; *id.* at Figures 1 & 2)." Almeroth

Decl. ¶ 29. According to Dr. Almeroth, this is because these terms do not have a plain and ordinary meaning to a POSITA. Almeroth Decl. ¶¶ 76–77.

92. I disagree. Consistent with the plain meaning of the terms, a POSITA reading the claims and specification would understand that the DOCSIS MAC processor and the DOCSIS controller are portions of the cable modem engine corresponding to the functions of MAC processing for DOCSIS, and controlling the DOCSIS functions, respectively. '775 Patent, 2:55–59; *see also* ¶¶ 57, 87, *supra*.

93. This plain understanding is confirmed by the specification, which describes these blocks and their corresponding functions in detail. For example, "DOCSIS MAC processor" 114 "implements real-time critical MAC functions for both upstream (US) and downstream (DS) communications." '775 Patent, 3:1–3. These MAC functions can include "US and DS synchronization, DS MAC address filtering, DS protocol filtering, US and DS PHS, concatenation, fragmentation, MAP processing, US transmission scheduling, as well as DOCSIS link-layer DES encryption and decryption." *Id.* at 3:3–7. Similarly, the specification describes how "DOCSIS controller" 116 implements DOCSIS functions such as MAC management message (MMM) processing, IGMP, MAC address learning, classification, US protocol filtering, CM IP stack and software downloading, cable modem IP/UDP functions, SNMP, DHCP, TFTP, and TOD functionality, and cable modem provisioning. '775 Patent, 3:27–38.

b. Dr. Almeroth misconstrues "DOCSIS MAC processor" and "DOCSIS controller" by requiring them to be implemented on separate, specific physical processors

94. Dr. Almeroth opines that Claim 18 is indefinite because the cable modem engine is implemented in a circuit "that includes at least one processor." Almeroth Decl. ¶ 78. Specifically, he opines:

> [T]his would cover a cable modem engine that includes only one processor. However, the claim also expressly requires that the cable modem engine contain a DOCSIS MAC processor and a DOCSIS controller, both of which are ARM processors.

Almeroth Decl. ¶ 78 (parentheticals omitted).

95. In my opinion there are two errors here. First, Dr. Almeroth misinterprets "DOCSIS MAC processor" and "DOCSIS controller" as being physical processors with some physical separateness. Second, Dr. Almeroth contends that they must be the specific brand/architecture of physical processors (ARM processors) identified as exemplary in the specification. A POSITA would find no support for any of these contentions.

96. There is an *exemplary* embodiment depicted in Figure 1 where "the processing-intensive functions of the cable modem and data networking are rationally distributed among three different [physical] processors." '775 Patent, 4:43–49. In this exemplary embodiment, there are two different physical processors in the cable modem engine, and the "DOCSIS MAC processor" functionality is assigned to one processor core while the "DOCSIS controller" functionality is assigned to the second processor core. But in another example embodiment, Claim 18 does not require that the functions of the "DOCSIS MAC processor" and the "DOCSIS controller" be embodied or implemented in separate physical processors. *See id.* at 4:16–19 ("This is accomplished by localizing data networking functions in the data networking engine processor [singular] and localizing cable modem functions in the cable modem engine processor [singular]") (annotation added). Thus, Claim 18 simply requires that the cable modem engine "includes at least ***one*** processor."

97. Moreover, a POSITA would find Dr. Almeroth's interpretation inconsistent with other description in the specification. The '775 Patent discloses that "A chip implementing cable modem system 100 will have only a small incremental hardware cost/functional increase over

current stand-alone cable modem chips. The major cost difference relative to current chips is the addition of ***another ARM940-type processor to the chip***." *Id.* at 4:58–62 (emphasis added). That means the cable modem engine itself may be implemented on a single processor core (the data networking engine embodied in the other). In fact, the '775 Patent clearly states "[t]his is accomplished by localizing data networking functions in the ***data networking engine processor*** [singular] and localizing cable modem functions in the ***cable modem engine processor*** [singular]". *See id.* at 4:16–19 (annotation and emphasis added). This is consistent with the claim language for the "cable modem engine [] second circuit" requiring "at least ***one***" processor (the "data networking engine [] first circuit" requiring the other). In light of this disclosure, a POSITA would not conclude that the claimed "DOCSIS MAC processor" and "DOCSIS controller" must be implemented on separate processors.

98. A POSITA would further understand that, although ARM processors are common processors, there are many other types of processors that were readily available at the time of the invention and there would be no reason to exclude other kinds of processors from the scope of the claims. The specification similarly makes this clear by explaining that Figure 1 is a non-limiting "embodiment." *See* '775 Patent, 3:17–19 ("***In one implementation***, processor 114 is an ARM9TDMI-based RISC processor") (emphasis added); 3:24–25 ("***In one implementation***, controller 116 is an ARM940-based RISC processor") (emphasis added).

99. Thus, in my opinion, a POSITA would be able to ascertain the scope of Claim 18 with reasonable certainty and would not misinterpret the "DOCSIS MAC processor" and "DOCSIS controller" functional blocks as limited to separate, specific physical processors.

3. "data bus" (Claim 18)

100. Dr. Almeroth opines that "data bus" is indefinite because of a purported disclaimer during prosecution of the '775 Patent related to the scope of the term "completely partitioned." Specifically, he states:

> The claim limitation requiring "a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine" renders Claim 18 and its dependents indefinite. The applicants successfully argued during prosecution that a "data networking engine" and a "cable modem engine" are not "completely partitioned" if they share "connecting circuitry" or "data paths." The "data bus" as claimed would be shared "connecting circuitry" and a shared "data path," meaning the cable modem engine and the data networking engine cannot be "completely partitioned" as claimed.

Almeroth Decl. ¶ 29; *see also* ¶ 79.

101. I disagree. Both terms "data bus" and "completely partitioned" appear in the '775 Patent claims, including Claim 18, and, as a result, no POSITA would consider there to be a disclaimer in the scope of the term "completely partitioned" to exclude a data bus. In addition, the Examiner understood the claim scope during prosecution and did not find a "data bus" incompatible with "completely partitioned."

102. A POSITA would <u>not</u> understand that the presence of a data bus between the data networking engine and the cable modem engine destroys their separate nature. *See, e.g.*, ¶¶ 82–84, 89, 90, *supra*. The '775 Patent confirms the standard understanding of a POSITA that two processors with complete separation of their functions remain completely separated even with a data bus in between allowing information exchange. *See, e.g.*, ¶¶ 82–84, 89, 90, *supra*; *see also*, '775 Patent, Fig 1, 3:14–17, 3:22–24.

103. Moreover, during prosecution, the Applicant never limited "completely partitioned" to exclude "any circuitry" or any shared "data path" as Dr. Almeroth asserts. *See*

Almeroth Decl. ¶¶ 57–63; *see also* ¶ 79. There is no redefinition or disclaimer and Dr. Almeroth has not identified any.

104. If one accepted Dr. Almeroth's incorrect analysis regarding disclaimer, then the requirements that Claim 18 have "a data networking engine implemented in a first circuit that includes at least one processor . . .;" "a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit . . .;" and "a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine," would seem to result in zero claim scope—if I understand what Dr. Almeroth is proposing. In other words, there could be no device that meets the elements of claim 18. This seems very unlikely to be the view of any POSITA.

105. It appears Dr. Almeroth reaches this conclusion based on a misunderstanding of the statements the Applicant made with respect to Brooks. The first time the Applicant addressed Brooks (in the May 19, 2009 office action response), the Applicant expressly stated that the "Office action does not identify what element of [Brooks] is being asserted as corresponding to Applicant's data networking engine," (Exhibit B at ENTROPIC_CHARTER_0005514) and continued to make this point when the Applicant was discussing Brooks.

106. Brooks discloses two programmable physical processors, 102 and 104, but as the Applicant pointed out, the functionality of these processors is ***not partitioned*** as required by the claims. Applicant reiterated this same problem throughout the dialogue with the Examiner concerning Brooks, specifically explaining that there is not a "data networking engine" in Brooks because processor 102 handles many cable modem functions, and processor 104 is described only

as providing operational system support and "may manage some message processing and scheduling." Exhibit B at ENTROPIC_CHARTER_0005582 (emphasis in original).

107. During prosecution, Applicant attempted to understand how the Examiner was attempting to map Brooks onto the claims. In this discussion, the Applicant again reiterated that Brooks ***does not disclose the claimed partitioning*** of the cable modem engine and data networking engine.

108. To properly frame the discussion, I first observe that a third component of Brooks was discussed, called the "CMAC/CPHY" component 224. As the Applicant explained in the April 5, 2010 office action response, "Figure 2 [of Brooks] makes clear that the cable modem functions are performed by CMAC unit 224 (*see, e.g.*, paragraph 0042)." *Id.* at ENTROPIC_CHARTER_0005557. I have included an annotated version of Brooks Figure 2 below, showing the CMAC unit and processors 102 and 104:

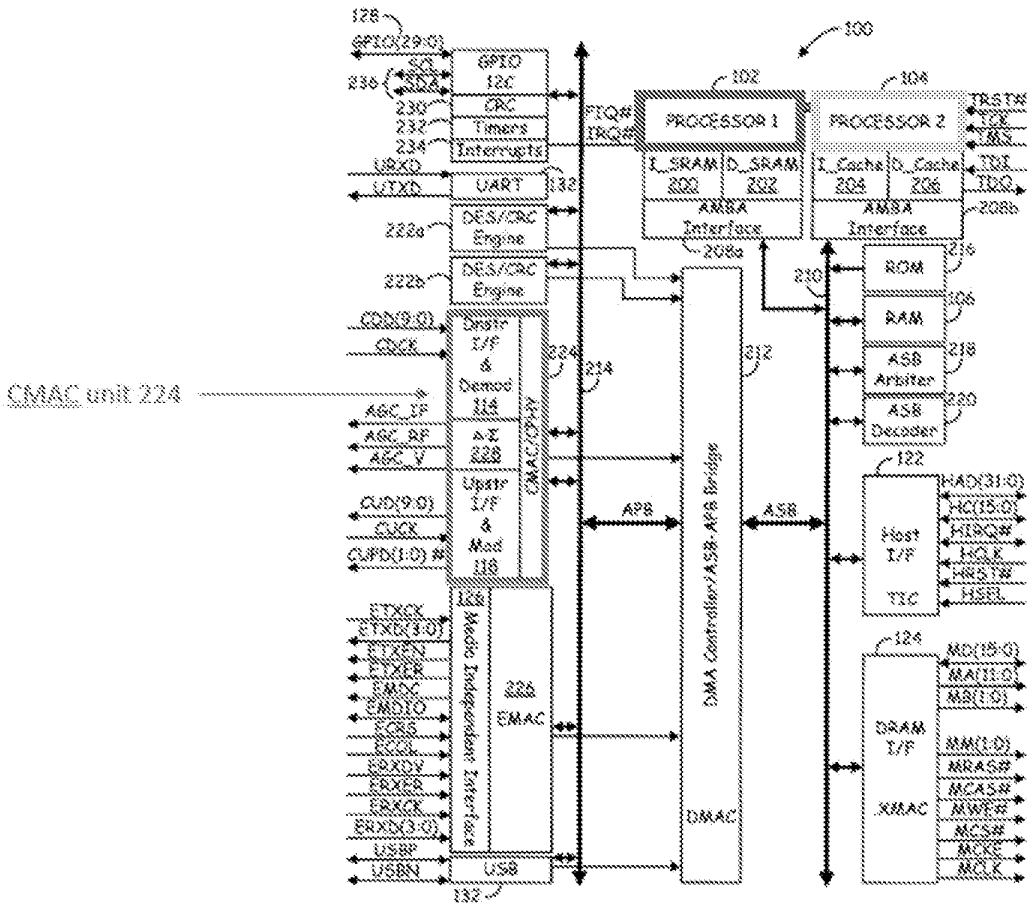


Fig. 2

Exhibit C, U.S. Pub. No. 2001/0039600 ("Brooks"), FIG. 2.

109. Applicant elaborated that CMAC 224 is responsible for, at least in part, the cable modem functions:

> [T]he Office Action make the conclusion statement [sic] that "the data networking engine and the cable modem engines are represented in Figure 1 and 2 of the [Brooks]" (*see, e.g.*, p. 8 of the Office action). However, Applicant is uncertain how any reasonable interpretation of these Figures can provide correspondence. For example, ***Figure 2 of [Brooks] discloses only two processors, each of which, therefore, must correspond to the claimed data-networking and cable-modem engines. However, the discussion of Figure 2 makes clear that the cable modem functions are performed by CMAC unit 224*** (*see, e.g.*, paragraph 0042). Therefore, in order for the cable modem engine to contain a processor and perform the CMAC functions as claimed, the cited cable modem engine must include circuitry to connect the processors with the CMAC unit. Because available connecting circuitry

> would be shared with the other processor, Applicant is uncertain how the asserted cable modem entire and home networking engine can be completely partitioned as claimed.

Exhibit B at ENTROPIC_CHARTER_0005557–0005558 (emphasis added); *see also* Exhibit C, [0042] ("a cable media access controller (CMAC) 224, including a System timer and interfaces to the cable downstream PHY circuitry 114 and cable upstream PHY circuitry 118, is provided to Support communications with a cable media 134").

110. The Applicant explained it was "uncertain how the asserted cable modem engine and home networking engine can be completely partitioned" because it appeared that the Examiner's assertion of Brooks would not make sense unless the Examiner was considering the "cable modem engine" to include ***one*** of the processors (102 or 104)—but ***not the other***—***plus the CMAC unit 224*** and the "available connecting circuitry [] shared with the other processor." Exhibit B at ENTROPIC_CHARTER_0005557–0005558.

111. However, the Applicant explained that in Brooks there is no indication that one processor and not the other would be a "completely partitioned" cable modem engine or data networking engine. *See id.* ("Because available connecting circuitry would be shared with the other processor, Applicant is uncertain how the asserted cable modem entire and home networking engine can be completely partitioned as claimed"). In other words, the Applicant was uncertain about how the Examiner was applying Brooks because there was no more of a reason to draw a box around the CMAC and processor 1 than there was to draw a box around the CMAC and processor 2, due to the specific layout of Brooks Figure 2.

112. In summary, Applicant's statements concerning Brooks focus on the point that there is no disclosure of ***partitioned*** engines (data networking and cable modem), with programmable processors. Everything from the file history that Dr. Almeroth focuses on simply reiterates this point in various ways. A POSITA would not understand the Applicant's statements

regarding Brooks to be a disclaimer of a data bus or other connection between the data networking engine and cable modem engine.

113. I also note an important point overlooked by Dr. Almeroth's position. The Applicant did not make any representations disclaiming a connection between the processors of a data networking engine and a cable modem engine because that connection in Brooks was not the subject of Applicant's statements.

114. The processors 102 and 104 of Brooks are connected directly, by a "system bus 108," in Figure 1, also known as "Advanced System Bus (ASB 210)" in Figure 2, highlighted below:

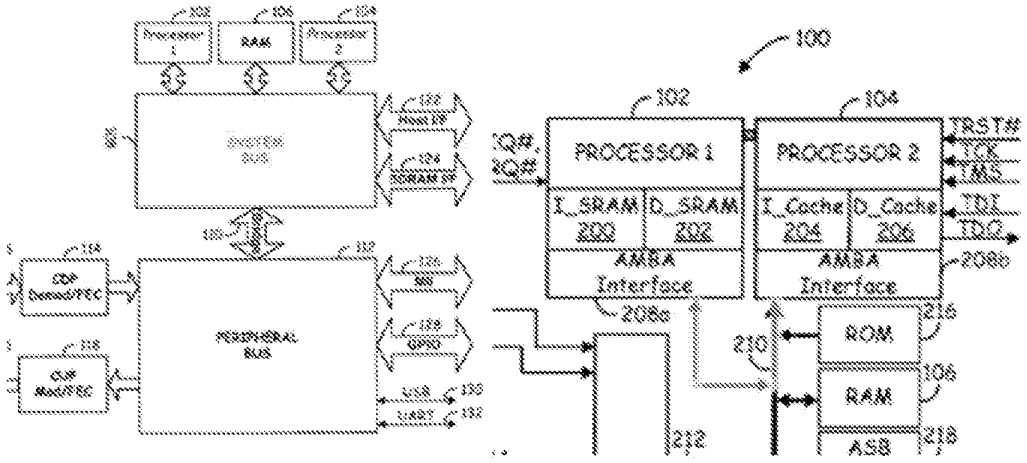


Exhibit C, FIGs. 1–2 (excerpt, annotated); *see also id.* at [0027] ("the first and second processors 102 and 104, are communicatively coupled to a system bus 108."), [0032] ("Advanced System Bus (ASB 210)"), [0034] ("The ASB210 is the bus on which the first and second processors 102 and 104, RAM memory 106, and other direct memory access (DMA) devices reside."). This connection was not referenced in the discussion with the Examiner that Dr. Almeroth relies upon.

115. What was referenced is a different connection. The Applicant pointed the Examiner to the connections between (1) each processor 102/104 and (2) a third component, *i.e.*, the CMAC

unit—***not*** the connection between processors 102 and 104 ***to each other***. Dr. Almeroth's annotation of Figure 2 illustrates the point. Dr. Almeroth highlights the shared connection between each of the two processors on the one hand, and the CMAC on the other (shown in yellow in Almeroth Decl. ¶ 62). But Dr. Almeroth does not highlight the direct connection between the processors—because that point is not the subject of the file history discussion.

116. To summarize, the issue of whether or not there can be a data path between the processor of a data networking engine and the processor of a cable modem engine was not at issue in the '775 Patent file history. A POSITA would not interpret Applicant's discussion of shared "connecting circuitry" or "data paths" as having been related to all "connecting circuitry" or "data paths," as Dr. Almeroth suggests, because clearly the Applicant and the Examiner knew that there was a connection between the processors.

117. Based on the above analysis, it is clear to me that the Applicant's statements regarding Brooks during the prosecution of the '775 Patent do not amount to any disavowal of claim scope, nor did the Applicant interpret the claims in any way that is inconsistent with the plain and ordinary meanings. Because Dr. Almeroth's opinion concerning indefiniteness relies on his misinterpretation of the prosecution history, it is my opinion that he has not shown any ambiguity in the claims scope.

118. A POSITA would be able to ascertain the scope of Claim 18 with reasonable certainty. A POSITA would understand that there is no ambiguity or conflict in having a "data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine" as claimed in Claim 18 of the '775 Patent.

VIII. '690 PATENT

A. Overview of the '690 Patent

119. The '690 Patent is titled "Receiver Determined Probe" and was filed on December 10, 2009, and issued on October 9, 2012. The '690 Patent claims priority to U.S. Provisional Application No. 61/122,687 dated December 15, 2008, and U.S. Provisional Application No. 61/179,454 filed on May 19, 2009. Accordingly, for my analysis herein, I have assumed the date of December 15, 2008 as the earliest possible priority date for the '690 Patent.

120. The '690 Patent is directed at aiding in the diagnosis of "*problems with subscriber services*." '690 Patent, 1:31–34 (emphasis added). The '690 Patent explains that there has been an "increase in the number of services and devices" offered through home networks which "increases the complexity of coordinating communication between the network nodes as each node may experience different access conditions along its portion of the network." *Id.* at 1:25–29. "This increase in complexity, further increases the likelihood that network problems may develop," and the content providers typically must "send[] a technician to the physical location of the home network to personally assess the network and diagnose the problem." *Id.* at 1:30–36. "[A]s the number of homes with subscriber services incorporated into their home networks increases, so does the amount of resources a service provider must devote to technical support and network maintenance." *Id.* at 36–40.

121. To help aid in the diagnosis of "problems with subscriber services" (*id.* at 1:31–34), the '690 Patent describes the use of probes to "characterize the communication channel over which data is to be sent between nodes in a network," including "various embodiments" in which "nodes on a network are programmed to generate a probe transmission in response to a request from the node that will be receiving the probe." *Id.* at Abstract, 1:41–43.

122. Exemplary "nodes" in a network are illustrated in Figure 1 of the '690 Patent, which I have annotated below. As shown below, these include nodes at the residence 101, as well as a Service Provider network node 112. *Id.* at FIG. 1, 4:10–24.

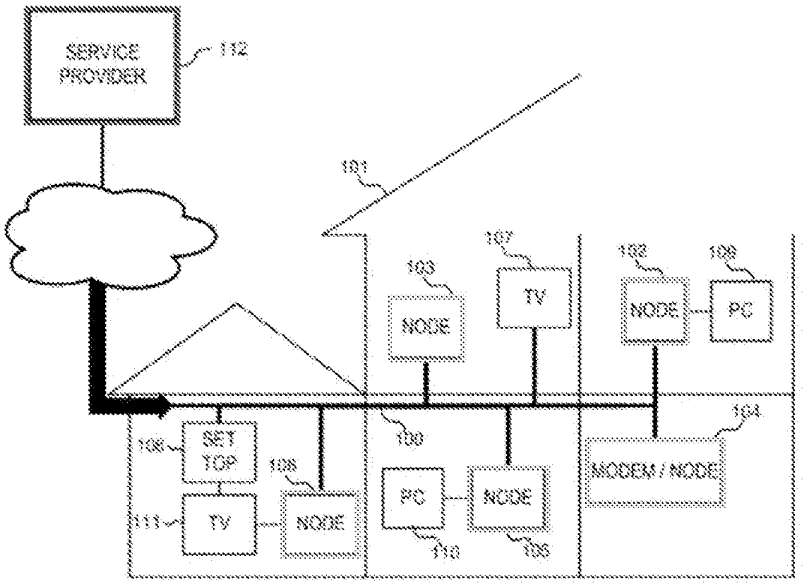


Fig. 1

'690 Patent, FIG. 1 (annotated).

123. According to various embodiments, nodes are "programmed to generate a probe transmission in response to a request from the nodes that will be receiving the probe." *Id.* at 1:66–2:3. The responsive "receiver determined probe" (also called simply a "probe") may comprise one or more of a plurality of parameters used for channel assessment, maintenance procedures, and/or off-site network diagnosis. *See id.* at 1:50–51, 4:25–27. *See also id.* at 2:20–27. An exemplary embodiment is shown in Figure 4, reproduced below.

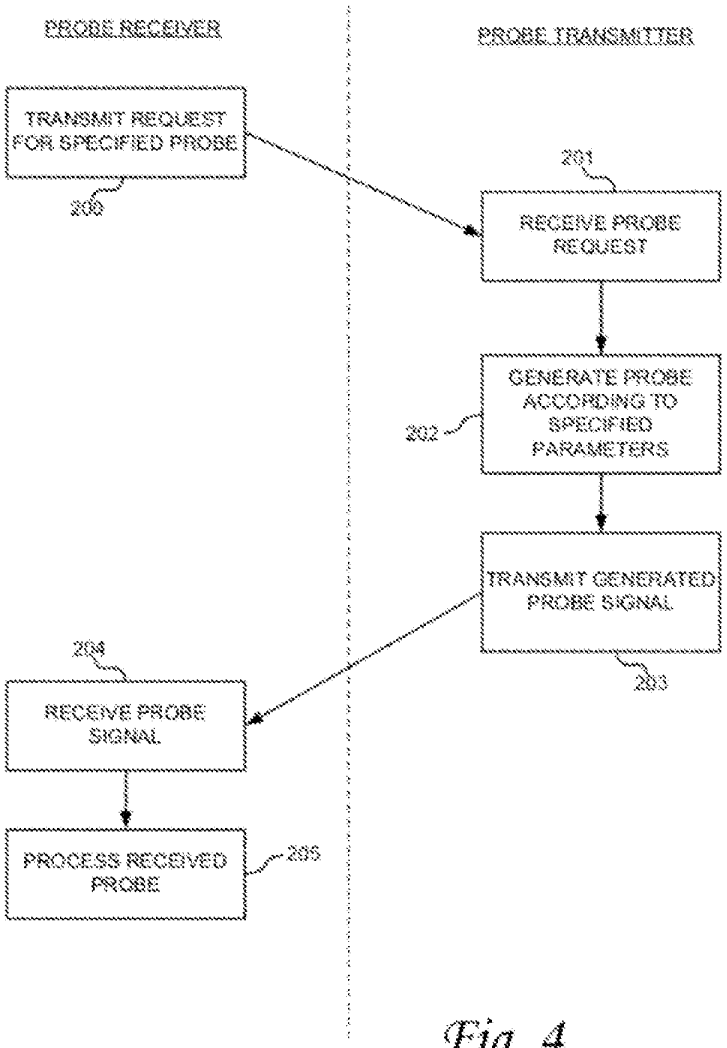


Fig. 4

'690 Patent, FIG. 4

124. The probe request may "specif[y] a plurality of parameters to be used . . . to generate a probe." *Id.* at 2:3–6. For example, in one embodiment, "at least one of the probe parameters indicates: a) a modulation profile for the probe; b) the payload content of the probe; c) the number of times to transmit the probe; d) the number of symbols for the payload of the probe; e) the preamble type for the probe; f) the cyclic-prefix length for the payload of the probe; g) the transmit power for the probe; and h) the transmit power scaling factor for the payload of the probe." *Id.* at

2:35--42. In addition, the probe request may specify a plurality of parameters that specify a form of the probe. *Id.* at 2:3--6.

B. Prosecution History of the '690 Patent

125. I have reviewed the prosecution history leading to the issuance of the '690 Patent. I note that Dr. Almeroth does not offer any summary or analysis of the '690 Patent's prosecution history in his Declaration.

126. Notably, during prosecution, the disputed terms discussed below and in Dr. Almeroth's declaration were understood by the Examiner and were not rejected as indefinite.

C. Disputed Terms of the '690 Patent

127. I understand that there is a dispute over one (1) claim term within Claim 1 and two (2) claim terms within Claim 9 of the '690 Patent. Below, I have reproduced Claims 1 and 9 of the in their entirety and have emphasized the terms that are in dispute.

1. A method comprising:

a) receiving in a first node, a probe request specifying a first plurality of parameters associated with the generation and transmission of a probe, wherein the first plurality of parameters at least specify content payload of the probe and a second node;

b) determining a second plurality of parameters associated with generation and transmission of the probe;

c) ***generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters***; and

d) transmitting the probe from the first node to the second node.

'690 Patent, Claim 1.

9. A method comprising:

a) a first node transmitting a probe request to a second node, the probe request specifying a first plurality of probe parameters for a physical layer probe, ***the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe***;

b) the first node receiving the probe from the second node, ***wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node***.

'690 Patent, Claim 9.

128. I understand Dr. Almeroth opines that the following terms in the '690 patent are indefinite:

- "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters" (Claim 1)
- "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" (Claim 9)
- "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe" (Claim 9)

Almeroth Decl. ¶ 30.

129. I disagree. As discussed further below, Dr. Almeroth misinterprets the plain and ordinary meaning of these phrases to manufacture an inconsistency that does not exist.

1. "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters" (Claim 1)

130. With respect to Claim 1, Dr. Almeroth opines that "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters" is indefinite because it is purportedly incompatible with the phrase "wherein the probe has a form dictated by the first plurality of parameters." *See* Almeroth Decl. ¶¶ 30, 83–84. This is because, according to Dr. Almeroth, "[b]y definition, the parameters define the form of a probe" and "[a] probe cannot be generated in accordance with 'the first plurality of parameters' and the 'second plurality of parameters,' but have its form dictated only by the 'first plurality of parameters' (as is

covered by the claim.)" Almeroth Decl. ¶ 30; *see also* ¶¶ 80–84. Dr. Almeroth's full statement from paragraph 30 is reproduced below:

> Claim 1 of the '690 Patent and its dependents are indefinite because "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters" is incompatible with "wherein the probe has a form dictated by the first plurality of parameters." By definition, the parameters define the form of a probe. A probe cannot be generated in accordance with the "first plurality of parameters" and the "second plurality of parameters," but have its form dictated only by the "first plurality of parameters" (as is covered by the claim.)

131. I disagree. Dr. Almeroth's reasoning is based on an incorrect interpretation of the claims. Dr. Almeroth manufactures a requirement that any and all "parameters" relating to the *generation* of the probe necessarily define the *form* of the probe. *See* Almeroth Decl. ¶ 30; *see also* ¶ 84 ("By definition, 'parameters' define the form of the probe that will be generated"). This is inconsistent with how a POSITA would read the specification and claims of the '690 Patent.

a. The claim language is clear on its face that not all parameters relate to the "form" of the probe

132. Beginning with the claims as a starting point, Claim 1 plainly recites that there is a first plurality of parameters and a second plurality of parameters "wherein the probe has a form dictated by the first plurality of parameters." Thus, the language of the claim on its face does not require ***all*** parameters to dictate the form of the probe.

133. A POSITA would understand that what the claim requires is that parameters are specified in the probe request, and at least one of these parameters (*i.e.*, the first plurality) dictates the form of the probe. A POSITA would understand that the other parameters (*i.e.*, the second plurality and any additional parameters) need not specify the form of the probe.

134. My findings are further supported by the claim language in Claim 9, wherein Claim 9 similarly recites a "first plurality of probe parameters" specified by the probe request and a "second plurality of parameters determined by the [node which generates the responsive probe]."

Only the first plurality of probe parameters is said to "compris[e] a form for the probe." *See* '690 Patent, Claim 9. A POSITA would therefore understand that the parameters "determined by the [node which generates the responsive probe]" need not comprise a form for the probe.

135. It should also be noted that both Claim 1 and Claim 9 make a distinction between parameters that are *specified* in the probe request (such as the first plurality) and parameters that are *determined* (the second plurality). In both cases, only parameters that are specified in the probe request are said to relate to the "form" for the probe.

b. The specification further confirms a POSITA's understanding that not all parameters relate to the "form" of the probe

136. The specification is consistent. For example, the specification recites:

> The receiving node may generate a probe request that specifies a plurality of parameters to be used in such a "receiver determined" probe to generate a probe having the "form" specified by these parameters.

'690 Patent, 2:3–6; *see also id.* at 2:17–19 ("the probe that is transmitted in response to the probe request will have a form dictated by the parameters specified in the probe request").

137. This confirms a POSITA's understanding of the plain claim language, that the probe request specifies parameters to be used in generating a probe, and the form of the probe is specified by at least one of these parameters (*i.e.*, the first plurality).

138. Furthermore, a POSITA would understand the point of the probe request is for a node to generate a probe containing responsive information—information which can be used, for example, for channel assessment, network maintenance procedures, or off-site network diagnosis. *See id.* at 1:48–52, 4:25–27. *See also id.* at 2:20–27. A POSITA would therefore understand the claimed "second plurality of parameters" could, for example, include such responsive information. This is made clear in Claim 9, which expressly recites "a second plurality of parameters *determined by the second node*." These second plurality of parameters may be the parameters that are, for

example, returned in the payload of the probe and which do not necessarily determine the "form" of the probe.

c. Dr. Almeroth fails to show support for his view that all parameters define the "form" of the probe

139. Dr. Almeroth asserts "[b]y definition, 'parameters' define the form of the probe that will be generated." Almeroth Decl. ¶ 84; *see also* ¶ 30. I disagree. The only support Dr. Almeroth cites for this conclusion is column 2, line 6, which reads in full context: "[t]he receiving node ***may*** generate a probe request that specifies a plurality of parameters to be used in such a 'receiver determined' probe to generate a probe having the 'form' specified by these parameters." '690 Patent, 2:3–6 (emphasis added).

140. Based on my review and understanding of the specification, there is nothing in the above-mentioned passage ('690 Patent 2:3–6), that a POSITA would understand as limiting the "form." The specification makes clear that "the receiving node ***may*** generate a probe request" wherein the responsive probe has a "'form' specified by" *e.g.*, according to the probe request's one or more parameters that "may" include a "form" parameter. For example, the phrase uses the term "may," which is permissive and indicates that an exemplary embodiment is being described. There is also no indication of the Applicant's express intent to define the term "form." The passage does not state that form "is" or "means" something. Furthermore, the passage refers only to "these parameters," as in the plurality of parameters specified in the probe request. The passage gives no indication that other parameters (such as those determined by the probe-generating node) must also specify the form of the probe. As such, nothing here is inconsistent with the plain language of Claims 1 and 9.

141. A POSITA would find no support for Dr. Almeroth's view that "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters" is incompatible with "the probe has a form dictated by the first plurality of parameters."

142. Based on the plain language of Claim 1, a POSITA could ascertain the scope of the claim with reasonable certainty. For example, a POSITA could ascertain, with reasonable certainty, whether a probe request specifies parameters, whether a probe is generated in accordance with those parameters, whether the probe is generated in accordance with a second plurality of parameters, and whether the probe has a form dictated by at least one of the parameters specified in the probe request.

143. For each of the reasons set forth above, it is my opinion that Dr. Almeroth has not shown that the scope of Claim 1 of the '690 Patent is not reasonably certain or is indefinite. *See also* ¶¶ 144–152, *infra*.

2. "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" (Claim 9) / "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe" (Claim 9)

144. According to Dr. Almeroth, Claim 9 is also indefinite for nearly the same reasons he opines that Claim 1 is indefinite. Dr. Almeroth's opinion, from paragraph 30 of his Declaration is reproduced below:

> Claim 9 of the '690 Patent and its dependents are indefinite because "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" is incompatible with "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe." By definition, the parameters define the form of a probe. A probe cannot be generated in accordance with the "first plurality of parameters" and the "second plurality of parameters," but have only the "first plurality of parameters" comprise its form (as is covered by the claim.)

145. I disagree. For the reasons discussed above, Dr. Almeroth is incorrect that "[b]y definition, the parameters define the form of a probe." *See e.g.*, ¶¶ 130–140, *supra*. A POSITA would not understand column 2, line 6 as defining or requiring all parameters to define the form of the probe. The language in that passage is permissive and exhibits no clear intent to define any term.

a. A POSITA would understand, in view of the intrinsic evidence, that not all parameters "compris[e] a form for the probe"

146. Further, the claim language makes clear that not all parameters must "compris[e] a form for the probe." Claim 9 recites "*the first plurality of probe parameters* comprising a form for the probe." A POSITA would understand the use of "comprising" to mean that other parameters can also be included in the "first plurality," in addition to the parameter(s) that specify a form for the probe. Dr. Almeroth's opinion improperly attempts to convert the open-ended "comprising" language to closed-ended "consisting of" language.

147. Dr. Almeroth also asserts that—because Claim 9 does not expressly recite the second plurality of parameters comprising a form for the probe—the claim (according to Dr. Almeroth) requires that *only* the first plurality of parameters determine the form. *See* Almeroth Decl. ¶ 84 ("the claims appear to cover the form of the probe being determined only by the parameters sent by the requesting node"). I disagree with his importation of the limitation "only." Claim 9 uses "comprising," indicating that the elements listed are necessary to satisfy the claim, but additional limitations can be added.

148. Thus a POSITA would not find it incompatible, based on the plain and ordinary meaning of the claim language, for a probe to be generated in accordance with the first and second plurality of parameters, wherein "the first plurality of probe parameters compris[es] a form for the probe."

149. In my opinion, a POSITA would be able to reasonably ascertain the scope of Claim 9 based on the plain and ordinary meaning of the claim language. For example, a POSITA would not have any difficulty ascertaining "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node." A POSITA would also not have any difficulty determining whether "the first plurality of probe parameters compris[es] a form for the probe including a modulation profile for the probe."

b. Among other things, Dr. Almeroth is incorrect that "both the requesting node and the transmitting node separately determine a 'plurality of parameters'" as if Claim 1 and Claim 9 are the same in this regard

150. I also note Dr. Almeroth asserts that Claims 1 and 9 require "both the requesting node and the transmitting node [to] separately ***determine*** a 'plurality of parameters associated with the generation' of the probe." Almeroth Decl. ¶ 83 (emphasis added). I disagree. Claim 1 recites a method comprising "determining a second plurality of parameters associated with the generation and transmission of the probe" not Claim 9. Further, Claim 1 does not specify which node determines these parameters.

151. In addition, the claims do not require the requesting node (*i.e.*, the node that transmits the probe request) to ***determine*** a plurality of parameters. Rather, Claims 1 and 9 both recite that the probe request ***specifies*** a plurality of parameters. Thus, Dr. Almeroth is simply incorrect about what the claims require.

152. Dr. Almeroth also asserts that the Claims 1 and 9 are somehow "unlike the disclosure." Almeroth Dec. ¶ 83. I disagree. This appears to be more akin to Dr. Almeroth providing an opinion related to the written description versus opining that a POSITA would not understand the claim terms with reasonable certainty. Regardless, as explained above, Dr.

Almeroth incorrectly interprets the claims, rendering his conclusion that the claims are unlike the disclosure also incorrect.

153. For each of the reasons set forth above, it is my opinion that Dr. Almeroth has not shown that the scope of Claim 9 of the '690 Patent is not reasonably certain or is indefinite.

IX. '682 PATENT

A. Overview of the '682 Patent

154. The '682 Patent is titled "Method And System For Service Group Management In a Cable Network" and was filed on January 9, 2018, and was issued on November 20, 2018. The '682 Patent claims priority to U.S. Application No. 15/434,673, filed on February 16, 2017 (now U.S. Patent No. 9,866,438), U.S. Application No. 15/228,703, filed on August 4, 2016 (now U.S. Patent No. 9,577,886), U.S. Application No. 13/948,444, filed on July 23, 2013 (now U.S. Patent No. 9,419,858), and U.S. Provisional Application No. 61/674,742, filed on July 23, 2012. Accordingly, for my analysis herein, I have assumed the date of July 23, 2012 as the earliest possible priority date for the '682 Patent.

155. The '682 Patent describes and claims a method and system for a "cable modem termination system (CMTS) [to] determine, for a plurality of cable modems served by the CMTS, a corresponding plurality of SNR-related metrics." '682 Patent, Abstract. The specification describes how the CMTS may assign cable modems ("CMs") into service groups based on the SNR-related metrics, where SNR means signal-to-noise ratio. In general, SNR is a ratio measurement of the (level of) signal to the (level of) noise with respect to the signal between the CMTS and CM. An exemplary system showing a CMTS and CMs is shown below in Figure 4A:

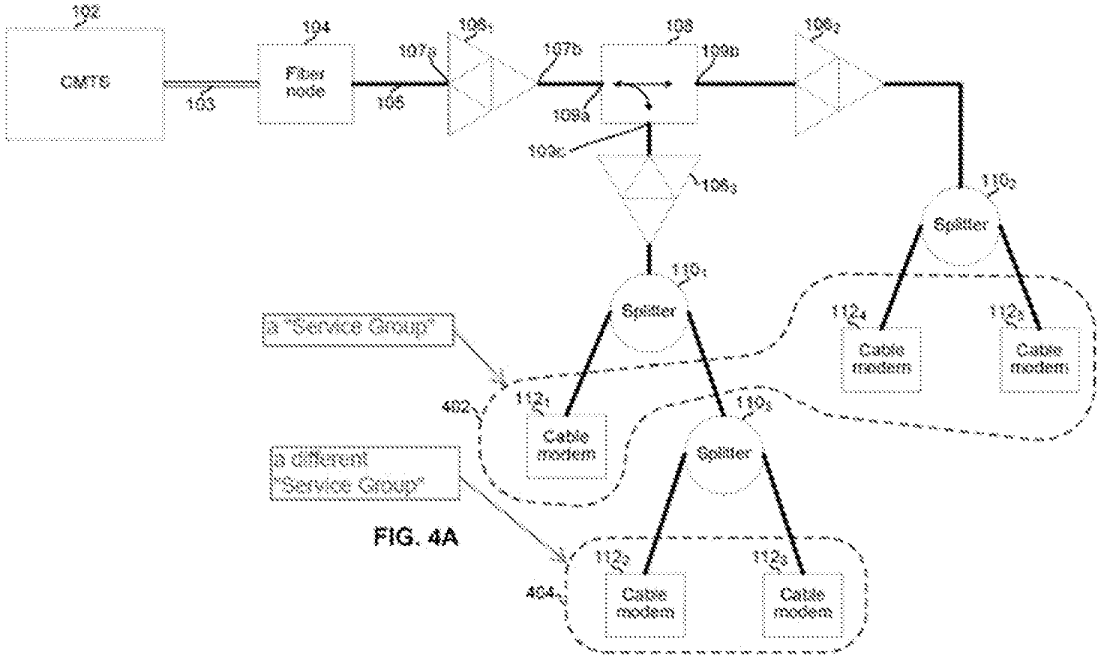


FIG. 4A

'682 Patent, FIG. 4A (annotated); *see also* 6:42–7:22, FIG. 4B.

156. Accordingly, the '682 Patent discloses that the CMTS builds a composite view of the various cable modems' SNR-related levels (*e.g.*, worst case SNR levels), wherein the '682 Patent calls these various SNR-related levels "SNR profiles." *Id.* at 3:53–58 ("SNR at a particular frequency or SNR over a range of frequencies (an SNR profile).").

157. The specification of the '682 Patent, as an example, describes that a plurality of CMs that share similar SNR-related metrics within a "service group" are said to have a "composite [worst-case] SNR profile for a [particular] service group." *Id.* at 4:14–17, 5:7–12.

B. Prosecution History of the '682 Patent

158. I have reviewed the prosecution history leading to the issuance of the '682 Patent. I note that Dr. Almeroth does not offer any summary or analysis of the '682 Patent's prosecution history in his Declaration.

159. Notably, during prosecution, the disputed terms discussed below and in Dr. Almeroth's declaration were understood by the Examiner and were not rejected as indefinite.

Furthermore, during prosecution, the Examiner not only understood the disputed terms and did not reject them as indefinite, but specifically cited to one of the disputed term as one of the reasons that this claim was allowable over prior art. *See* Exhibit D, 04/03/2018 Non-Final Rejection, 24–27 (ENTROPIC_CHARTER_0005329–0005332).

C. Disputed Terms of the '682 Patent

160. I understand that there is a dispute over two (2) claim terms within Claim 1 of the '682 Patent. Below I have reproduced Claim 1 in its entirety, and have emphasized the terms that are in dispute.

> 1. A method comprising:
>
> determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
>
> assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;
>
> generating, by said CMTS for each one of said plurality of service groups, ***a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups***;
>
> selecting, by said CMTS, one or more physical layer communication parameter to be used for ***communicating with said one of said plurality of service groups*** based on said composite SNR-related metric; and
>
> communicating, by said CMTS, with one or more cable modems ***corresponding to said one of said plurality of service groups*** using said selected one or more physical layer communication parameter.

'682 Patent, Claim 1.

1. "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics"

161. I understand that Charter asserts that the term "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" is indefinite because there is no way to determine what "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" means and has provided the expert opinion

of Dr. Almeroth in support of its position. I disagree and set forth my rebuttal herein. As discussed further below, it is my opinion that Dr. Almeroth has not identified any ambiguities or lack of reasonable certainty in the claims when considered in light of the intrinsic record.

a. I disagree that "worst case" and "composite worst case SNR" are the "same thing" in the context of Claim 1 or are otherwise indefinite

162. Dr. Almeroth begins by explaining his understanding of the disclosure of the '682 Patent. *See* Almeroth Decl. ¶¶ 85–91. He contends that the "composite worst-case SNR profile" for a service group is "the worst case SNR for [each] subcarrier among the CMs in that particular service group." *See* Almeroth Decl. ¶ 89 (quoting '682 Patent, 5:42–46).

163. Dr. Almeroth then provides an example of how he understands the "composite worst-case SNR profile" to be determined: "if there are 5 cable modems (CM[A] - CM[E]) in a hypothetical service group, the 'composite worst-case SNR profile' for that service group reflects the worst SNR of all the cable modems in the service group for each subcarrier . . . In this example, CM[A] has the worst SNR at subcarriers 2, 5 and 7, CM[B] has the worst SNR at subcarrier 1, CM[C] has the worst SNR at subcarrier 6, CM[D] has the worst SNR at subcarriers 3 and 8, and CM[E] has the worst SNR at subcarrier 4." Almeroth Decl. ¶ 90. Dr. Almeroth annotates Figure 2B to support his example:

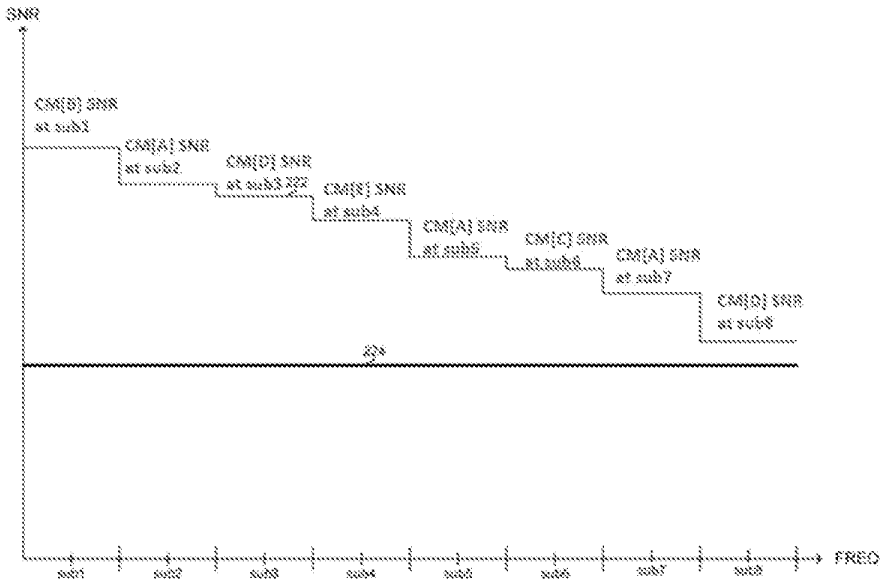


FIG. 2B

Almeroth Decl. ¶ 90.

164. Dr. Almeroth's example and annotations of Figure 2B misrepresent what the specification says about what is being described in Figure 2B. Specifically, Dr. Almeroth appears to be arguing that the steps each relate to a single CM's worst SNR, and that those worst SNRs are used to determine the "composite worst-case SNR profile." Almeroth Decl. ¶ 90.

165. However, the specification makes clear that "line 222 in FIG. 2B represents ***a composite*** worst-case SNR profile for one or more CM(s) in the HFC network to which the message 202 is destined." '682 Patent, 4:9–12 (emphasis added). The specification further explains that while the CMs report their SNR readings, only the CMTS can build a composite view of all reporting CMs based on the collective CM readings. *Id.* at 4:40–56. From that information, the CMTS assigns CMs into service groups. *Id.*

166. The specification further explains, that the exemplary profile line 222, is based on a "minimum desired headroom" "228" needed to reliably have a robust enough signal to overcome

the noise, the CMTS accordingly selects corresponding "physical layer [communication] parameters" to ensure reliable communications with each CM within a service group. '682 Patent, 5:13–20. A POSITA would understand that this means that the exemplary line 222 in Figures 2B and 2C shows the ceiling that the CMTS must transmit at for all CMs in the entire service group to reliably communicate. Below I reproduce Figure 2C of the '682 Patent for further clarification:

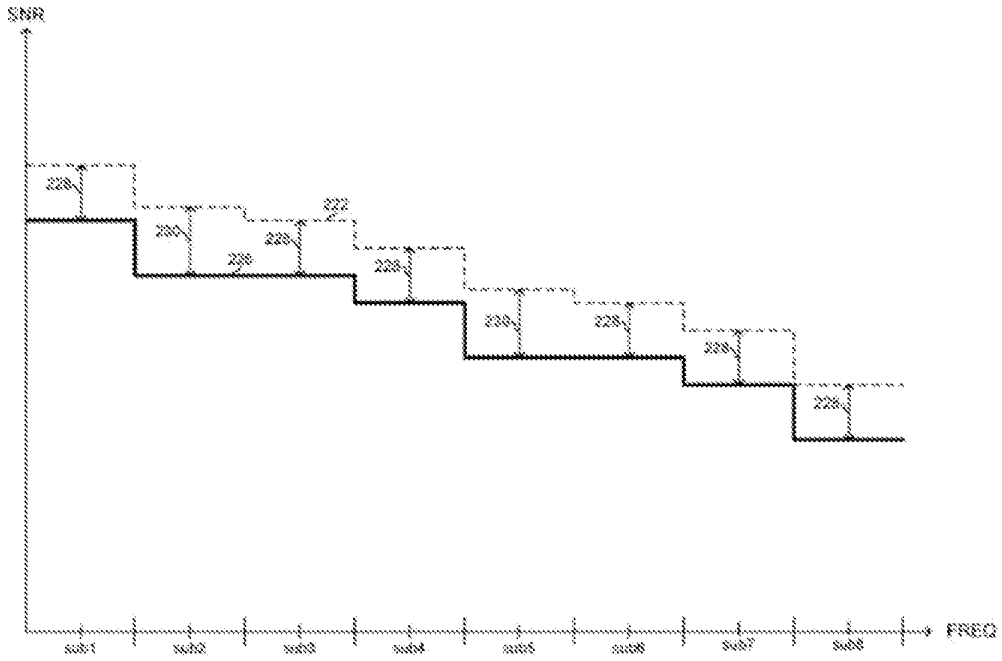


FIG. 2C

167. The rest of Dr. Almeroth's opinion focuses on how "composite worst-case SNR profile" does not have a plain and ordinary meaning. He concludes that"[t]here is no way to know how the 'composite SNR-related metric' can be 'based *at least in part on*' the 'worst-case SNR profile' since the two refer to the same thing." *See* Almeroth Decl. ¶ 96 (emphasis in original).

168. Dr. Almeroth's opinion mischaracterizes the difference between a "composite SNR-related metric" and a "worst-case SNR profile." The specification describes the "composite SNR-related metric" and "a worst-case SNR profile" as different things. While the specification describes how "worst-case SNR profile" must be a profile that in some way takes into account the

worst-case SNR of a cable modem or a service group, a "composite SNR-related metric" need not inherently involve worst-case SNR. '682 Patent, 4:3–20, 4:43–5:6, 5:7–20.

169. The '682 Patent discusses the *composite SNR-related metric* as being a composite of metrics in the context of worst-case SNR because that is part of the disclosed invention: in one embodiment, using the worst-case SNR in this way could allow for more efficient utilization of an HFC network to improve its overall data throughput and better overall data throughput for the cable modems in that network. '682 Patent, 5:40–57; *see also id.* at 4:25–28. Accordingly, the *composite SNR-related metric* could also include the ***best-case*** SNR, an ***average*** SNR, or some other SNR-related metric entirely. Claim 1 of the '682 Patent discloses and the specification teaches that a *composite SNR-related metric* need only be based "at least in part on a worst-case SNR profile." '682 Patent Claim 1, 4:25–28, 5:42–46. The *composite SNR-related metric* could also be based in part on other SNR profiles or SNR-related metrics. *Id.*

b. I disagree with Dr. Almeroth's opinion that "worst case" SNR is unintelligible or always 0 in the context of Claim 1

170. Dr. Almeroth similarly misconstrues what "worst-case" means. *See* Almeroth Decl. ¶ 94. Dr. Almeroth contends, without any explanation, that the "worst case" SNR will always be an SNR of 0, and thus a "worst-case SNR profile" would contain only 0s and consequently be unintelligible. His position seems to be that because an SNR profile of only 0s is nonsensical, a "worst-case SNR profile" must actually be referring to a "composite worst-case SNR profile." Almeroth Decl. ¶ 94. Dr. Almeroth's position would require one to assume (erroneously so) that SNR is a static value unrelated to data throughput. Even so, neither the '682 Patent specification nor the claims requires that a "worst case" SNR always be zero.

171. Taken together, Dr. Almeroth's mischaracterization of the individual terms making up the claim term "a composite SNR-related metric based at least in part on a worst-case SNR

profile of said SNR-related metrics" is an attempt to create ambiguity and indefiniteness where there is none.

172. Thus, it is my opinion that there is no ambiguity regarding how to determine "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics." The specification clearly teaches that the purpose of the composite SNR is to group modems, at least in part, by composite SNR performance such that one modem with a lower performance does not reduce the potential throughput of every modem in a group. As discussed above, a POSITA would understand that the intrinsic record supports the plain and ordinary meaning such that a *composite SNR-related metric* need only be based at least in part on *a worst-case SNR profile*.

2. "[communicating with/corresponding to] said one of said plurality of service groups"

a. Among other things, Dr. Ameroth is wrong that there is no antecedent basis

173. I understand that Charter asserts that the term "[communicating with/corresponding to] said one of said plurality of service groups" is indefinite because there is no identified or antecedent "one of said plurality of service groups" to which "said one of said plurality of service groups" refers and has provided the expert opinion of Dr. Almeroth in support of its position. I disagree and set forth my rebuttal herein.

174. Dr. Almeroth's opinion misses the clear antecedent basis in Claim 1

175. In my opinion, the claim term(s) "[communicating with/corresponding to] said one of said plurality of service groups" should be construed according to its plain and ordinary meaning because 1) Dr. Almeroth's fails to identify the antecedent clearly listed in the prior element of Claim 1, and 2) the meaning of the words as they are read in the content of the full claim are abundantly clear. Dr. Almeroth appears to only write a single paragraph of merely three sentences

and two citations for the proposition that this claim term is indefinite. *See* Almeroth Decl. ¶ 97. Dr. Almeroth's ultimate opinion as to this claim term is that "[t]here is no antecedent in the claim for 'said one of said plurality of service groups,' and there is no way to know which service group among the 'plurality of service groups' is being referred to." *Id.*

176. However, the antecedent basis is clearly contained in the prior claim element. I have emphasized the relevant portions of the claim here to demonstrate that Dr. Almeroth ignores that there are two steps of antecedent basis that the elements rely on:

> 1. A method comprising:
>
> determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
>
> assigning, by said CMTS, each cable modem among a **plurality of service groups** based on a respective corresponding SNR-related metric;
>
> generating, by said CMTS for each one of said **plurality of service groups**, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics *corresponding to said* one of said plurality of service groups;
>
> selecting, by said CMTS, one or more physical layer communication parameter to be used for *communicating with said* one of said plurality of service groups based on said composite SNR-related metric; and
>
> communicating, by said CMTS, with one or more cable modems *corresponding to said* one of said plurality of service groups using said selected one or more physical layer communication parameter.

'682 Patent, Claim 1 (emphasis added).

177. When the claim language is viewed in total, it is clear that there is not only an antecedent basis, but that a POSITA would be able to follow each element of Claim 1 and understand the invention. The specification identifies that an advantageous embodiment would be to perform Claim 1 for as many service groups in the plurality of service groups as preferred in order to achieve superior cable modem performance in the network. '682 Patent, Abstract, 5:40–57.

178. A POSITA would further understand that a composite SNR-related metric generated for service group A, for example, would be the same composite SNR-related metric and same service group in the selecting and communicating elements of Claim 1. Nonetheless, the claimed invention only ***requires*** communicating with a single service group of the plurality of service groups in the selecting and communicating elements of Claim 1. As such, Dr. Almeroth's assertion that one cannot determine which service group is being referred to does not create any indefiniteness, and the claim term should be construed according to its plain and ordinary meaning.

179. For each of the reasons set forth above, it is my opinion that Dr. Almeroth has not shown that the scope of Claim 1 of the '682 Patent is not reasonably certain or is indefinite.

X. ADDITIONAL REMARKS

180. I currently hold the opinions expressed in this Declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations. Additionally, it is my understanding that discovery is ongoing in this matter. I reserve the right to rely on additional discovery that occurs after this Declaration is submitted. To the extent that additional information becomes available relevant to the opinions expressed in this Declaration, I will update my opinions as appropriate.

181. I also reserve the right to respond to any additional arguments or opinions raised by Charter or Charter's expert(s). I further reserve the right to respond to any new positions raised by Charter or respond to any further expert declaration provided by Charter regarding claim construction issues.

I hereby declare that all statements made are of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this proceeding.

Dated: April 14, 2023

By: R. A. Kramer Ph. D.
Richard A. Kramer Ph.D.
Salem, Oregon

EXHIBIT 8

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ENTROPIC COMMUNICATIONS, LLC, Plaintiff v. CHARTER COMMUNICATIONS, INC. Defendant.	Civil Action No. 2:22-cv-00125-JRG

DECLARATION OF DR. KEVIN ALMEROTH
REGARDING CLAIM CONSTRUCTION

I, Kevin C. Almeroth, declare as follows:

I. QUALIFICATIONS

1. I am currently a Professor Emeritus in the Department of Computer Science at the University of California, Santa Barbara (UCSB). While at UCSB, I held faculty appointments and was a founding member of the Computer Engineering (CE) Program, Media Arts and Technology (MAT) Program, and the Technology Management Program (TMP). I also served as the Associate Director of the Center for Information Technology and Society (CITS) from 1999 to 2012. I have been a faculty member at UCSB since July 1997.

2. I hold three degrees from the Georgia Institute of Technology: (1) a Bachelor of Science degree in Information and Computer Science (with minors in Economics, Technical Communication, and American Literature) earned in June 1992; (2) a Master of Science degree in Computer Science (with specialization in Networking and Systems) earned in June 1994; and (3) a Doctor of Philosophy (Ph.D.) degree in Computer Science (Dissertation Title: Networking and System Support for the Efficient, Scalable Delivery of Services in Interactive Multimedia System, minor in Telecommunications Public Policy) earned in June 1997. During my education, I have taken a wide variety of courses as demonstrated by my minor. My undergraduate degree also included a number of courses more typical of a degree in electrical engineering including digital logic, signal processing, and telecommunications theory.

3. One of the major concentrations of my research over the past 30+ years has been the delivery of multimedia content and data between computing devices, including various network architectures. In my research, I have studied large-scale content delivery systems, and the use of servers located in a variety of geographic locations to provide scalable delivery to hundreds or thousands of users simultaneously. I have also studied smaller-scale content delivery systems in

which content is exchanged between individual computers and portable devices. My work has emphasized the exchange of content more efficiently across computer networks, including the scalable delivery of content to many users, mobile computing, satellite networking, delivering content to mobile devices, and network support for data delivery in wireless networks.

4. In 1992, the initial focus of my research was on the provision of interactive functions (e.g., VCR-style functions like pause, rewind, and fast-forward) for near video-on-demand systems in cable systems; in particular, how to aggregate requests for movies at a cable head-end and then how to satisfy a multitude of requests using one audio/video stream broadcast to multiple receivers simultaneously. This research has continually evolved and resulted in the development of techniques to scalably deliver on-demand content, including audio, video, web documents, and other types of data, through the Internet and over other types of networks, including over cable systems, broadband telephone lines, and satellite links.

5. An important component of my research has been investigating the challenges of communicating multimedia content, including video, between computers and across networks including the Internet. Although the early Internet was used mostly for text-based, non-real time applications, the interest in sharing multimedia content, such as video, quickly developed. Multimedia-based applications ranged from downloading content to a device to streaming multimedia content to be instantly used. One of the challenges was that multimedia content is typically larger than text-only content, but there are also opportunities to use different delivery techniques since multimedia content is more resilient to errors. I have worked on a variety of research problems and used a number of systems that were developed to deliver multimedia content to users. One content-delivery method I have researched is the one-to-many communication facility called "multicast," first deployed as the Multicast Backbone, a virtual overlay network supporting one-to-many

communication. Multicast is one technique that can be used on the Internet to provide streaming media support for complex applications like video-on-demand, distance learning, distributed collaboration, distributed games, and large-scale wireless communication. The delivery of media through multicast often involves using Internet infrastructure, devices and protocols, including protocols for routing and TCP/IP.

6. Starting in 1997, I worked on a project to integrate the streaming media capabilities of the Internet together with the interactivity of the web. I developed a project called the Interactive Multimedia Jukebox (IMJ). Users would visit a web page and select content to view. The content would then be scheduled on one of a number of channels, including delivery to students in Georgia Tech dorms delivered via the campus cable plant. The content of each channel was delivered using multicast communication.

7. In the IMJ, the number of channels varied depending on the capabilities of the server including the available bandwidth of its connection to the Internet. If one of the channels was idle, the requesting user would be able to watch their selection immediately. If all channels were streaming previously selected content, the user's selection would be queued on the channel with the shortest wait time. In the meantime, the user would see what content was currently playing on other channels, and because of the use of multicast, would be able to join one of the existing channels and watch the content at the point it was currently being transmitted.

8. The IMJ service combined the interactivity of the web with the streaming capabilities of the Internet to create a jukebox-like service. It supported true Video-on-Demand when capacity allowed, but scaled to any number of users based on queuing requested programs. As part of the project, we obtained permission from Turner Broadcasting to transmit cartoons and other short-subject content. We also connected the IMJ into the Georgia Tech campus cable television network

so that students in their dorms could use the web to request content and then view that content on one of the campus's public access channels.

9. More recently, I have also studied issues concerning how users choose content, especially when considering the price of that content. My research has examined how dynamic content pricing can be used to control system load. By raising prices when systems start to become overloaded (*i.e.*, when all available resources are fully utilized) and reducing prices when system capacity is readily available, users' capacity to pay as well as their willingness can be used as factors in stabilizing the response time of a system. This capability is particularly useful in systems where content is downloaded or streamed on-demand to users.

10. As a parallel research theme, starting in 1997, I began researching issues related to wireless devices and sensors. In particular, I was interested in showing how to provide greater communication capability to "lightweight devices," *i.e.*, small form-factor, resource-constrained (*e.g.*, CPU, memory, networking, and power) devices. Starting in 1998, I published several papers on my work to develop a flexible, lightweight, battery-aware network protocol stack. The lightweight protocols we envisioned were similar in nature to protocols like Bluetooth, Universal Plug and Play (UPnP) and Digital Living Network Alliance (DLNA).

11. From this initial work, I have made wireless networking—including ad hoc, mesh networks and wireless devices—one of the major themes of my research. My work in wireless networks spans the protocol stack from applications through to the encoding and exchange of data at the data link and physical layers.

12. At the application layer, even before the large-scale "app stores" were available, my research looked at building, installing, and using apps for a variety of purposes, from network monitoring to support for traditional computer-based applications (*e.g.*, content retrieval) to new

applications enabled by ubiquitous, mobile devices. For example, my research has looked at developing applications for virally exchanging and tracking "coupons" through "opportunistic contact" (*i.e.*, communication with other devices coming into communication range with a user). In many of the courses I have taught there is a project component. Through these projects I have supervised numerous efforts to develop new "apps" for download and use across a variety of mobile platforms.

13. Toward the middle of the protocol stack, my research also looked to build wireless infrastructure support to enable communication among a set of mobile devices unaided by any other kind of network infrastructure. These kinds of networks are useful either in challenged network environments (e.g., when a natural disaster has destroyed existing infrastructure) or when suitable support for network communication never existed. The deployment of such networks (or even the use of traditional network support) are critical to support services like disaster relief, catastrophic event coordination, and emergency services deployment.

14. Yet another theme is monitoring wireless networks, in particular different variants of IEEE 802.11 compliant networks, to (1) understand the operation of the various protocols used in real-world deployments, (2) use these measurements to characterize use of the networks and identify protocol limitations and weaknesses, and (3) propose and evaluate solutions to these problems. I have successfully used monitoring techniques to study wireless data link layer protocol operation and to improve performance by enhancing the operation of such protocols. For wireless protocols, this research includes functions like network acquisition and channel bonding.

15. Protecting networks, including their operation and content, has been an underlying theme of my research almost since the beginning of my research career. Starting in 2000, I have been involved in several projects that specifically address security, network protection, and firewalls. After

significant background work, a team on which I was a member successfully submitted a $4.3M grant proposal to the Army Research Office (ARO) at the Department of Defense to propose and develop a high-speed intrusion detection system. Key aspects of the system included associating streams of packets and analyzing them for viruses and other malware. Once the grant was awarded, we spent several years developing and meeting the milestones of the project. A number of my students worked on related projects and published papers on topics ranging from intrusion detection to developing advanced techniques to be incorporated into firewalls. I have also used firewalls, including their associated malware detection features, in developing techniques for the classroom to ensure that students are not distracted by online content.

16. My recent work ties some of the various threads of my past research together. I have investigated content delivery in online social networks and proposed reputation management systems in large-scale social networks and marketplaces. On the content delivery side, I have looked at issues of caching and cache placement, especially when content being shared and the cache has geographical relevance. We were able to show that effective caching strategies can greatly improve performance and reduce deployment costs. Our work on reputation systems showed that reputations have economic value, and as such, creates a motivation to manipulate reputations. In response, we developed a variety of solutions to protect the integrity of reputations in online social networks. The techniques we developed for content delivery and reputation management were particularly relevant in peer-to-peer communication and recommendations for downloadable "apps."

17. As an important component of my research program, I have been involved in the development of academic research into available technology in the market place. One aspect of this work is my involvement in the Internet Engineering Task Force (IETF). The IETF is a large and open international community of network designers, operators, vendors, and researchers concerned with

the evolution of the Internet architecture and the smooth operation of the Internet. I have been involved in various IETF groups including many content delivery-related working groups like the Audio Video Transport (AVT) group, the MBone Deployment (MBONED) group, Source Specific Multicast (SSM) group, the Inter-Domain Multicast Routing (IDMR) group, the Reliable Multicast Transport (RMT) group, the Protocol Independent Multicast (PIM) group, etc. I have also served as a member of the Multicast Directorate (MADDOGS), which oversaw the standardization of all things related to multicast in the IETF. Finally, I was the Chair of the Internet2 Multicast Working Group for seven years.

18. My involvement in the research community extends to leadership positions for several academic journals and conferences. I am the co-chair of the Steering Committee for the ACM Network and System Support for Digital Audio and Video (NOSSDAV) workshop and on the Steering Committees for the International Conference on Network Protocols (ICNP), ACM Sigcomm Workshop on Challenged Networks (CHANTS), and IEEE Global Internet (GI) Symposium. I have served or am serving on the Editorial Boards of IEEE/ACM Transactions on Networking, IEEE Transactions on Mobile Computing, IEEE Network, ACM Computers in Entertainment, AACE Journal of Interactive Learning Research (JILR), and ACM Computer Communications Review. I have co-chaired a number of conferences and workshops including the IEEE International Conference on Network Protocols (ICNP), IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), International Conference on Communication Systems and Networks (COMSNETS), IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS), the International Workshop On Wireless Network Measurement (WiNMee), ACM Sigcomm Workshop on Challenged Networks (CHANTS), the Network Group Communication (NGC) workshop, and the Global Internet Symposium, and I have served on the

program committees for numerous conferences.

19. Furthermore, in the courses I taught at UCSB, a significant portion of my curriculum covered aspects of the Internet and network communication including the physical and data link layers of the Open System Interconnect (OSI) protocol stack, and standardized protocols for communicating across a variety of physical media such as cable systems, telephone lines, wireless, and high-speed Local Area Networks (LANs), including DOCSIS. The courses I have taught also cover most major topics in Internet communication, including data communication, multimedia encoding, and mobile application design. My research and courses have covered a range of physical infrastructures for delivering content over networks, including cable, Integrated Services Digital Network (ISDN), Ethernet, Asynchronous Transfer Mode (ATM), fiber, and Digital Subscriber Line (DSL). For a complete list of courses I have taught, see my curriculum vitae (CV).

20. In addition, I co-founded a technology company called Santa Barbara Labs that was working under a sub-contract from the U.S. Air Force to develop very accurate emulation systems for the military's next generation internetwork. Santa Barbara Labs' focus was in developing an emulation platform to test the performance characteristics of the network architecture in the variety of environments in which it was expected to operate, and, in particular, for network services including IPv6, multicast, Quality of Service (QoS), satellite-based communication, and security. Applications for this emulation program included communication of a variety of multimedia-based services, including video conferencing and video-on-demand.

21. In addition to having co-founded a technology company myself, I have worked for, consulted with, and collaborated with companies for nearly 30 years. These companies range from well-established companies to start-ups and include IBM, Hitachi Telecom, Turner Broadcasting System (TBS), Bell South, Digital Fountain, RealNetworks, Intel Research, Cisco Systems, and

Lockheed Martin.

22. Through my graduate education, leadership with CITS, involvement in TMP, role in the development of the Internet2 infrastructure, and consulting with ISPs, I have gained a strong understanding in the role of the Internet in our society and the challenges of deploying large-scale production networking infrastructure. CITS, since its inception, has looked at the role of the Internet in society, including how the evolution of technology have created communication opportunities and challenges, including, for example through disruptive technologies like P2P. TMP looks to focus on non-purely technical issues, including, for example, state-of-the-art business methods, strategies for successful technology commercialization, new venture creation, and best practices for fostering innovation. Through my industry collaborations and Internet2 work, I have developed significant experience in the challenges of deploying, monitoring, managing, and scaling communication infrastructure to support evolving Internet services like streaming media, conferencing, content exchange, social networking, and e-commerce.

23. I am a Member of the Association of Computing Machinery (ACM) and a Fellow of the Institute of Electrical and Electronics Engineers (IEEE).

24. Additional details about my employment history, fields of expertise, courses taught, and publications are further included in my CV attached as Appendix A to this Declaration.

II. MATERIALS CONSIDERED AND COMPENSATION

25. In preparing this declaration, I reviewed U.S. Patent Nos. 8,223,775 (the "'775 Patent"), 8,284,690 (the "'690 Patent") and 10,135,682 (the "'682 Patent"), including the claims of these patents. I have also reviewed the prosecution histories of these patents and the other materials referenced in this declaration.

26. I am being compensated at the rate of $800 per hour. My opinions are objective, and

compensation for my services is not contingent on my opinions or the outcome of this action.

III. LEVEL OF ORDINARY SKILL IN THE ART

27. A person of ordinary skill in the art ("POSITA") would be a person having at least: i) a bachelor-level degree in electrical engineering or a related subject and three or more years of experience working in the field of cable television signal processing and communication systems; ii) a master's-level degree in electrical engineering or a related subject and one or more years of experience working in the field of cable television signal processing and communication systems; or iii) a Ph.D.-level degree in electrical engineering or a related subject and at least some experience working in the field of cable television signal processing and/or communication systems. Additional education may substitute for professional experience, and significant work experience may substitute for formal education.

IV. SUMMARY OF MY OPINIONS

28. For purposes of this declaration, I have been asked to render opinions only with respect to certain claim terms in the '775, '690 and '682 Patents. For convenience, I use the nomenclature "claim term" to refer to individual claim terms as well as entire claim phrases.

29. The claim terms in the '775 Patent on which I was asked to opine appear in claim 18 of that patent. The following chart identifies those terms and a summary of my opinions with respect to those terms:

'775 Patent Claim 18 Term	Summary Of My Opinions
"a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment"	This claim term renders claim 18 and its dependents indefinite because there is no way to determine what "circuit" means in the claims or how many circuits a particular cable modem contains. Nor is there a way to determine where one circuit begins and another ends. It is therefore impossible to determine if any particular cable modem contains "a first circuit" and "a second circuit' as claimed, or if the "second circuit" is "separate from the first circuit."
"a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media"	This claim term renders claim 18 and its dependents indefinite because there is no way to determine what "circuit" means in the claims or how many circuits a particular cable modem contains. Nor is there a way to determine where one circuit begins and another ends. It is therefore impossible to determine if any particular cable modem contains "a first circuit" and "a second circuit' as claimed, or if the "second circuit" is "separate from the first circuit."
"DOCSIS MAC processor"	If "DOCSIS MAC processor" does not mean the DOCSIS MAC processor as described in the patent specification (*see, e.g.*, '775 Patent, at 3:1-20; 4:41-57; *id.*, at Figures 1 & 2), then it is indefinite. "DOCSIS MAC processor" does not have a plain and ordinary meaning (the DOCSIS specifications do not define this term nor is there a commonly accepted meaning in the industry.)
"DOCSIS controller"	If "DOCSIS controller" does not mean the DOCSIS controller as described in the patent specification (*see, e.g.*, '775 Patent, at 3:21-48; 4:41-57; *id.*, at Figures 1 & 2), then it is indefinite. "DOCSIS controller" does not have a plain and ordinary meaning (the DOCSIS specifications do not define this term nor is there a commonly accepted meaning in the industry.)

'775 Patent Claim 18 Term	Summary Of My Opinions
"data bus"	The claim limitation requiring "a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine" renders claim 18 and its dependents indefinite. The applicants successfully argued during prosecution that a "data networking engine" and a "cable modem engine" are not "completely partitioned" if they share "connecting circuitry" or "data paths." The "data bus" as claimed would be shared "connecting circuitry" and a shared "data path," meaning the cable modem engine and the data networking engine cannot be "completely partitioned" as claimed.

30. The claim terms in the '690 Patent on which I was asked to opine appear in claims 1 and 9 of that patent. The following chart identifies those terms and a summary of my opinions with respect to those terms:

'690 Patent Claim 1 Term	Summary Of My Opinions
"generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters"	Claim 1 of the '690 Patent and its dependents are indefinite because "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters" is incompatible with "wherein the probe has a form dictated by the first plurality of parameters." By definition, the parameters define the form of a probe. A probe cannot be generated in accordance with the "first plurality of parameters" and the "second plurality of parameters," but have its form dictated only by the "first plurality of parameters" (as is covered by the claim.)

'690 Patent Claim 9 Term	Summary Of My Opinions
"wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node"	Claim 9 of the '690 Patent and its dependents are indefinite because "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" is incompatible with "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe." By definition, the parameters define the form of a probe. A probe cannot be generated in accordance with the "first plurality of parameters" and the "second plurality of parameters," but have only the "first plurality of parameters" comprise its form (as is covered by the claim.)
"the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe"	Claim 9 of the '690 Patent and its dependents are indefinite because "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" is incompatible with "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe." By definition, the parameters define the form of a probe. A probe cannot be generated in accordance with the "first plurality of parameters" and the "second plurality of parameters," but have only the "first plurality of parameters" comprise its form (as is covered by the claim.)

31. The claim terms in the '682 Patent on which I was asked to opine appear in claim 1 of that patent. The following chart identifies those terms and a summary of my opinions with respect to those terms:

'682 Patent Claim 1 Term	Summary Of My Opinions
"a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics"	The asserted claims of the '682 Patent are indefinite because neither "composite SNR-related metric" nor "worst-case SNR profile" have a plain and ordinary meaning. To the extent those terms standing alone are not indefinite, they must both refer to the disclosed "composite worst-case SNR profile." In that event, however, the claims are indefinite because there is no way to know how the "composite SNR-related metric" can be "based *at least in part on*" the "worst-case SNR profile" since the two refer to the same thing.
"[communicating with/corresponding to] said one of said plurality of service groups"	The asserted claims of the '682 Patent are indefinite because there is no identified or antecedent "one of said plurality of service groups" to which "said one of said plurality of service groups" refers.

V. THE '775 PATENT

A. The Disclosure of the '775 Patent

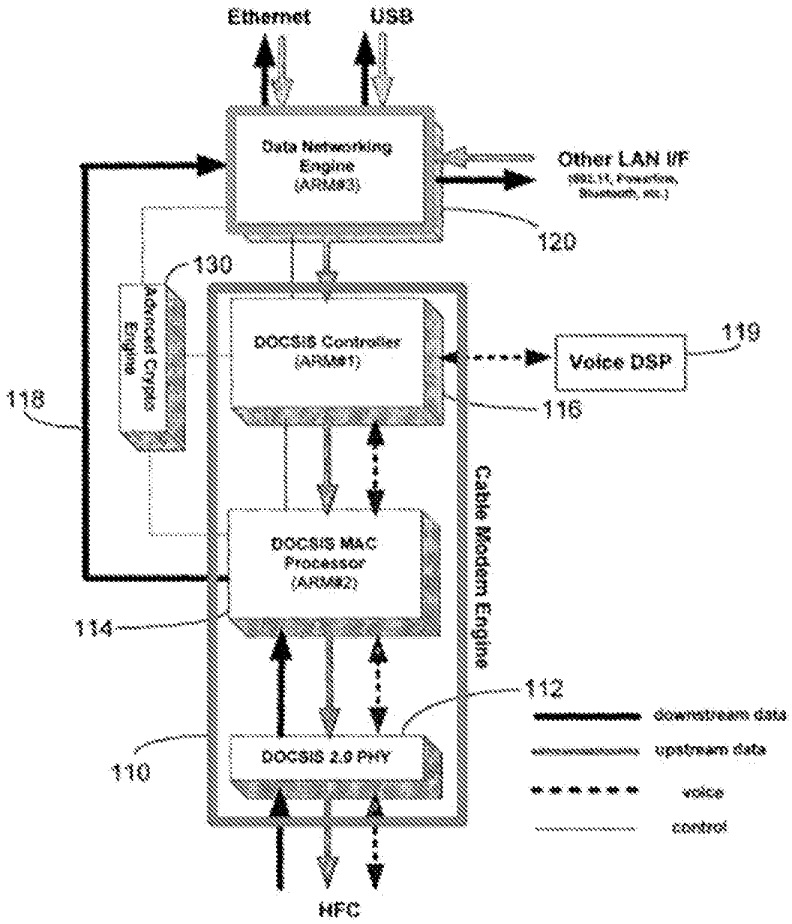
32. The '775 Patent is titled "Architecture For A Flexible And High-Performance Gateway Cable Modem." As the title suggests, the patent is directed to an allegedly novel architecture of a cable modem. ('775 Patent, 1:7-9.). A cable modem is a device in a cable customer's home which provides the customer with access to the Internet over a cable television network. (*See, e.g.*, Appx. B, Excerpted Newton's Telecom Dictionary (17th Ed. 2001), at 113.) The "architecture" of a computer-implemented device refers to how the device's components are connected to, and operate with, each other. (*Id.*, at 55.)

33. In the case of the '775 Patent, the alleged invention is a cable modem having a "functionally partitioned … architecture." ('755 Patent, 1:8-9.) In other words, the cable modem is "partitioned" into discrete components, each of which is responsible for performing defined functions.

34. One way the disclosed cable modem is partitioned is its separation into a so-called

"cable modem engine" ("CME") and a so-called "data networking engine" ("DNE"). (*Id.*, 1:66-2:2.) I say "so-called" because these are not known terms in the art. A POSITA would know to rely on the specification's description of those "engines" to understand what they are.

35. Figure 1 of the '775 Patent "illustrates a cable modem system architecture 100 according to the present invention. System 100 comprises three major subsystems: cable modem engine 110; data networking engine 120; and advanced crypto engine 130." (*Id.*, 2:49-54.) Figure 1 of the patent is reproduced below. I have annotated the figure to show the DNE in green and the CME in red (the "advanced crypto engine" is not pertinent to my declaration):



36. The CME is responsible for all DOCSIS and VoIP/PacketCable functionality. (*Id.*, 2:23-24; 2:15-17; 4:19-21.) DOCSIS stands for "Data Over Cable Service Interface Specification,"

and is the cable industry standard that specifies functions and interfaces for transmission of digital data between cable networks and subscribers. (Appx. C, Excerpted Microsoft Computer Dictionary (5th Ed. 2002), at 171.) "VoIP" stands for "Voice over IP," and is a technology for sending/receiving voice communications over IP networks. (Appx. B, at 757.) PacketCable is a specification for implementing VoIP on a cable network. ('775 Patent, 2:15-19; Appx. D, "PACKETCABLE™ – CableLabs" (available at https://www.cablelabs.com/specifications-library/packetcable); Appx. E, PacketCable™ 1.0 Architecture Framework Technical Report (December 1, 1999), at 1.)

37. The DNE "implement[s] all data networking processing and home networking applications." ('775 Patent, 2:12-13.) "In one implementation…the data networking functionality provided by the data networking engine is in accordance with the CableHome specification." (*Id.*, 2:15-19.)

1. The Partitioning of the CME and DNE

38. The alleged invention of the '775 Patent is a cable modem that has a particular structure specified by the patent. The specification repeatedly emphasizes that a key aspect of this alleged invention is the "complete" partitioning of the DNE and CME within the cable modem:

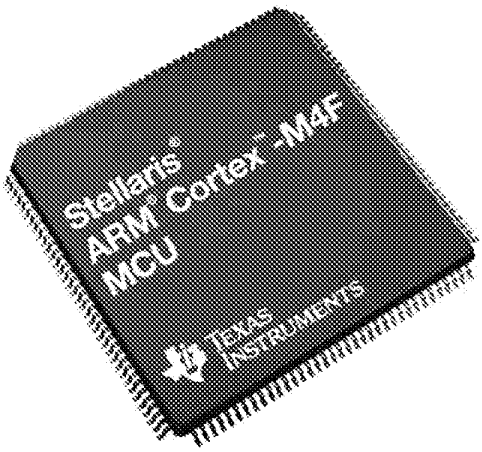
> One embodiment of the invention is a cable modem system comprising a data networking engine that performs data networking functions and a cable modem engine that performs all other cable modem functions, wherein the cable modem engine is ***completely partitioned*** from the data networking engine. (*Id.*, 1:66-2:4.)
>
> The data networking engine is ***completely decoupled*** from the cable modem engine. (*Id.*, 2:13-15.)
>
> The data networking engine is ***partitioned*** from the cable modem engine so that the data and home networking functionality is ***completely decoupled*** from the DOCSIS and VoIP functionality. (*Id.*, 2:24-27.)

> In one implementation, the entire embedded portal services (PS) functionality of the CableHome specification is contained within data networking engine **120**, with the CableHome functionality being ***completely decoupled*** from the PacketCable and DOCSIS functionality provided by cable modem engine **110**. (*Id.*, 3:53-58.)
>
> Cable modem **100** ***completely partitions*** data networking functions (advanced bridging/routing, NAT/firewall, VPN, web server and CableHome applications) from DOCSIS cable modem functionality. (4:13-16.)

39. However, the specification does not explain what constitutes "complete" partitioning or *how* the DNE and CME are completely partitioned. As I explain in paragraphs 57-63 below, this issue was raised during prosecution of the '775 Patent. The applicant successfully distinguished prior art by arguing that complete partitioning requires that the DNE and CME not share any connecting circuitry, data paths or memory devices.

2. The Structure of the DNE

40. The DNE constitutes one "ARM processor." (*Id.*, Fig 1; 4:48-49.) An ARM processor is an "Advanced RISC Machine" processor, which is a type of microprocessor that can be incorporated into computerized devices. (Appx. C at 35.) Below is a photograph of an ARM processor:



(Retrieved from Power Systems Design, "TI delivers leading analog integration, best-in-class low power and floating-point performance in new Stellaris® ARM® Cortex™-M4F microcontrollers" (*available at* https://www.powersystemsdesign.com/articles/ti-delivers-leading-analog-integration-best-in-class-low-power-and-floating-point-performance-in-new-stellaris-arm-cortex-m4f-microcontrollers/8/3325).)

41. The DNE is one of three ARM processors within the disclosed cable modem. It is referred to as "ARM #3" in the specification and the figures. ('775 Patent, Fig 1; 4:48-49.)

3. The Structure of the CME

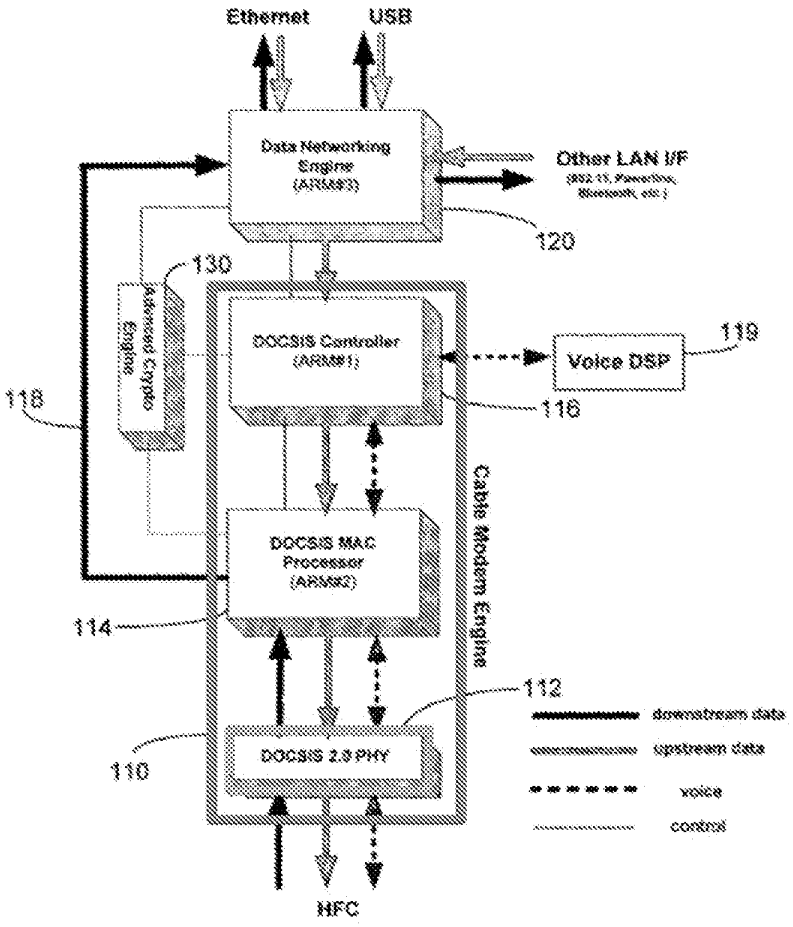
42. In contrast to the DNE, which is made up of only one ARM processor, the CME comprises multiple ARM processors and other discrete hardware components. In fact, another aspect of the alleged cable modem architecture invention is that the CME itself is partitioned into specific components:

> Another embodiment of the invention is a cable modem architecture. The architecture includes a cable modem engine having a DOCSIS PHY layer with a hardware transmitter and receiver, a DOCSIS MAC processor that implements real-time critical MAC functions for both upstream and downstream communications, and a DOCSIS controller implementing VoIP functionality. (*Id.*, 2:5-11.)

43. The DOCSIS PHY layer includes a "hardware transmitter and receiver." (*Id.*, 2:7-8; 2:58-59.) As explained in the specification, this DOCSIS PHY layer hardware "receives downstream data, transmits upstream data and receives and transmits voice data from/to an external source. In one implementation, the external source is a HFC (hybrid fiber coax) cable employing both fiber optic and coaxial cable as an effective means for delivering combined data, video, voice, CATV and other communications." (*Id.*, 2:61-67.)

44. I have annotated Figure 1 of the '775 Patent below to indicate the DOCSIS PHY

layer in blue and the CME in red:

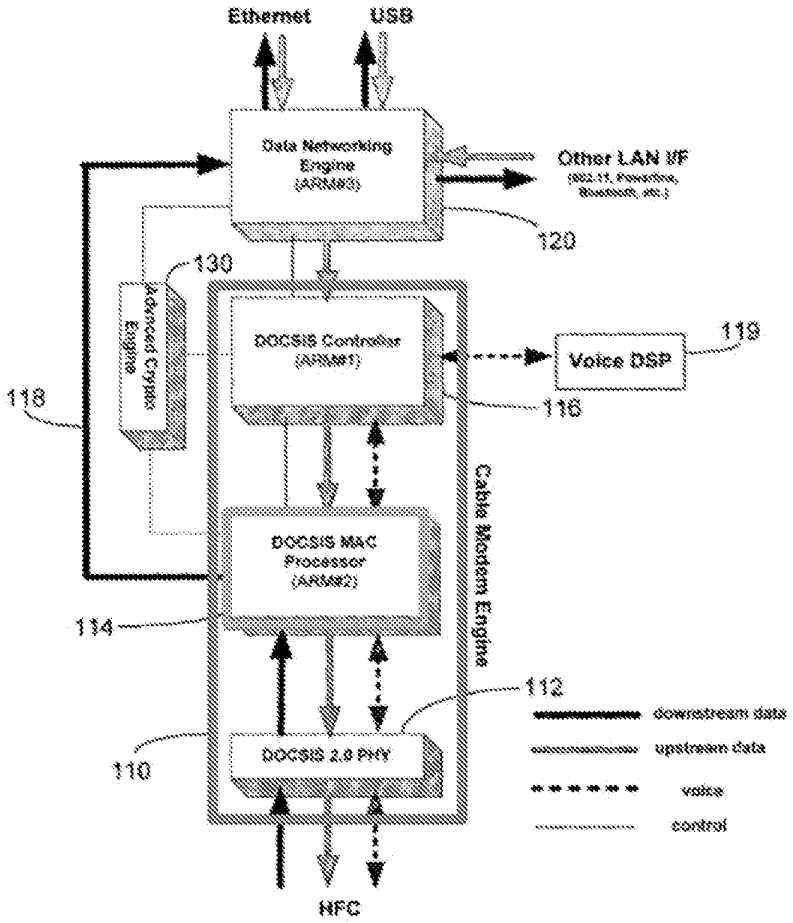


45. The CME also contains what is referred to in the specification as a "DOCSIS MAC processor." The term "DOCSIS MAC processor" does not have a plain and ordinary meaning in the art. A POSITA would know to rely on the specification's description of the "DOCSIS MAC processor" to understand what it is.

46. The acronym "MAC" standing alone, however, does have a plain meaning in the art. It stands for "Medium Access Control." MAC functions relate to accessing a shared physical transmission medium by network-attached devices. (Appx. B, at 432.)

47. In the '775 Patent, the DOCSIS MAC processor is implemented as another one of

the three ARM processors within the cable modem ('775 Patent, Fig 1; 3:17-18.) It is referred to as "ARM #2" in the specification and the figures. (*Id.*, Fig 1; 4:47.) I have annotated Figure 1 of the '775 Patent below to indicate the DOCSIS MAC processor in blue and the CME in red:

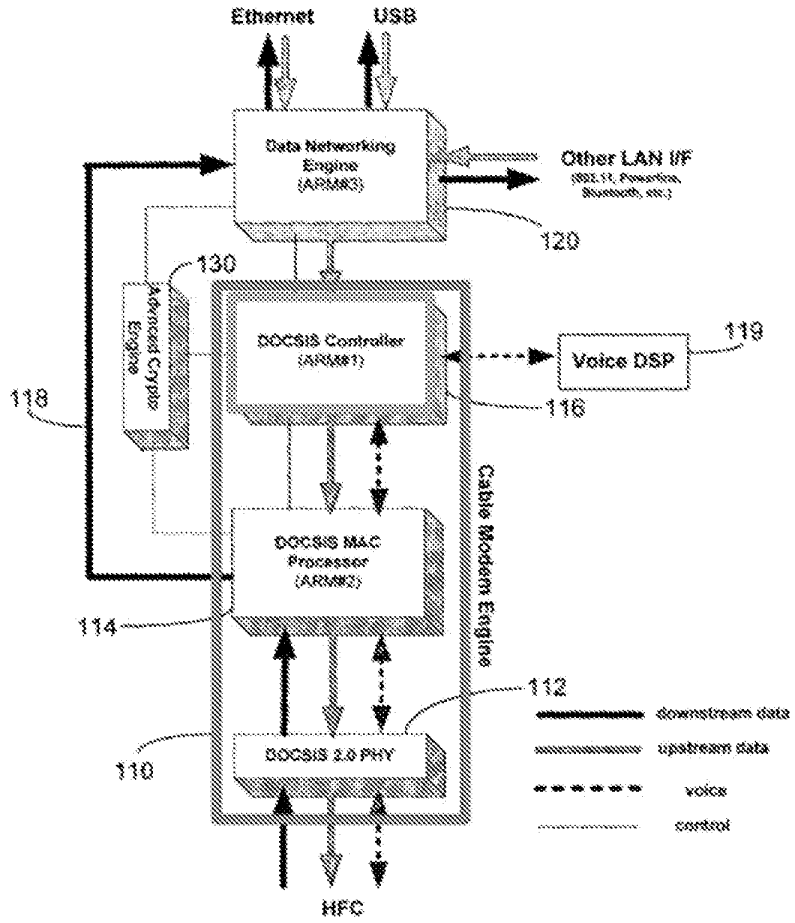


48. The DOCSIS MAC processor is described as performing a number of MAC functions. "These functions include US and DS synchronization, DS MAC address filtering, DS protocol filtering, US and DS PHS, concatenation, fragmentation, MAP processing, US transmission scheduling, as well as DOCSIS link-layer DES encryption and decryption." (*Id.*, 3:1-7.) Notwithstanding the name of the deice, the DOCSIS MAC processor does not perform all of the MAC functions of the cable modem. As I explain below, according to the specification, the "DOCSIS

controller" also performs MAC functions.

49. The CME also contains what is referred to in the specification as a "DOCSIS controller." The term "DOCSIS controller" does not have a plain and ordinary meaning in the art. A POSITA would know to rely on the specification's description of the "DOCSIS controller" to understand what it is.

50. In the '775 Patent, the DOCSIS controller is implemented as another one of the three ARM processors within the cable modem (*Id.*, Fig 1; 3:25.). It is referred to as "ARM #1" in the specification and the figures. (*Id.*, Fig 1; 4:47-48.) I have annotated Figure 1 of the '775 Patent below to indicate the DOCSIS controller in blue and the CME in red:

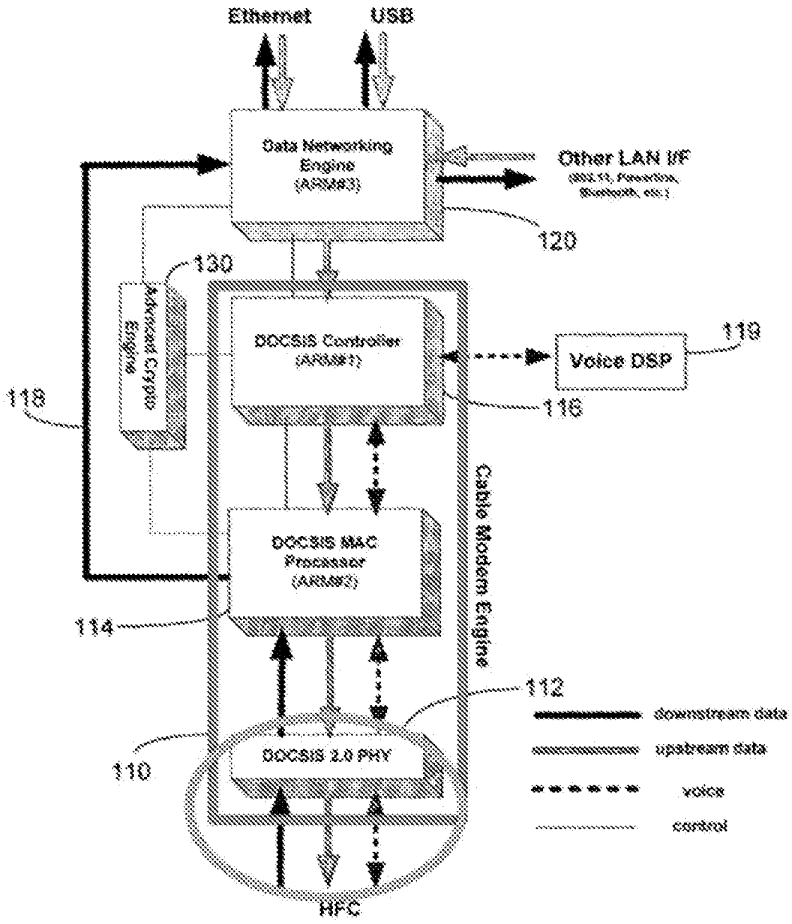


51. The DOCSIS controller performs all VoIP/PacketCable functionality. (*Id.*, 2:6-19, 3:39-48.) It also performs a number of other functions. (*Id.*, 3:21-38.) As I mentioned above, the DOCSIS controller performs a number of MAC functions, such as "MAC management message (MMM) processing" (*id.*, 3:27-29), "MAC address learning" (*id.*, 3:30), and "voice MAC driver" functions (*id.*, 3:46).

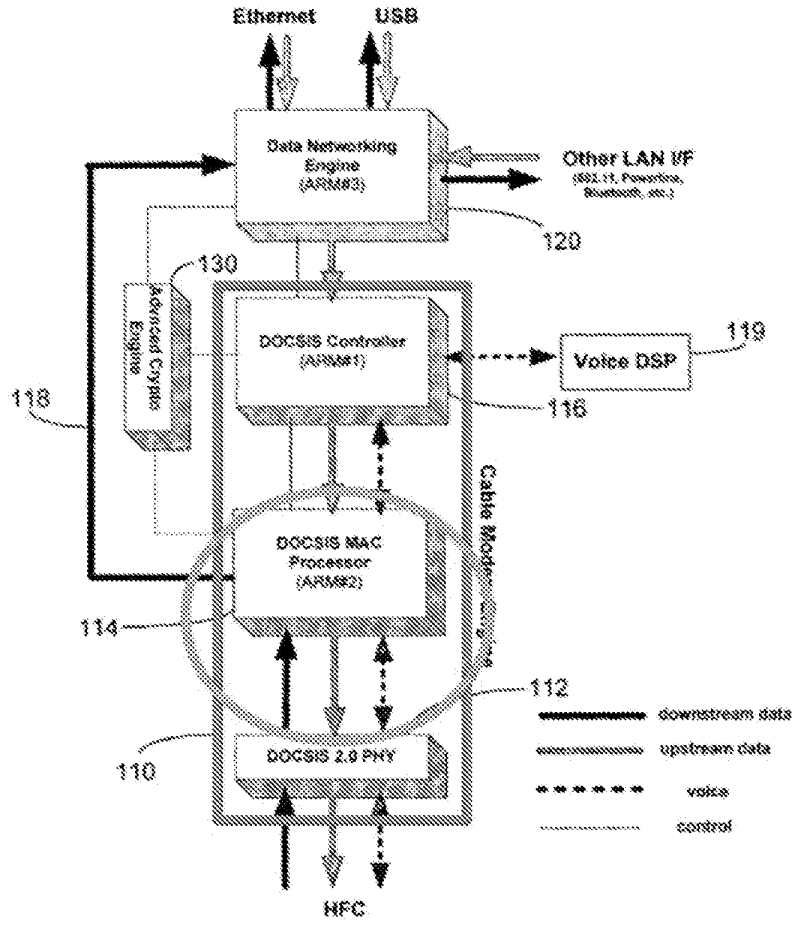
4. Data Flow Within the CME

52. As depicted in Figure 1 of the '775 Patent, the cable modem transmits upstream data (represented by a solid grey arrow), receives downstream data (represented by a solid black arrow), and transmits and receives voice data (represented by a dashed two-way arrow). (*Id.*, 2:61-63; Fig 1.)

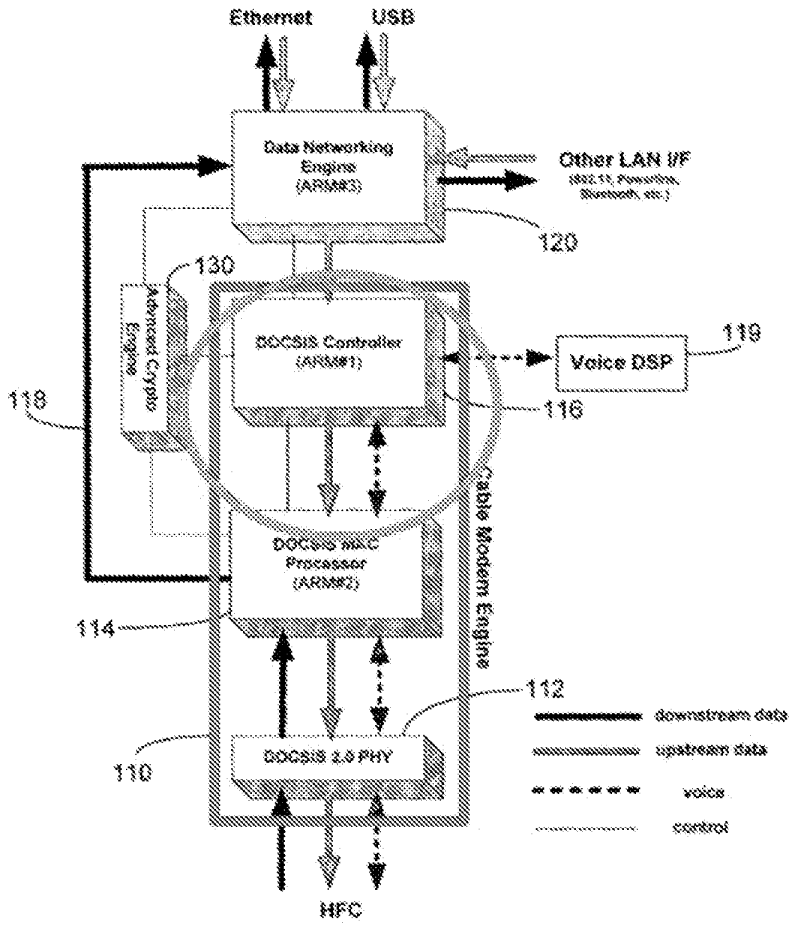
"Downstream" data is data a cable modem receives and is referred to in the specification as "DS PDU packets." (*Id.*, Fig 1; 2:61-63; 3:7-9; 3:11-17; 3:22-24; 4:49-53.) "Upstream" data is data the cable modem transmits and is referred to in the specification as "US PDU packets." (*Id.*, Fig 1; 2:61-63; 3:7-11; 3:21-22.) All upstream and downstream data and all voice data goes through the DOCIS PHY layer hardware. (*Id.*, 2:61-67.) I have annotated Figure 1 of the '775 Patent in blue below to indicate where this is shown in the figure:



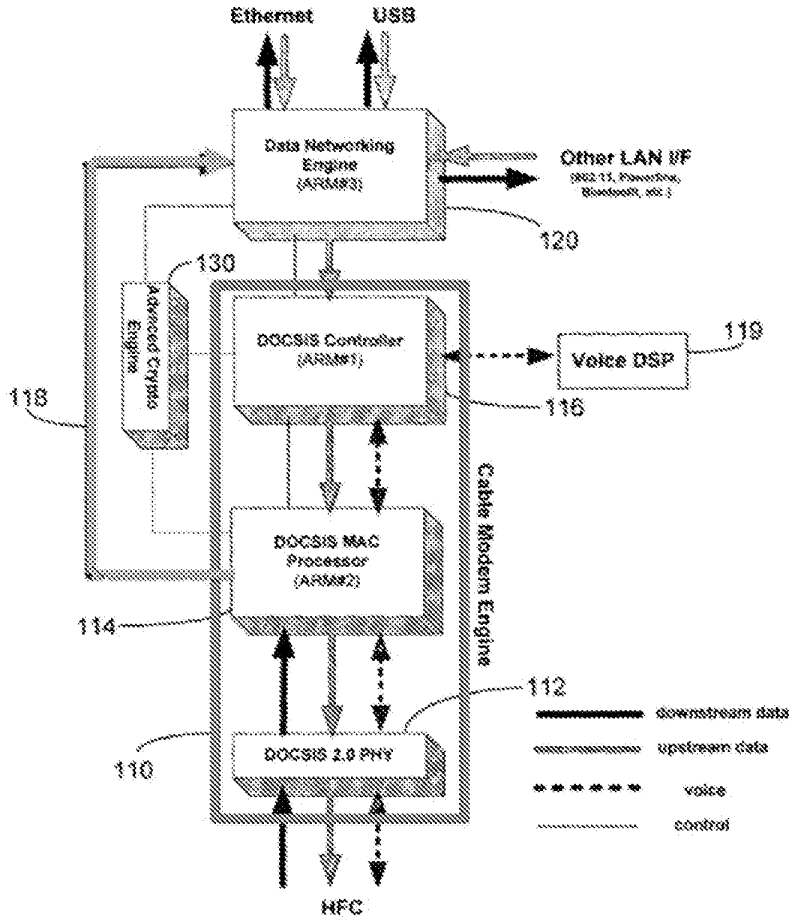
53. Similarly, all upstream and downstream data and all voice data goes through the DOCSIS MAC processor (*Id.*, 3:7-10.) I have annotated Figure 1 of the '775 Patent in blue below to indicate where this is shown in the figure:



54. In contrast, however, while all upstream and downstream voice data goes though the DOCSIS controller, only upstream data goes through the DOCSIS controller. (*Id.*, 3:9-11.) I have annotated Figure 1 of the '775 Patent in blue below to indicate where this is shown in the figure:



55. Downstream data bypasses the DOCSIS controller entirely and is sent by the DOCSIS MAC processor directly to the DNE. I have annotated Figure 1 of the '775 Patent in blue below to indicate where this is shown in the figure:



56. The reason the DOCSIS MAC processor sends all downstream data directly to the DNE – bypassing the DOCSIS controller – is described in the specification as follows:

> To increase downstream throughput, all processing of DS PDU (protocol data unit) packets is done within processor **114** without involving controller **116**. After being processed, DS PDU packets are forwarded by processor **116** directly to data networking engine **120** along path **118**, bypassing controller **116**. (*Id.*, 3:11-16)

> To further boost downstream throughput, the downstream PDU packets are directly forwarded from the DOCSIS MAC processor **114** to the data networking engine **120** without going through DOCSIS controller **116**. This is made possible by exploiting the asymmetric nature of the DOCSIS US/DS **152** and **154**. (*Id.*, 4:49-55)

B. The Prosecution History of the '775 Patent

57. During prosecution of the '775 Patent, the examiner rejected the claims over US Published Application U.S. 2001/0039600 to Brooks et al. ("Brooks," Appx. F). As relevant to my declaration, the examiner found that Brooks teaches the claim limitation "the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine." (Appx. G, Excepts of Prosecution History of the '775 Patent, 2/5/10 Office Action at 4, 8.) This limitation appears in claim 18 of the '775 Patent as issued. ('775 Patent, 8:24-27.)

58. In attempting to overcome the rejection, the applicants argued as follows:

> [T]he Office Action make the conclusion statement [sic] that "the data networking engine and cable modem engines are represented in Figures 1 and 2 of the [Brooks] reference…" However, Applicant is uncertain how any reasonable interpretation of these Figures can provide correspondence. For example, *Figure 2 of [Brooks] discloses only two processors, each of which, therefore, must correspond to the claimed data-networking and cable-modem engines*. However, the discussion of Figure 2 makes clear that the cable modem functions are performed by CMAC unit 224 *(see, e.g.,* paragraph 0042). Therefore, in order for the cable modem engine to contain a processor and perform the CMAC functions as claimed, *the cited cable modem engine must include circuitry to connect the processors with the CMAC unit. Because available connecting circuitry would be shared with the other processor, Applicant is uncertain how the asserted cable modem engine and home networking engine can be completely partitioned as claimed.*

(Appx. G, 4/5/10 Request to Withdraw Finality and Response to Final Office Action, at 6-7 (emphasis mine).) Thus, because the processor the examiner designated as the CME "shared" "connecting circuitry" with the processor the examiner designated as the DNE, the applicants argued the CME and DNE were not "completely partitioned."

59. Initially, the examiner was not persuaded by this argument and repeated his rejection of the claims. In so doing, he confirmed his view that one of Brooks' disclosed processors is the DNE and the other is the CME:

> *The first processor* processes information flowing to and from cable media interface circuitry. This *constitutes the data networking engine*, which performs the interacting with equipment, as claimed. *The second processor* performs the management of some message processing and scheduling, which constitutes cable modem functions other than those of the data networking engine (please see paragraph 0026). This then *constitutes the cable modem engine*, as claimed.

(Appx. G., 5/11/10 Advisory Action at 2 (emphasis mine).)

60. In response, the applicants started by reaffirming the argument they had previously made that if two processors share the same "connecting circuitry" they cannot be completely partitioned:

> [I]t was pointed out that in Brooks '600, only two processors were disclosed. Therefore, from the Examiner's position that "the data networking engine and cable modem engines are represented in figures 1 and 2" (Office Action, p. 8), *it would follow that one of the two processors corresponded to the networking engine, and the other of the two processors corresponded to the cable modem engine.* It was further pointed out that while the discussion concerning Figure 2 in Brooks '600 paragraph 0042 makes clear that cable modem functions are performed by CMAC unit 224, if the cable modem engine is to contain a processor and perform CMAC functions as claimed, the cited cable modem engine must include circuitry to connect one of the processors with the CMAC unit. *It was noted, however, that because available connecting circuitry would be shared by both the one processor and the other processor, the asserted cable modem engine and home networking engine could not be completely partitioned as claimed.*

(Appx. G, 6/7/10 Amendment at 6-7 (emphasis mine).)

61. The applicants then argued further that Brooks' disclosure "does not square with the claim 1 feature that 'the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine"

> because the CMAC/CPHY block (114, 118, 224 and 228) communicates with both the processors 102 and 104 *by sharing the same data paths and sharing the same direct memory access controller*. (See peripheral bus 112 - bridge 110 - system bus 108 in Fig. 1 and APB 214- DMA Controller/ASB-APB Bridge 212- ASB 210 in Fig. 2, and paragraphs 0034 and 0035).

(*Id.* at 8.)

62. Figure 2 of Brooks is reproduced below. I have annotated the figure to indicate in red the two processors relied on by the examiner as the CME and DNE. The "CMAC/CPHY block" is indicated in blue. The "connecting circuitry" which is "shared" by the two processors is highlighted in yellow. The shared DMA controller is highlighted in green.

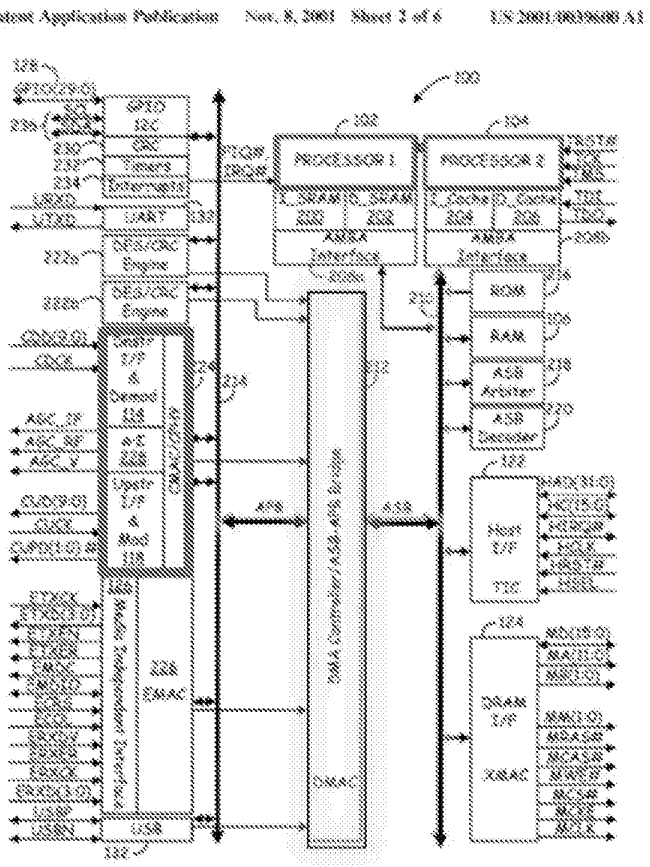


Fig. 2

I note that a DMA controller is a device which controls access to memory devices. (Appx. H, Excerpted The Authoritative Dictionary of IEEE Standards Terms (7th Ed. 2000), at 317-318 (definitions of "direct memory access" and "direct memory access controller").)

63. After the applicant made these arguments, the examiner dropped his rejection of the claims in view of the Brooks reference. (Appx. G, 9/2/11 Office Action.)

C. Claim 18 of the '775 Patent

64. Claim 18 of the '775 Patent requires "a data networking engine *implemented in a first circuit* that includes at least one processor" and "a cable modem engine *implemented in a second circuit* that includes at least one processor, *the second circuit being separate from the first circuit*." ('775 Patent, 7:34-35; 8:5-7 (emphasis mine).) The specification does not explain in what sense the word "circuit" is used in the claim. In fact, the specification does not contain the word "circuit" at all.

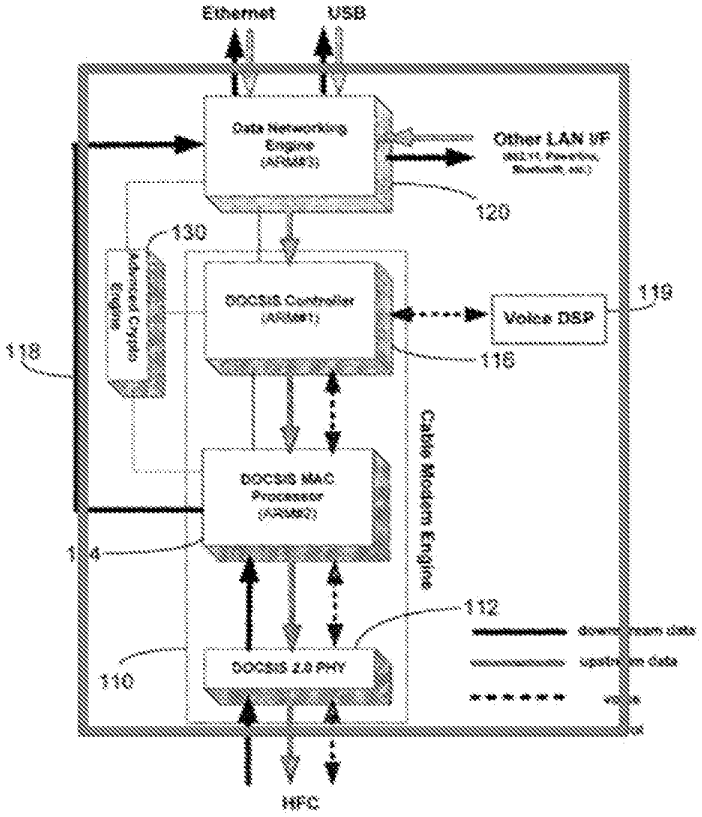
65. In the context of computer-related systems, a single "circuit" can mean anything from a basic simple electrical path or single transistor, to all of the devices on a single circuit board, to all of the circuit board(s) in a computer or computerized device. Standard definitions of "circuit" reflect this ambiguity. For example, the Microsoft Computer Dictionary, 5th Edition (2002), p. 99, defines "circuit" as:

> 1. Any path that can carry electrical current. 2. A combination of electrical components interconnected to perform a particular task. At one level, a computer consists of a single circuit; at another, it consists of hundreds of interconnected circuits.

(Appx. C, at 99.)

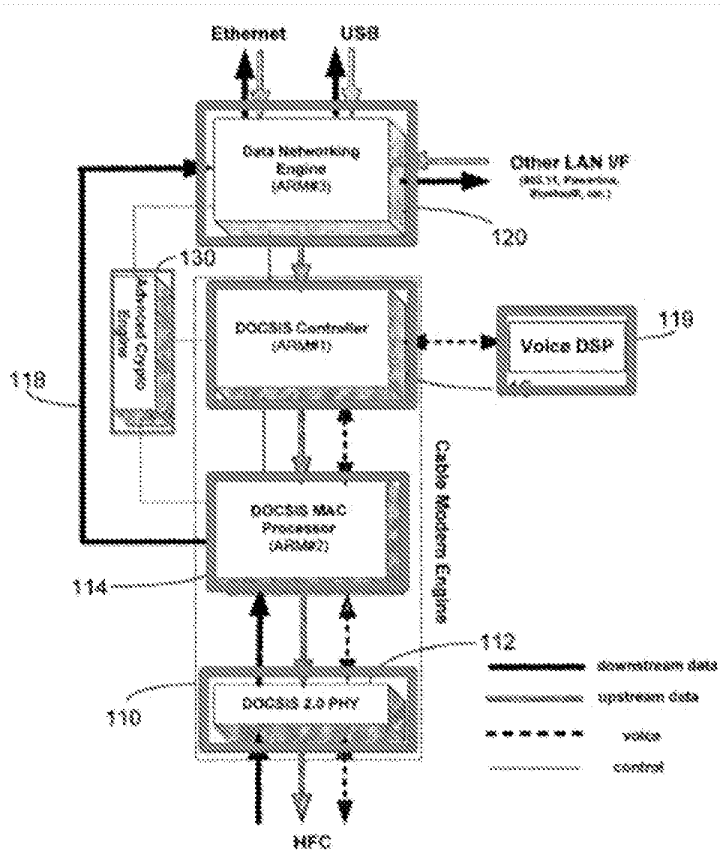
66. As a result, it is impossible to know how many circuits a device contains, or what those circuits are, unless one knows what meaning of the word "circuit" is being employed. This can be demonstrated with reference to Figure 1 of the '775 Patent. If one were to ask how many circuits it depicts or what the boundaries are of those circuits, there would be no way to answer without knowing what meaning of the word "circuit" to apply.

67. For example, Figure 1 of the '775 Patent depicts a cable modem. Thus, all of Figure 1 – the entire cable modem – can be deemed a single circuit ("at one level, a computer consists of a single circuit"). I annotate Figure 1 below by showing this single "circuit" in red:



68. Applying this meaning of "circuit," the cable modem disclosed in the '775 Patent contains only one circuit. The claim 18 requirement that a cable modem contain a "first circuit" and a "second circuit" would not be satisfied.

69. On the other hand, Figure 1 shows a number of discrete devices, each of which is responsible for its own specialized tasks. As such, each of ARM #1 (the "DOCSIS controller"), ARM # 2 (the "DOCSIS MAC processor"), ARM # 3 (the "Data Networking Engine"), the DOCSIS 2.0 PHY hardware, the Voice DSP (Digital Signal Processor) and the "Advanced Crypto Engine" can each be considered a separate "circuit," as each is a discrete piece of hardware made up of electrical components for performing their designated tasks. I indicate each of these different "circuits" in red below:



70. Applying this meaning of "circuit," the disclosed "cable modem engine" is implemented in at least three different circuits – the ARM #1 "circuit," the ARM # 2 "circuit" and the DOCSIS 2.0 PHY "circuit." The claim 18 requirement that the cable modem engine be implemented "in a second circuit" would not be satisfied.

71. Then again, each of the different devices identified in Paragraph 67 above are themselves made up of many electrical devices. For example, each of ARM #1, ARM #2 and ARM # 3 is made up of billions of transistors and electrical paths. Using that definition of "circuit," each of these ARMs is literally made up of billions of different circuits. I have attempted to depict this in my annotation of Figure 1 below, where each of these ARMs is made up of many different circuits represented by red dots:

Regarding dependent claim 4, Schain taught a cable modem system further comprising an advanced crypto engine configured to perform all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem engine (column 12, lines 55-64).

Regarding dependent claim 5, Schain taught a cable modem engine includes: a DOCSIS PHY layer; a DOCSIS MAC processor; and a DOCSIS controller, and wherein the at least one processor of the data networking engine is a RISC processor (column 13, lines 26-36).

Regarding dependent claim 6, Schain taught DOCSIS PHY layer includes a hardware transmitter and receiver (column 7, lines 47-51).

Regarding dependent claim 10, Schain taught the data networking engine is configured to perform all data networking processing including advanced multi-port bridging routing with NAT/firewall and VPN, and home networking applications (column 11, lines 59-67; column 12, lines10).

Regarding dependent claim 11, Schain does not specifically teach the data networking engine comprises the entire embedded portal services functionality of the CableHome specification. “Official notice” is taken embedded portal services functionality CableHome specification is well known in the art. It would have been obvious to one of ordinary skill in the art at the time the invention was made that incorporating the CableHome specification in Schain's data networking engine would

have improved effectiveness. The motivation would have been to provide new services in a standardized manner.

Claims 3, 8, 9, 12-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schain as applied to claims 2, 5 above, and further in view of Winters et al., US 2006/0080650 A1 (hereafter referred to as Winters).

Regarding dependent claim 3, Schain does not specifically teach VoIP functionality is embedded in the cable modem engine. However, Winters taught VoIP functionality is embedded in the cable modem engine (paragraphs 5-6). It would have been obvious to one of ordinary skill in the at the time the invention was made that incorporating Winter's VoIP functionality in Schain's cable modem would have extended functionality. The motivation would have to expand Schain's functionality to include voice telephony and provide capabilities for other cable modem services.

Regarding dependent claim 8, Schain does not specifically teach all VoIP functionality is implemented in the DOCSIS controller. However, Winters taught VoIP functionality is implemented in the DOCSIS controller of a cable modem (paragraphs 5-6). It would have been obvious to one of ordinary skill in the at the time the invention was made that incorporating Winter's VoIP functionality in Schain's cable modem would have extended functionality. The motivation would have to expand functionality to include voice telephony and provide capabilities for other cable modem services.

Regarding dependent claim 9, Winters taught the VoIP functionality is in conformance with the PacketCable specification (paragraphs 5-6).

Regarding dependent claim 12, Schain taught the cable modem engine includes: the DOCSIS PHY layer includes a transmitter and receiver (column 7, lines 47-51); the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications (column 12, lines 25-38); and the DOCSIS controller is configured to implement other functionality (column 10, lines 54-62); and wherein the data networking engine includes a processing element configured to implement a majority of data networking processing and home networking applications decoupled from the implementation of the MAC functions and the other functionality of the cable modem engine (column 8, lines 35-48). Schain does not specifically teach the other functionality is VoIP functionality. However, Winters taught VoIP functionality is implemented in the DOCSIS controller of a cable modem (paragraphs 5-6). It would have been obvious to one of ordinary skill in the at the time the invention was made that incorporating Winter's VoIP functionality in Schain's cable modem would have extended functionality. The motivation would have to expand functionality to include voice telephony and provide capabilities for other cable modem services.

Regarding dependent claim 13, Winters taught the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, wherein the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality provided by the data networking engine is completely

decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine (paragraphs 5-6).

Regarding dependent claim 14, Schain does not the DOCSIS MAC processor is an RISC processor, and wherein the DOCSIS controller is an RISC processor (column 13, lines 26-36). Schain does not specifically teach ARM940-based or ARM9TDMI-based. However, both models are from a well know processor family. It would have been obvious to one of ordinary skill in the art at the time the invention was made that incorporating ARM 940-based processors in Schain's RISC processors would have been an acceptable selection. The motivation would have been because ARM 940 based processors have similar advantages.

Regarding claim 15, Schain taught a method for providing a flexible and partitioned cable modem gateway comprising:

providing data and home networking functionality in a data networking engine (column 4, lines 22-28);

providing DOCSIS and other functionality in a cable modem engine (column 4, lines 28-43; column 8, lines 35-48); and

partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and other functionality (column 10, lines 6-15). Schain does not specifically teach the other functionality is VoIP functionality in accordance with the PacketCable specification. However, Winters taught VoIP functionality is implemented in the DOCSIS controller of a cable modem in accordance with PacketCable specification (paragraphs 5-6). It would

have been obvious to one of ordinary skill in the at the time the invention was made that incorporating Winter's VoIP functionality in Schain's cable modem would have extended functionality. The motivation would have to expand functionality to include voice telephony and provide capabilities for other cable modem services.

Regarding dependent claim 16, Schain taught the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver (column 11, lines 9-15). Schain does not specifically teach the data networking engine comprises the entire embedded portal services functionality of the CableHome specification. "Official notice" is taken embedded portal services functionality CableHome specification is well known in the art. It would have been obvious to one of ordinary skill in the art at the time the invention was made that incorporating the CableHome specification in Schain's data networking engine would have improved effectiveness. The motivation would have been to provide new services in a standardized manner.

Schain does not specifically teach the other functionality is VoIP functionality in accordance with the PacketCable specification. However, Winters taught VoIP functionality is implemented in the DOCSIS controller of a cable modem in accordance with PacketCable specification (paragraphs 5-6). It would have been obvious to one of ordinary skill in the at the time the invention was made that incorporating Winter's VoIP functionality in Schain's cable modem would have extended functionality. The

motivation would have to expand functionality to include voice telephony and provide capabilities for other cable modem services.

In combination Schain-Winter the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine (column 10, lines 6-15).

Allowable Subject Matter

Claim 7 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: the DOCSIS MAC processor is configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to PATRICE WINDER whose telephone number is (571)272-3935. The examiner can normally be reached on Monday-Friday, 12:00 pm - 8:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thu V. Nguyen can be reached on 571-272-6967. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Patrice L Winder/
Primary Examiner, Art Unit 2452

August 29, 2011

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appln. No.	:	10/675,566	Conf. No.:	9980
First Named Inventor	:	Gordon Y. Li		
Filed	:	September 30, 2003		
Art Unit	:	2452		
Examiner	:	Winder, Patrice L.		
Docket No.	:	348162-982350		

Title: Architecture For A Flexible And High-Performance Gateway Cable Modem

AMENDMENT AND RESPONSE TO OFFICE ACTION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Madam:

In response to the Office action mailed September 2, 2011, please enter the amendments set forth below and consider the following remarks.

Amendments to the Claims are reflected in the listing of claims that begins on page 2 of this paper.

Remarks begin on page 9 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (**Canceled**)

2. (**Currently Amended**) A cable modem system as claimed in claim [[1]] 7, wherein all DOCSIS functions are localized in the cable modem engine.

3. (**Original**) A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. (**Currently Amended**) A cable modem system as claimed in claim [[1]] 7, and further comprising an advanced crypto engine configured to perform all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem engine.

5. (**Canceled**)

6. (**Currently Amended**) A cable modem system as claimed in claim [[5]] 7, wherein the DOCSIS PHY layer includes a hardware transmitter and receiver.

7. (**Currently Amended**) A cable modem system comprising: ~~as claimed in claim 5,~~

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to

perform home networking functions including interfacing with customer provided equipment, wherein the at least one processor is a RISC processor;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine including a DOCSIS PHY layer, a DOCSIS controller, and a DOCSIS controller and programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and

a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine;

wherein the DOCSIS MAC processor is configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. (**Currently Amended**) A cable modem system as claimed in claim [[5]] 7, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. (**Original**) A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. (**Currently Amended**) A cable modem system as claimed in claim [[5]] 7, wherein the data networking engine is configured to perform all data networking processing

including advanced multi-port bridging routing with NAT/firewall and VPN, and home networking applications.

11. (**Original**) A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. (**Currently Amended**) A cable modem system as claimed in claim [[5]] 7, wherein with regard to the cable modem engine ~~includes~~:

the DOCSIS PHY layer includes a transmitter and receiver;

the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications; and

the DOCSIS controller is configured to implement VoIP functionality; and wherein the data networking engine includes a RISC processor configured to implement a majority of data networking processing and home networking applications decoupled from the implementation of the MAC functions and the VoIP functionality of the cable modem engine.

13. (**Currently Amended**) A cable modem ~~architecture~~ system as claimed in claim 12, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, wherein the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. (**Currently Amended**) A cable modem ~~architecture~~ system as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. (**Currently Amended**) A method of ~~for~~ cable modem operation as claimed in claim 17, further comprising:

providing a flexible and partitioned cable modem gateway comprising:

providing data and home networking functionality in the data networking engine;

providing DOCSIS and VoIP functionality in the cable modem engine; and

partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

16. (**Currently Amended**) A cable modem system as claimed in claim [[5]] 7, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

17. (**New**) A method of cable modem operation comprising:

executing, via at least one processor of a first circuit that implements a data networking engine, first software that causes the data networking engine to perform home networking functions including interfacing with customer provided equipment, wherein the at least one processor is a RISC processor;

executing, via one or more processors of a second circuit that implements a cable modem engine programmed with second software, the second software to cause the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem

functions including interfacing with cable media, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, wherein the second circuit is separate from the first circuit, and wherein the cable modem engine includes a DOCSIS PHY layer, a DOCSIS controller and a DOCSIS controller;

connecting, via a data bus, the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine;

processing, via the DOCSIS MAC processor, downstream PDU packets and forwarding the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

18. (**New**) A method as claimed in claim 17, further comprising:

providing VoIP functionality in accordance with the PacketCable specification in the DOCSIS controller; and

providing the embedded portal services functionality of the CableHome specification in the data networking engine;

wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

19. (**New**) A method as claimed in claim 17, further comprising:

providing the embedded portal services functionality of the CableHome specification in the data networking engine; and

providing VoIP functionality in accordance with the PacketCable specification in the DOCSIS controller;

wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver; and

wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

20. (**New**) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a DOCSIS controller and a DOCSIS MAC processor, the DOCSIS MAC processor configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput; and

a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

21. (**New**) A cable modem system as claimed in claim 20, wherein all DOCSIS functions are localized in the cable modem engine.

22. (**New**) The cable modem system as claimed in claim 20 wherein the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications.

REMARKS

In reply to the non-final Office Action mailed September 2, 2011, please enter the amendments set forth above and consider the following remarks. By this response, Applicants cancel claims 1 and 5 without prejudice or disclaimer, amend claims 2, 4, 6-8, 10, 12-15, and 16, and present new claims 17-22. No new matter has been added. After entry of this paper, claims 2-4 and 6-22 will be pending in this application.

In the Office action, the Examiner (i) rejected claims 1-2, 4-6, 10 and 11 under 35 U.S.C. 103(a), as being anticipated by Schain et al. (US 6,944,706 B2); (ii) rejected claims 3, 8, 9, 12-16 under 35 U.S.C. 103(a) as being unpatentable over Schain et al. as applied to claims 2, 5 above, and further in view of Winters et al. (US 2006/0080650 A1). With regard to the rejections, Applicants respectfully traverse, submitting that the standing rejections are unsupportable/moot/overcome as against the claims presented for at least the reasons set forth below. Reconsideration is respectfully requested.

Claim Rejections Under 35 USC § 103 (a)

Claims 1-2, 4-6, 10 and 11 stand rejected under 35 U.S.C. 103(a), as being anticipated by Schain et al. (US 6,944,706 B2).

Claims 3, 8, 9, 12-16 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Schain et al. as applied to claims 2, 5 above, and further in view of Winters et al. (US 2006/0080650 A1).

Applicants respectfully traverse these rejections.

As an initial matter, Applicants have canceled claims 1 and 5 without prejudice or disclaimer, and respectfully submit the rejections against these claims are moot..

Further and without acquiescence, in the interests, e.g., of advancing the prosecution of this case, avoiding additional costs, etc., Applicants have canceled the rejected claims, or amended the claims to depend from a claim indicated as allowable by the Examiner. Accordingly, Applicants submits that the rejections are moot or now unsupported in view of the amended claims, and respectfully request that they be withdrawn.

Specifically, the Examiner indicates on page 9 of the Office Action that claim 7 is allowable if rewritten in independent form. Claim 7 has been rewritten in independent

form, and claims 2-4, 6, 8-14, and 16 depend directly or indirectly on claim 7. Independent claim 15 has been amended to depend on new claim 17 which recites subject matter indicated as allowable by the Examiner (*see, e.g.*, Office Action, pg. 9).

New Claims

Claims 17-22 are new claims presented in place of the claims canceled by Applicant without prejudice or disclaimer. New claims 17-22 are either copies of existing claims (with different dependencies or additional language) or are new claims reciting features indicated to be patentable. Further, all of these claims either depend on allowable claims or recite subject matter consistent with existing allowable claims. Accordingly, Applicants respectfully submit that these new claims present no new matter, and are allowable for at least the same reasons as their related claims.

Closing Remarks

In view of the above, it is respectfully submitted that the claims are now in condition for formal allowance, and early and favorable action to that end is respectfully requested.

The Examiner is encouraged to call Applicants' attorney at the number below if doing so will in any way advance the prosecution of this application.

The Commissioner is hereby petitioned to grant any extensions of time required to enter this paper as well as authorized to charge any fees which may be required, or credit in the overpayment, to Deposit Account No. 07-1896 referencing Attorney Docket No. 348162-982350.

Respectfully submitted,

DLA PIPER US LLP

Dated: March 2, 2012

By: /Andy Schwaab/
Andrew B. Schwaab
Reg. No. 38,611
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UNITED STATES PATENT AND TRADEMARK OFFICE

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NOTICE OF ALLOWANCE AND FEE(S) DUE

94518 7590 03/19/2012

DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303

EXAMINER
WINDER, PATRICE L

ART UNIT	PAPER NUMBER
2452	

DATE MAILED: 03/19/2012

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	348162-982350	9980

TITLE OF INVENTION: ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	06/19/2012

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

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B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

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Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
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94518 7590 03/19/2012
DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303

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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	348162-982350	9980

TITLE OF INVENTION: ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	06/19/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
WINDER, PATRICE L	2452	370-401000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 .....
2
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(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

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- ☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number ..... (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
- ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	348162-982350	9980

94518 7590 03/19/2012

DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303

EXAMINER	
WINDER, PATRICE L	

ART UNIT	PAPER NUMBER
2452	

DATE MAILED: 03/19/2012

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 1748 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 1748 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 10/675,566	Applicant(s) LI ET AL.	
	Examiner PATRICE WINDER	Art Unit 2452	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *3-2-2012*.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *2-4 and 6-22*.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

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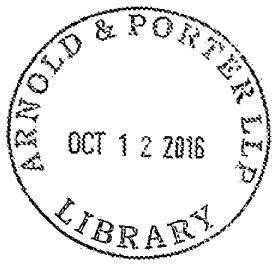
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2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
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9. ☐ Other _____.

/Patrice L Winder/
Primary Examiner, Art Unit 2452

Appendix H

IEEE 100
The Authoritative Dictionary of IEEE Standards Terms

Seventh Edition



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12-cv-00125-RC

Appendix H

direction of lay (cable) The lateral direction, designated as left-hand or right-hand, in which the elements of a cable run over the top of the cable as they recede from an observer looking along the axis of the cable. (PE/T&D) [4], [10]

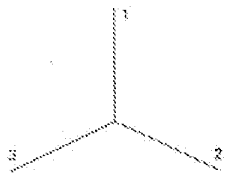
direction of polarization (of an elliptically polarized wave) The direction of the major axis of the electric vector ellipse. *See also:* elliptically polarized wave. (AP/PROP) 211-1997

direction of propagation (1) (A) (point in a homogeneous isotropic medium) The normal to an equiphase surface taken in the direction of increasing phase lag. *See also:* radiation. **(B) (point in a homogeneous isotropic medium)** The direction of time-average energy flow. *Notes:* 1. In a uniform waveguide the direction of propagation is often taken along the axis.X. 2. The directional response pattern is often shown as the response relative to the maximum response. *See also:* waveguide; radiation. (PE/EEC/MTT) [119], 146-1980

(2) (waveguide) The direction of time average energy flow in a given mode. *Note:* In the case of a uniform lossless waveguide, the direction of propagation at every point is parallel to the axis. (MTT) 146-1980w

(3) At any point in a medium, the direction of the time-averaged energy flow. *See also:* Poynting vector. (AP/PROP) 211-1997

direction of rotation of phasors (power and distribution transformers) Phasor diagrams should be drawn so that an advance in phase of one phasor with respect to another is in the counterclockwise direction. In the following figure, phasor 1 is 120 degrees in advance of phasor 2, and the phase sequence is 1, 2, 3.



direction of rotation of phasors
(PE/TR) C57.12.80-1978r

direction operation Operation by means of a mechanism connected directly to the main operating shaft or an extension of the same. (SWG/PE) [56], C37.100-1992, C37.30-1971s, C37.100-1981s

directive A line from a file that is interpreted by the batch server. The line is usually in the form of a comment and is an additional means of passing options to the qsub utility. (C/PA) 1003.2d-1994

directive gain* *See:* directivity.

* Deprecated.

directive gain in physical media In a given direction and at a given point in the far field, the ratio of the power flux per unit area from an antenna to the power flux per unit area from an isotropic radiator at a specified location delivering the same power from the antenna to the medium. *Note:* The isotropic radiator must be within the smallest sphere containing the antenna. Suggested locations are antenna terminals and points of symmetry if such exist. (AP/ANT) 145-1983s

directivity (1) (gain) The value of the directive gain in the direction of its maximum value. *See also:* antenna. (AP) 149-1979r

(2) (directional coupler) The ratio of the power output at an auxiliary port, when power is fed into the main waveguide or transmission line in the preferred direction, to the power output at the same auxiliary port when power is fed into the main guide or line in the opposite direction, the incident power fed into the main guide or line being the same in each case, and reflectionless terminations being connected to all ports. *Note:* The ratio is usually expressed in decibels. (IM/HFIM) [40]

(3) (of an antenna) (in a given direction) The ratio of the radiation intensity in a given direction from the antenna to the radiation intensity averaged over all directions. *Notes:* 1. The average radiation intensity is equal to the total power radiated by the antenna divided by 4π. 2. If the direction is not specified, the direction of maximum radiation intensity is implied. (AP/ANT) 145-1993

directivity factor (A) (transducer used for sound emission) (audio and electroacoustics) The ratio of the sound pressure squared, at some fixed distance and specified direction, to the mean-square sound pressure at the same distance averaged over all directions from the transducer. *Notes:* 1. The distance must be great enough so that the sound pressure appears to diverge spherically from the effective acoustic center of the transducer. Unless otherwise specified, the reference direction is understood to be that of a maximum response. The frequency must be stated. **(B) (transducer used for sound reception)** The ratio of the square of the open-circuit voltage produced in response to sound waves arriving in a specified direction to the mean-square voltage that would be produced in a perfectly diffused sound field of the same frequency and mean-square sound pressure. *Notes:* 1. This definition may be extended to cover the case of finite frequency bands whose spectrum may be specified. 2. The average free-field response may be obtained in various ways, such as by the use of a spherical integrator, by numerical integration of a sufficient number of directivity patterns corresponding to different planes, or by integration of one or two directional patterns whenever the pattern of the transducer is known to possess adequate symmetry. *See also:* microphone. (SP) [32]

directivity, partial *See:* partial directivity.

direct lighting (illuminating engineering) Lighting involving luminaires which distribute 90 to 100 percent of the emitted light in the general direction of the surface to be illuminated. The term usually refers to light emitted in a downward direction. (EEC/IE) [126]

direct liquid cooling system (semiconductor rectifiers) A cooling system in which a liquid, received from a constantly available supply, is passed directly over the cooling surfaces of the semiconductor power converter and discharged. *See also:* semiconductor rectifier stack. (IA) [62]

direct liquid cooling system with recirculation (semiconductor rectifiers) A direct liquid cooling system in which part of the liquid passing over the cooling surfaces of the semiconductor power converter is recirculated and additional liquid is added as needed to maintain the required temperature, the excess being discharged. *See also:* semiconductor rectifier stack. (IA) [62]

direct lookup A table lookup in which the position of an entry is computed as a function of its key value. (C) 610.5-1990w

directly controlled system That portion of the controlled system that is directly guided or restrained by the final controlling element to achieve a prescribed value of the directly controlled variable. *See also:* feedback control system. (IM/IA/IAC) [120], [60]

directly controlled variable (automatic control) The variable in a feedback control system whose value is sensed to originate the primary feedback signal. *See also:* feedback control system. (PE/ICTL/EDPG) 421-1972s

Directly Executable Test Oriented Language (DETOL) A test language used to control a specific type of automatic test equipment. (C) 610.13-1993w

directly grounded *See:* grounded solidly.

direct manipulation User manipulation of symbols in the display by direct interaction with the symbol. It is generally performed through the use of a display structure, such as a pointer, and a cursor control device, such as a mouse. (PE/NP) 1289-1998

direct memory access (DMA) (1) Access to data by which data is transferred directly between main memory and storage devices. (C) 610.5-1990w

(2) Ability of I/O controller modules to independently access memory. An I/O controller with DMA capabilities can access

commands, fetch data, and report status by accessing memory directly. (C/BA) 896.3-1993w

(3) A method for transferring data between an external device and memory without interrupting program flow or requiring CPU intervention. *Note:* The interface device takes control of the memory and transfers the data. *See also:* programmed input-output; direct memory transfer. (C) 610.10-1994w

(4) This refers to the ability of I/O controller modules to independently access memory. An I/O controller with DMA capabilities can access commands, fetch data, and report status by accessing memory directly. (C/BA) 896.4-1993w

direct memory access controller (DMAC) The block transfer processor used to implement direct memory access. (C) 610.5-1990w

direct memory control (DMC) *See:* direct memory transfer.

direct memory transfer (DMT) A method for transferring data between an external device and memory without interrupting program flow. *Note:* The CPU microcode flow is changed to a routine which transfers the data. *Synonym:* direct memory control. *See also:* direct memory access; programmed input-output. (C) 610.10-1994w

direct metric A metric that does not depend upon a measure of any other attribute. (C/SE) 1061-1998

direct metric value A numerical target for a quality factor to be met in the final product. For example, mean time to failure (MTTF) is a direct metric of final system reliability. (C/SE) 1061-1998

direct numerical control Numerical control in which a dedicated computer controls the operation of the parts programs in a single numerical control machine. (C) 610.2-1987

direct on-line starting (rotating machinery) The process of starting a motor by connecting it directly to the supply at a rated voltage. *See also:* asynchronous machine. (PE) [9]

direct operation Operation by means of a mechanism connected directly to the main operating shaft or an extension of the same. (SWG/PE) C37.30-1971s, C37.100-1992, [56], C37.100-1981s

direct orbit (communication satellite) An inclined orbit with an inclination between zero and ninety degrees. (COM) [19]

director element (1) (data transmission) A parasitic element located forward of the driven element of an antenna, intended to increase the directive gain of the antenna in the forward direction. (PE) 599-1985w

(2) A parasitic element located forward of the driven element of an antenna, intended to increase the directivity of the antenna in the forward direction. (AP/ANT) 145-1993

directory (1) (A) A list of data items and information about those items, used to reference the items; for example, the directory for each user's personal disk space contains an entry for each file within that space, and a reference to its physical location. *Contrast:* dictionary. *See also:* data directory; file directory. (B) *See also:* index. (C) 610.5-1990, 610.12-1990

(2) A contiguous collection of one or more entries, which is contained within the node's ROM. (C/MM) 1212-1991s

(3) A file that contains directory entries. No two directory entries in the same directory shall have the same name. (C/PA) 9945-1-1996, 9945-2-1993

(4) A repository of information about objects that provides directory services to its users, which allows its users access to the information. (PA/C) 1328.2-1993w, 1224.2-1993w, 1327.2-1993w, 1326.2-1993w

(5) A file that contains directory entries. No two entries in a directory shall have the same filename. (C) 1003.5-1999

directory-assistance call (telephone switching systems) A call placed to request the directory number of a customer. (COM) 312-1977w

directory attribute The information of a particular type concerning an object and appearing in an entry describing the object in the DIB. *Synonym:* attribute. (C/PA) 1328.2-1993w, 1327.2-1993w, 1224.2-1993w, 1326.2-1993w

directory attribute type That component of a directory attribute that indicates the class of information given by that attribute. It is an object identifier, and so completely unique. *Synonym:* attribute type. (C/PA) 1328.2-1993w, 1224.2-1993w, 1327.2-1993w, 1326.2-1993w

directory attribute value A particular instance of the class of information indicated by a directory attribute type. *Synonym:* attribute value. (C/PA) 1328.2-1993w, 1224.2-1993w, 1327.2-1993w, 1326.2-1993w

directory class *See:* object class.

directory entry (1) A ROM entry that specifies the address of another ROM directory. (C/MM) 1212-1991s

(2) An object that associates a filename with a file. Several directory entries can associate names with the same file. *Synonym:* link. (C/PA) 9945-1-1996, 9945-2-1993

(3) An object that associates a filename with a file. Several directory entries can associate different filenames with the same file. (C) 1003.5-1999

directory information base The complete set of information to which the directory provides access and that includes all of the pieces of information that can be read or manipulated using the operations of the directory. (C/PA) 1328.2-1993w, 1224.2-1993Ow, 1326.2-1993w, 1327.2-1993w

directory information tree The directory information base, considered as a tree, whose vertices (other than the root) are the directory entries. (C/PA) 1328.2-1993w, 1326.2-1993w, 1327.2-1993w, 1224.2-1993w

directory medium A medium that contains a distribution in a POSIX.1 hierarchical file system format. (C/PA) 1387.2-1995

directory number (telephone switching systems) The full complement of digits required to designate a customer in a directory. (COM) 312-1977w

directory-numbering plan (telephone switching systems) The arrangement whereby each customer is identified by an office and main-station code. (COM) 312-1977w

directory object Anything in some "world," generally the world of telecommunications and information processing or some part thereof, that is identifiable (can be named) and that it is of interest to hold information on in the directory information base. (C/PA) 1326.2-1993w, 1327.2-1993w, 1224.2-1993w, 1328.2-1993w

directory operation Processing performed within the directory to provide a service, such as a read directory operation; it is given some arguments as input, performs some processing, and returns some results. An application process causes a directory operation to be performed by invoking an interface operation. (C/PA) 1328.2-1993w, 1327.2-1993w, 1326.2-1993w, 1224.2-1993w

directory syntax *See:* attribute syntax.

directory system agent An OSI application process that is part of the directory. (C/PA) 1328.2-1993w, 1326.2-1993w, 1327.2-1993w, 1224.2-1993w

directory user agent An OSI application process that represents a user accessing the directory. *Note:* This may be composed of an arbitrary number of system processes and application processes, including the one or more that are the user(s). (C/PA) 1328.2-1993w, 1327.2-1993w, 1224.2-1993w, 1326.2-1993w

Appendix I

NEWTON's TELECOM DICTIONARY

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Brad Greene, Text Layout

reference level for the voltages of all other signals (such as RXD/TXD), except Frame Ground.

Signal Level The strength of a signal, generally expressed in either absolute units of voltage or power, or in units relative to the strength of the signal at its source.

Signal Processing Signal processing is a combination of computer telephony call control and media processing. Call control means moving telephone calls around — answering them, hanging up on them, transferring them, conferencing them, etc. — all the stuff you do on your office phone every day. Media processing means bringing computer power to bear on the media stream, the actual voice, video or data inside the phone call. You might save it to your hard disk. You might want to have your PC software listen for key words in what you saved, for example, the caller's phone number. You might even want your software to try transcribing the conversation into text you could use in your word processor. See Call Control, Digital Signal Processing, Media Processing and Native Signal Processing.

Signal Processing Component An SCSA definition. An atomic bundle of signal processing functionality which can be allocated to a single group. It can be capable of supporting the functionality of one or more resources or a simple coder.

Signal Processing Element An SCSA definition. That part of a Signal Processing Component which is associated with a single Resource.

Signal Processing Platform A SCSA definition. This is a software component that supports a specific hardware package. This is typically an executable program and may control one or more instances of the vendor-specific hardware package. Each SPP may support several different types of signal processing functionality clustered into SPCs.

Signal Repeaters A signal repeater does nothing more than receive a signal and retransmit it. Repeaters are used where the original transmission is very weak, or the transmission is being sent over long distances.

Signal Strength Indicator A display on a cellular radio that lets you know before you call about the relative strength of the cellular transmitter in your immediate area. On most cellular radios, the signal strength indicator has five bars, with five the strongest. It's best to call when you have four or five. Three is marginal. Below three, forget it. Go elsewhere and try again.

Signal Switching Point SSP. See SSP. For a full explanation of the Advanced Intelligent Network, see AIN.

Signal-to-noise-ratio 1. Often abbreviated as SNR or S/N. A measurement of the relative level of noise on a circuit and, therefore, the quality of a transmission. SNR is the ratio of the usable signal being transmitted to the noise or undesired signal. Human beings are fairly tolerant of noise, and within limits, can distinguish content from the "noise," but computer systems are not. If the level of extraneous noise is high in a data communications environment, data packets have to be re-sent. That not only slows down the data transfer, but also reduces the efficiency with which the circuit and network are used. SNR usually is measured in decibels (dB). See also dB.

2. The ratio between useful information and idle chatter to be found on an Internet Usenet newsgroup, bulletin board, or chat room. Often used derogatorily, for example: "The signal-to-noise ratio in this newsgroup is pretty low."

Signal Transfer Point The packet switch in the Common Channel Interoffice Signaling (CCIS) system. The CCIS is a packet switched network operating at 4800 bits per second. CCIS replaces both SF (Single Frequency) and MF (Multi-frequency) by converting dialed digits to data messages. See SCP, STP and Signaling System 7. For a full explanation of the Advanced Intelligent Network, see AIN.

Signals Signal being transmitted are information. They can be spoken words such as a telephone conversation, music, or even computer data. The simplest signal we can send is a sine wave. All sound waves are combinations of simpler sine waves of different amplitudes and frequencies to produce complicated wave forms. Similarly, computer data is a series of ones and zeros which electrically look like a square wave. Square waves, like all other types of waves, can be represented by a combination of sine waves with different frequencies and amplitudes. That a complex wave is the sum of simple sine waves was discovered by the French mathematician Jean Baptiste Joseph Fourier and is called Fourier's Theorem.

Signals Intelligence SIGINT. A federal government term. A category of intelligence information comprising, either individually or in combination, all communications intelligence, electronics intelligence, and foreign instrumentation signals intelligence, however transmitted. Signals intelligence is a polite term for reading someone else's mail. See NSA and SIGINT.

Signaling In any telephone system — inside an office or across the country — some form of signaling mechanism is required to set up and tear down the calls. When you call from your office desk across the country to someone else's desk, many forms of different signaling are used. There's the signaling between your office desk phone and your office phone system. There's the signaling between your office phone system and your local telephone company central office. And there's the signaling between your local central office and the central office you're trying to reach across the country. All forms of these signaling may be different. Simple examples of signalings are ringing of your phone (someone is calling), dial tone (it's OK to dial), ringing (hopefully someone will answer), etc.

Originally, telephone systems such as POTS (Plain Old Telephone Service) used in-band signaling to carry signals. With in-band signaling, signals such as DTMF tones (touchtones), are carried in the same circuit as the talk path. Newer signaling (i.e. most of it today) is carried as out-of-band signaling, which uses a separate data network. This is much more efficient. For example, voice circuits need not be allocated for calls that do not complete. Also, this approach allows additional quantities of information to be transferred to support advanced applications such as Caller ID, roaming in wireless systems, and 800 number routing. See Signaling System 7.

Signaling Connection Control Part SCCP. Part of the SS7 protocol that provides communication between signaling nodes by adding circuit and routing information to the signaling message. The ISDN-UP (Integrated Services Digital Network User Part) and TCAP (Transaction Capabilities Application Part) use the SCCP (Signaling Connection Control Part) and the MTP (Message Transfer Part) to transport information. Definition from Bellcore in reference to its concept of the Advanced Intelligent Network.

Signaling Gateway SG. A software-based device that resolves interface issues between circuit-switched and packet-switched networks. See also MGCP and SCTP.

Signaling Information Fields SIF. In SS7 (Signaling System 7) signaling messages, the SIF is a variable length field which contains all the signaling information. Also included is any routing information in the Routing Label, which the network uses to properly connect the call. Such signaling information might include the Calling Party Number (CPN) subfield, along with the Presentation Indicator (PI). The SIF contains 2-272 octets of data. See also Calling Party Number, Presentation Indicator, and SS7.

Signaling Link Selection Code SLS. The part of a routing label that identifies the SS7 signaling link on which the message should be sent.

Signaling Point A node in a SS7 signaling network that either originates and receives signaling messages, or transfers signaling messages from one signaling link to another, or both. SPs are located at each switch in a Signaling System 7 network. They interface the switch with the Signal Transfer Points (STPs). See Signal Transfer Points and Signaling System 7.

Signaling Point Code A binary code uniquely identifying a SS7 signaling point in a signaling network. This code is used, according to its position in the label, either as destination point code or as originating point code.

Signaling Point Interface SPOI. The demarcation point on the SS7 signaling link between a LEC network and a Wireless Services Provider (WSP) network. The point established the technical interface and can designate the test point and operational division of responsibility for the signaling.

Signaling System Number 1 SS1. A tone supervision system using a 500 Hertz tone modulated at a 20 Hertz rate to signal call requests between switchboards. International equivalent of Bell's 1000/20 manual ringdown signaling. Now obsolete.

Signaling System Number 2 SS2. A two-tone (600/750 Hertz) tone system for dial-pulsing selection information. Never used internationally. Closely akin to early Bell mobile radiotelephone dialing systems. Now obsolete.

Signaling System Number 3 SS3. A single-frequency (2280 Hertz) tone system used on one-way circuits only. Not intended for transit connections involving a third nation. A prime method through the late 1970s. Now obsolete.

Signaling System Number 4 SS4. A two-tone (2040 and 2400 Hertz) system for international transit and terminal traffic. The first truly global "direct dialing" signaling system. Now obsolete.

Signaling System Number 5 SS5. A two-tone (2400 and 2600 Hertz) system combined with multifrequency inter-register signaling for both terminal and transit traffic. Closest international equivalent to North American Bell "DDD trunks using SF supervision." Now obsolete.

Signaling System Number 6 SS6. A common digital data path between two switching machines to negotiate and oversee connection control on transmission facil-

EXHIBIT 9

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ENTROPIC COMMUNICATIONS, LLC, Plaintiff, vs. CHARTER COMMUNICATIONS, INC., Defendants.	Civil Action No. 2:22-cv-00125-JRG

VIDEOTAPED REMOTE DEPOSITION OF
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Friday, April 28, 2023
Volume I

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PAGES 1 - 162

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ENTROPIC COMMUNICATIONS, LLC.,
Plaintiff,
vs.
Civil Action No.
2:22-cv-00125-JRG
CHARTER COMMUNICATIONS, INC.,
Defendants.

Videotaped remote deposition of KEVIN ALMEROTH, PH.D., Volume I, taken on behalf of Plaintiff with all participants appearing remotely via videoconference and the Deponent testifying from Santa Barbara, California, beginning at 9:03 a.m. and ending at 2:31 p.m. on Friday, April 28, 2023, before Melissa M. Villagran, RPR, Certified Shorthand Reporter No. 12543.

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INDEX

DEPONENT	EXAMINATION
KEVIN ALMEROTH, PH.D.	
Volume I	
BY MS. ALLOR	8

EXHIBITS

DEPOSITION		PAGE
Exhibit 1	Deposition Notice	15
Exhibit 2	Declaration	15
Exhibit 3	'775 patent	23
Exhibit 4	Excerpts from a Microsoft Computer Dictionary, 3rd Edition	65
Exhibit 5	Webster's New World Computer Dictionary 10th Edition	94
Exhibit 6	'690 Patent	119

INDEX (CONTINUED)

EXHIBITS

DEPOSITION	PAGE
Exhibit 7 '682 patent	136

INFORMATION REQUESTED

(None.)

INSTRUCTION NOT TO ANSWER

(None.)

Santa Barbara, California; Friday, April 28, 2023

9:03 a.m.

THE VIDEOGRAPHER: Good morning. We are on record at 9:03 a.m., April 28, 2023. This is the video-recorded deposition of Dr. Kevin Almeroth. My name is Dustin Brown here with our court reporter Melissa Villagran.

This deposition is being held remotely. The caption of this case is Entropic Communications, LLC versus Charter Communications, Incorporated. 09:03:24

Please note that audio and video recording will take place unless all parties agree to go off the record. If there are any objections to the proceeding, please state them at the time of your appearance beginning with the noticing attorney. 09:03:40

Appearances, please.

MS. ALLOR: Katie Allor from K&L Gates on behalf of the plaintiff, Entropic Communications, LLC, and with me today are my colleagues, Jason Engel and Connor Meggs. 09:03:51

MR. BENYACAR: David Benyacar with the firm of Arnold & Porter representing Charter Communications.

KEVIN ALMEROTH, PH.D.,

having been administered an oath, was examined and testified as follows:

EXAMINATION

BY MS. ALLOR:

Q Okay.

Good morning, Dr. Almeroth.

A Good morning.

Q Have you been deposed before? 09:04:23

A Yes, ma'am.

Q How many times?

A North of 100.

Q So you would say you are pretty good at giving depositions? 09:04:38

A I've had a lot of practice. I don't know that I'd say I'm necessarily very good.

Q Okay.

Well, I'm just going to go over some quick ground rules with you just today so we're all on the same page. Since we're on Zoom and sometimes it can be a little -- you know, the signal can go in and out, if you can't hear me or can't understand a question, would you ask me so I can repeat it, and same thing if the court reporter can't hear us. 09:04:49 09:05:03

we'll ask that she lets us know so that we can repeat what we're saying.

Is that fair?

A Yes.

Q And, again, you know, since we're, you know, at -- in a deposition, we need to give oral answers. We can't nod our head or shake. The court reporter needs to you answer for her. 09:05:11

Is that fair?

A Yes. 09:05:23

Q And since it's on Zoom, it's -- sometimes it's a little hard to talk over each other. So we got to make sure -- you have to let me finish my question. I'm going to let you finish your answer unless your attorney, you know, objects accordingly if they need to. 09:05:35

Is that fair?

A Yes.

Q So we're here today regarding a declaration you gave on claim construction; is that right? 09:05:45

A Yes.

Q And this declaration is directed to three different patents. The first patent is U.S. 8,223,775.

Is it -- is it all right with you if I refer 09:06:03

Page 10

to that as the '775 patent?
A Yes.
Q And then the second patent is U.S. 8,284,690, and I'm going to refer to that as the '690 patent.
Is that all right with you? 09:06:19
A Yes.
Q And then the third patent is U.S. 10,135,682. And I'll refer to that as the '682 patent.
Is that all right with you?
A Yes. 09:06:34
Q So your opinions are directed only to those three patents?
A In this declaration, I believe that is the case.
Q Did you look at the other patents that are involved in this case? 09:06:44
A I might have looked at them at some point. I don't specifically remember.
Q Do you intend on offering any opinions relating to the other three patents that are being litigated as well? 09:06:59
A I don't have any knowledge about what I might be asked to do in the future.
Q Are you planning to present a technical tutorial to the Court? 09:07:19

Page 11

A I don't have plans one way or another. I don't know the answer to that question as I sit here right now.
Q Earlier you said you've been deposed around 100 times. 09:07:34
Have all those been for patent cases?
A No.
Q What other types of cases have you been involved in?
A I believe there's been a couple of trade secret cases a couple of copyright cases. 09:07:45
Q Have you been involved in any IPR proceedings at the U.S. Patent Office?
A Yes.
Q Are you planning to be involved in any IPRs for Charter? 09:08:02
A I don't have plans one way or another as I sit here right now.
Q Are you planning to give an infringement or -- sorry, a non-infringement opinion in this litigation? 09:08:20
A As I sit here now, I don't have plans one way or another.
Q What did you do prepare for today?
A Generally reviewed my declaration and 09:08:31

Page 12

materials cited in the declaration, the patents, Dr. Kramer's declaration, and met with counsel, Mr. Benyacar.
Q And about how long did you spend reviewing materials? 09:08:51
A Maybe about eight to ten hours. I don't have a good estimate for you.
Q And how long did you meet with counsel for?
A I think it was part of that time, maybe six to eight hours. 09:09:12
Q And was there anyone else present besides David?
A I don't believe so.
Q When were you engaged by Charter for this matter? 09:09:28
A My best recollection is it would have been sometime earlier this year.
Q And have you ever worked for Charter in the past?
A Yes. 09:09:44
Q What type of case was it?
A I believe that there were two of them. One they were sued by Sprint for patent infringement and then also they were accused of copyright infringement by a plaintiff representing copyright 09:10:08

Page 13

holders for things like songs, music.
Q And have you ever worked with Arnold & Porter, the attorneys representing Charter in this matter?
A Yes, I have. 09:10:30
Q And what -- what cases have you worked with them outside of the ones that you mentioned for Charter?
A I actually know that I worked with them on the Sprint case. I'm not sure I worked with them on 09:10:44
the other case, and then I've worked with them probably a couple of additional times on other cases. I don't have particular cases in mind, though.
Q Have you spoken with any other experts that Charter has engaged in this -- for this matter? 09:10:59
A I don't believe so.
Q Have you talked to anyone by the name of Kathleen Quigley?
A I don't believe so. I don't recall doing so 09:11:15
sitting here right now.
Q Have you spoken with anyone outside of the attorneys at A&P regarding this matter?
A I don't believe so. I don't remember anyone sitting here right now. 09:11:39

Page 14

Q So no one directly at Charter? You have not been in contact with anyone directly at Charter?
A I don't believe so especially as it relates to the subject matter of these patents.
Q What did you do to prepare your declaration? 09:11:59
A Reviewed the patents, the other materials that are identified within the declaration, determined what the scope of my assignment was, and then formulated opinions.
Q Did you have input on what terms were going 09:12:29 to be involved in claim construction?
A As I sit here now, I don't specifically recall if I did or not. I might have and -- and don't specifically remember.
Q Were there terms that you suggested for 09:12:47 construction that were not put in your declaration?
A I don't believe so, or at least sitting here now, I don't specifically recall.
Q Did you write the first draft of your declaration? 09:13:10
A I would have.
Q About how many hours have you spent or did you spend drafting your declaration?
A I don't have an ability to separate out hours spent drafting versus developing opinions. All told 09:13:24

Page 15

I think it was in the neighborhood of about 20 hours plus or minus.
Q I'm going to introduce your -- sorry. I previously marked as Exhibit 1 your deposition notice, so that should be in your exhibit folder: 09:13:42
(Exhibit 1 was marked for identification and is attached hereto.)
MS. ALLOR: I'm now going to mark as Exhibit 2, your declaration. 09:13:53
(Exhibit 2 was marked for identification and is attached hereto.)
BY MS. ALLOR:
Q And due to the file size, once I do get it 09:14:05 introduced, I would recommend downloading it because it is quite large because it might be easier to use that.
A Great. I'll do that as soon as it shows up.
All right. 09:14:22
It just showed up. I am downloading it.
Q One thing I forgot to cover in the beginning since we are on Zoom and you are on your computer, I want to make sure you don't have any web pages open besides the ones that are through Veritext. 09:14:41

Page 16

Is that fair?
A Absolutely.
I've -- I've actually got three windows open. One is Exhibit Share. One is the Zoom and I actually have the PDF for Exhibit 1 open. 09:14:55
But that's it. No other forms of communication, that kind of thing.
Q Great.
A Downloaded what you've marked as Exhibit 2, and I've got it opened. 09:15:09
Q Great.
And just sort of a follow-up to your computer stuff, you're not going to be accessing your e-mails during the course of our deposition today.
Is that fair? 09:15:18
A Yes, I will not do that.
Q Okay.
So if you could just go to the last page of Exhibit 2 and just confirm -- well, actually not the last page -- the last page of your actual 09:15:33 declaration of the appendix and just confirm that is your signature.
A Yes. It looks like Page 44. Yes, that is my signature.
Q In preparing for today, did you find any 09:15:51

Page 17

errors in your declaration that you wish to correct?
A I -- in preparing for today, I did not find anything that I thought needed to be corrected.
Q And I believe we have your CV attached as Appendix A. If you could turn to that. 09:16:13
A Okay.
I have it up.
Q Does your CV accurately reflect your education?
A I believe it does. 09:16:22
Q Does it accurately reflect your work experience?
A I believe it does.
Q Is there anything that's missing from your CV that would be relevant to the proceedings today? 09:16:35
A Not that I can think of. It looks to be pretty accurate in terms of the things that normally get added over time. So the very end of the declaration which identifies cases that I've been deposed in, I believe that was accurate as of the 09:16:56 time this declaration was filed. There might be a couple of other cases, and then with respect to some of the service work that I do serving on program committees, there might be a couple of additional program committees for some of the conferences that 09:17:14

are listed there, but I think otherwise, it's -- it's accurate.

Q. Would any of the more recent cases that may not be listed, would any of those have to do with cable television signal processing and communication systems? 09:17:29

A. I don't believe so.

Q. Besides for this current case that you're involved in, what other cases would involve technology relating to cable television, signal processing and communication systems that are listed on your CV? 09:17:46

A. I could go through and try and identify the ones. I suspect the first case with Charter would be relevant. 09:18:24

Let me just ask for clarification. Do you want me to go and potentially identify cases that would be relevant.

Q. I was just curious if any came up in your mind or in looking at your list that -- that relate to cable television, signal processing and communications? 09:18:47

A. Okay. Certainly the Sprint versus Charter one. I think there's also a Comcast versus Row V (phonetic). 09:18:57

That was a little bit higher layer in the protocol stack, but it was cable related.

There's the Sony Music. I think Cox is on here. Charter should be on here somewhere.

Those related more to the content delivery itself, though, of course, that content has to be processed, and the content is sent over DOCSIS. So those might potentially be related. Those are the ones that come to mind. 09:19:18

Any of the ones on the list for -- I think there was Cox, Charter. Let's see if Comcast is on here. 09:19:42

There's a Comcast IPR against Row v. Guides (phonetic). That might have some -- some relevance as well. So generally it's some of the different cable providers, Comcast, Charter, Cox, those kinds of companies. 09:20:01

Q. And besides doing expert witness work on those cases for those companies, have you ever worked in the cable TV industry? 09:20:26

A. Not as I would characterize as an employee. But I've had collaborations with a number of different companies who were working in this space and then also, you know, working on some of the underlying technologies as an academic researcher. 09:20:55

I've had that kind of experience.

Q. Would any of these collaborations involve developing the cable TV systems, whether that be, you know, the broadband communication systems or solutions? 09:21:20

A. Generally I have -- would have worked on the technology itself as opposed to kind of the last steps of, say, the manufacturing process for any equipment that the various companies have worked on or developed or used. 09:21:48

Q. If we could go to Exhibit 2, your declaration, Paragraph 27.

Here you give a definition of a POSITA for this proceeding, if you could look at that.

A. Yes, I've got that up. 09:22:13

Q. So which part of this definition do you contend that you qualify as a POSITA under?

A. All of them.

Q. So you worked in the field of cable television signal processing and communication systems for three or more years? 09:22:49

A. Yes, ma'am.

Q. And is that the work you were talking about, the collaboration work, or are you referring to your expert witness work? 09:23:01

A. I am referring to both of those things plus working in the field as a researcher since at least 1994.

Q. If you look at Paragraph 25 of your declaration. 09:23:31

A. Yes.

Q. So there you list the materials that you reviewed in preparing your declaration. Is there anything missing from this list?

A. As of the time that I filed this declaration, I believe this list is complete especially in the context of referencing materials that are -- that are part of the declaration cited in the declaration. 09:23:42

Q. Were you asked to search for dictionaries or other extrinsic evidence that was not included with your declaration? 09:23:58

A. I don't specifically recall. I think that the things included in the declaration are ultimately what I relied on in forming my opinions, plus my knowledge and experience in the field. 09:24:22

Q. There's a couple dictionaries included as appendices -- sorry -- subject dictionaries included as appendices to your declaration. For example, Appendix B is Newton's Telecom Dictionary. 09:24:42

Did you locate that dictionary for counsel?
A I don't specifically recall. I don't think so. Obviously there are some dictionaries that are commonly used in claim construction. I think that's one of them, so... But I don't specifically recall 09:25:09
suggesting that one.
Q What about Appendix C, which is the Microsoft Computer Dictionary?
Is that one that you suggested to counsel to use for your declaration? 09:25:24
A I think it's about the same answer. I don't think that I did. I don't specifically recall that I did, but it's one that I have seen and used in my work.
Q So I want to start with your opinion on the 09:25:37
'775 patent. So I will introduce that for you so you have it available.
A It just appeared.
Q Shoot. The label didn't get on there. We'll -- we'll fix that afterwards. It didn't apply 09:26:19
the label.
A Okay. It's in the file name. I should be able to refer to it.
But, yes, I've got it open.
Q Okay. 09:26:28

So we've got -- we've got the '775 patent, which has been marked as Exhibit 3.
(Exhibit 3 was marked for identification and is attached hereto.) 09:26:33
BY MS. ALLOR:
Q And it also bears the Bates No. Entropic_ Charter_0000001.
When you were preparing your declaration and opinion with respect to the '775 patent, what date 09:26:52
did you use as the priority date?
A My recollection is I assumed for purposes of the priority date, the filing date September 30th, 2003.
Q And did you identify that anywhere in your 09:27:09
declaration?
A I don't have the declaration memorized. It's either there or it's not.
Q And so you were -- you were basing your opinion on that priority date; is that correct? 09:27:32
A For the '775, that's what I had assumed.
Q And you would agree that as of that priority date, September 30, 2003, a POSITA would have been familiar with DOCSIS function?
A I think that's reasonable. 09:27:54

Q If you look at Appendix C of your declaration, the Microsoft Computer Dictionary, one of the pages that you included was actually a definition for DOCSIS.
It's on actually two different pages. The 09:28:13
first one is the full, data over cable service interface specification, and then on the next page it says the actual definition for DOCSIS.
Do you see those?
A I do. 09:28:28
Q Is there a reason you didn't cite to these definitions in your declaration?
A Not that I can think of.
Q Was there a purpose for including them in the appendix? 09:28:43
A I'm trying to see if there was something else on the page that was specifically referenced that might have been the reason. But not that I specifically recall.
Q If we turn to Paragraph 40 of your 09:29:04
declaration.
A I'm there.
Q Here you've included an image and then you are discussing an ARM processor.
A Yes. 09:29:31

Q Is that correct?
A Yes.
Q What is your understanding of an ARM processor?
A Essential what's here, it's Advanced RISC 09:29:35
Machine. RISC stands for reduced instruction set computer -- controller, I think. I don't remember exactly what the c is. But you can have specialized ARM processors to perform functions for whatever they are designed to include. 09:29:57
Q So what is an Advanced RISC Machine?
A I'm not sure what else you would be asking for in terms of the description.
Q Well, there's a definition included in Appendix C that you provided with your declaration. 09:30:28
Are those -- if you turn to Appendix C, Microsoft Computer Dictionary, Pages 21 has Advanced RISC.
Is that a fair definition for it?
A I think it's on Page 35 at the top. Let me 09:30:50
read it.
I mean, I think it's a definition for what an ARM is. I haven't specifically taken a position or offered a particular construction for that term.
I don't recall that it's -- maybe it appears 09:31:30

Page 26

in one of the dependent claims or -- or something. But I certainly think it's the definition that's included in that dictionary.

Q And did -- was there a reason for including these pages of the dictionary, the one that has both Advanced RISC and ARM, is there a reason for including those with your declaration? 09:31:52

A I think the declaration pretty much speaks for itself on why they were included in terms of providing some context for understanding what the specification discloses with respect to the alleged invention. 09:32:07

Q So are you -- are you saying you relied on these definitions in your declaration?

MR. BENYACAR: Object to the form. 09:32:26

THE DEPONENT: To the extent that I have identified these definitions in the declaration to support the paragraphs in which those descriptions appear, that would be the context for how I have used those definitions in my declaration. 09:32:44

BY MS. ALLOR:

Q Oh, so you -- you do cite to Appendix C at 35 in Paragraph 40 of your declaration, but there's no citation that I can find to para- -- to Page 21 of that dictionary. 09:33:14

Page 27

So I guess my question is, why -- why did you include the Page 21 that has the definition of Advanced RISC?

A I think it provides some background, some context for what's described in the declaration. 09:33:36

Q So you would say it's a fair definition that a POSITA would -- would find this to be a fair definition for Advanced RISC?

A With respect to a fair definition or a kind of formal definition, I don't think I've taken a position that that's what the term should be defined as specifically. It's really just providing some background. 09:33:51

It's not, that I call, a term in a particular claim that I looked at. So it -- it's not a really formal construction that I would be offering, but I think the -- the dictionaries that are included in the definition, they do provide some context for what a person of skill in the art would have understood an ARM processor to be. 09:34:13 09:34:28

Q And so it's fair to say that these two definitions that are included in the Microsoft Computer Dictionary would be -- would be the plain and ordinary meaning to a POSITA of an ARM?

A Yeah. I think that's -- that's different 09:34:57

Page 28

than what I said in my previous answer. I'm not sure I have developed an opinion about whether or not they would be a plain and ordinary meaning that I -- that I've offered that kind of analysis or opinion in the declaration. 09:35:15

Q Would you agree that ARM processors were widely known in the art in the time period of the '775 patent?

A Well, I think they were certainly known and referenced with respect to qualifying that -- to be saying widely known or not, I think they were certainly known to people of skill in the art. They were probably widely known. I don't think I've taken a formal position on that. 09:35:39

Q So if a POSITA was reading a reference from that time period and they saw the -- the phrase ARM processor, they would understood what that meant, right? 09:36:02

A That's a little bit broader statement and it really depends on what kind of ARM processor and in what context. 09:36:19

I think a person of skill in the art reading ARM in the context of the '775 patent would understand how that term is used in the '775.

Q So if we could turn to Figure 1 of the '775 patent. 09:36:47

Page 29

A Okay.

Q And if you look at the block -- the first block at the top that's labeled "data networking engine," and I will probably refer to that as DNE. Is that okay with you? 09:37:00

A Yes.

Q So you see the DNE and there's, in parentheses, ARM No. 3?

A Yes. 09:37:12

Q What would that mean to a POSITA when they were looking at the '775 patent?

A I believe it's described in the specification. Let me -- well, I think there's references -- I mean, 114 talks about an ARM processor. That's around Column 3. And then in column 4 it basically just says ARM1 and ARM2, and it doesn't specifically call out ARM3. That's kind of the additional processor described around Line 62. 09:38:14 09:38:43

So I mean there's a couple different places in the specification where it just generally references the use of an ARM processor.

Q And so the next -- the next block down is -- there's three boxes within a box called "Cable Modem 09:39:03

Engine."
A Yes. I see that.
Q And is it -- is it all right with you if I refer to the cable modem engine throughout our discussion as the CME? 09:39:17
A Yes. That's fine.
Q Okay.
And so CME is labeled as Box 110.
A I see that.
Q Would you -- would you agree that there is 09:39:26 two processors listed as ARM1 and ARM2 within that CME?
A There are two -- at least two processors, ARM1, ARM2. I had actually looked to see whether or 09:39:46 not Box 112 is described as a processor of any type and I -- I didn't see that the specification ever said that it was. So it looks like there's really just the two.
Q And would a POSITA looking at the CME and the ARM1 and ARM2, would they know what was being 09:40:18 referred to there?
A That question is a little bit vague with respect to would they know what's being referred to.
They would see the reference to ARM1 and ARM2. I think based on the specification there 09:40:36

would be an understanding that those would be processors specific to what's labeled as the DOCSIS controller and the DOCSIS MAP processor respectively.
But with respect to would they know what the 09:40:52 DOCSIS controller was or what functions it performed, I think you'd have to look at the specification, since I think I've opined those are not terms of art, and there is some overlap between what the specification describes and then that 09:41:14 becomes somewhat problematic, I think, which is one -- one of bases for my indefiniteness opinions.
Q So I think you were looking at Column 3 when you answered a question for me earlier and pointing to the ARM processors that are described there. 09:41:29
Is that fair?
A Yes. I did point to Column 3.
Q And at line -- Column 3, Line 17, it says (as read):
"Processor 114 is an ARM9 09:41:47 TDMI-based RISC processor."
Do you see that?
A I do.
Q What does that phrase, ARM9 TDMI based RISC processor mean to you? 09:42:04

A It's just describing a particular type of ARM processor.
Q And is there a significance to the word "based" in that phrase?
A I'm not sure what you're asking. It says 09:42:25 based, so it would be for the particular type of ARM processor there's some characteristics beyond just a general ARM processor. And so saying that it's -- it's based would indicate that it's describing maybe processors within that family of processors. 09:42:55
Q So is it fair to say that RISC processors are a family of a type of processors?
A It depends.
Q What does it depend on?
A Which processors you're talking about, 09:43:16 whether they have families, whether or not you consider the different versions of the processors to be in the same families. It depends.
Q Is it fair to say an ARM processor is just a processor that implements a particular ARM core? 09:43:34
A It depends on the context in terms of how much specificity you need or want in providing a description as to what the processor is.
Q So the ARM9 TDMI, is it fair to say that that refers to a family of general purpose 09:44:04

microprocessors?
A I don't believe I've taken a position on whether or not they are general purpose or not. In a general sense, someone can probably characterize them as general purpose. 09:44:35
Q So as of the priority date of the '775 patent, September 30, 2003, is it fair to say that there were many known types of general processors?
MR. BENYACAR: Object to the form. 09:44:55
THE DEPONENT: I haven't really tried to answer that question. I suppose it depends on what you would consider a general processor, what would be considered many. So it -- it probably depends.
BY MS. ALLOR: 09:45:21
Q Well, as a POSITA, what would you consider a general processor to be?
A I haven't really tried to define that term in the context of these patents or established some threshold for determining what's a general processor 09:45:33 versus not.
Q You can't provide me with an explanation as a POSITA of what a general processor is as of 2003?
A With respect to some formal definition, I don't believe I've included it in the declaration. 09:45:52

Page 34

So I'm not really prepared to give you a formal opinion on the fly.
Q What is a circuit?
A That is a good question. It really doesn't have a particular definition in the context of the '775 patent. 09:46:16
I think as my declaration says, there's particular definitions of what a circuit can be and then trying to understand what that term means with any kind of reasonable certainty in the '775 patent becomes difficult, if not impossible. 09:46:40
Q There's no known definition for a circuit as of 2003?
MR. BENYACAR: Object to the form.
THE DEPONENT: That's not what I said. 09:47:04
BY MS. ALLOR:
Q If you turn to Appendix C at Page 100 of your PDF exhibit -- Exhibit 2 of your declaration, you've included a definition from the Microsoft Computer Dictionary for a circuit. 09:47:27
Isn't that right?
A Appendix B is Newton, so maybe Appendix C.
Q I'm sorry. Appendix C. C. On Page 100.
A Yes. I've included that definition of circuit and referenced in Paragraph 65 of my 09:47:49

Page 35

declaration.
And I think attempting to apply that definition of circuit in the context of the '775 patent leads to problems with understanding what the scope of the claims are and the fact that 09:48:11
there's isn't reasonable certainty as to what the scope of the claim would be trying to apply this kind of definition.
Q So my question was actually: Is that what a circuit is? 09:48:31
Is that definition you have provided in Appendix C, where it says (as read):
"Circuit, No. 1, any path that can carry electrical current.
Number 2, the combination of 09:48:41
electrical components interconnected to perform a particular task."
Are those definitions of circuits?
MR. BENYACAR: Objection. You didn't read the whole definition. 09:48:52
BY MS. ALLOR:
Q Oh, I'm sorry. (As read):
"At one level a computer consists of a single circuit, at another it consists of hundreds of interconnected 09:49:00

Page 36

circuits."
A So I -- I think that is a definition of circuit and I think applying that kind of definition in the context of the claims at issue in the '775 creates a problem of what the reasonable certainty 09:49:14
of the scope of the claims are for the reasons set forth in the declaration.
Q That analysis you've done in your declaration, that's really an infringement analysis not a claim construction? 09:49:31
MR. BENYACAR: Object to the form.
THE DEPONENT: I -- are you asking me or is that your characterization?
BY MS. ALLOR:
Q Yeah. Yes. I'm asking. 09:49:42
A I -- I disagree.
Q So the question in claim construction is whether or not a POSITA would understand the term, and are you telling me that you don't understand what a circuit is? 09:49:56
A I disagree with your characterization of the question. It's not -- the question of indefiniteness is not whether or not a definition for a term would have existed, but whether or not a person of skill in the art, at the time of patent, 09:50:14

Page 37

could determine the scope of the claim with reasonable certainty.
So this definition demonstrates that there is ambiguity with respect to how the claim is describing and claiming a circuit. Given that it 09:50:32
could mean lots of different things, a person of skill in the art would not know how to interpret what a circuit was in the context of the claims.
Q But a POSITA reading the '775 patent would know what a circuit is and would understand that 09:50:56
this definition you provided are two possible definitions for a circuit; is that correct?
A A person of skill in the art reading the specification would have in mind what a circuit is consistent with what I think I've identified in 09:51:13
Paragraph 65, but that definition results in unreasonable certain -- uncertainty with respect to what the scope of the claims are and how the claims are claiming a circuit. The claims don't say what a circuit is supposed to be in the context of the 09:51:32
alleged invention.
And so the -- part of the definition demonstrates the range of ambiguity -- sorry -- the range of possible definition for what a circuit could be. I think focusing on -- it has lots of 09:51:50

Page 38

different definitions at different levels.
So at one level it can mean a single circuit, at another it could be a set of hundreds of interconnected circuits. It could be a circuit board, it could be a whole chip. And so the specification doesn't say which level of the circuit to use in understanding what the scope of the claims are. And so that results in unreasonable certainty or uncertainty with respect to what the scope of the claims are. 09:52:04 09:52:31
Q So if the court were to construe the term circuit with respect to the '775 patent according to this first definition given in the Microsoft Computer Dictionary, the definition says (as read):
"Any path that can carry electrical current." 09:52:45
Would it be your opinion that the claim -- the claims are indefinite if that is the definition of circuit?
A Yes. 09:52:57
Q So you wouldn't be able to define the boundaries of the first and second circuit based on this definition?
A It's not the boundaries of -- of any circuit.
If we look at the '775 patent, for example 09:53:14

Page 39

claim 1, you have a data network engine implemented in a first circuit, you have a cable modem engine implemented in a second circuit, and so those have to be separate from each other.
And -- and that becomes the issue with respect to how do you define what's part of the data network engine circuit and what's part of the cable modem engine circuit, and then trying to understand how those are supposed to be separate. 09:53:36
Q And I believe you turned to claim 1, but I don't think claim 1 is at issue here. 09:53:55
So is your opinion the same with respect to claim 18?
A Yes.
Q So if the construed circuit to mean any path that can carry electrical current, it's your opinion that a data networking engine implemented in a first circuit would be indefinite? 09:54:15
A Yes.
Q And the same question with respect to a cable modem implemented in the second circuit. 09:54:36
It's your opinion that if the court applied that first construction from the dictionary, that that -- that term would be indefinite?
A That term would be indefinite with respect to 09:54:48

Page 40

understanding what the scope of the claims is especially in the context of how the second circuit has to be separate from the first circuit.
Q Well, the claims itself -- claim 18 itself says it would be separate -- separated by a data box, correct? 09:55:11
MR. BENYACAR: Object to the form.
THE DEPONENT: I don't think claim 18 is saying that the data bus establishes what the separate requirement is, that just having a data bus between the two would be sufficient to establish the separateness between the first circuit and the second circuit. 09:55:30
In fact, I think that was an issue I've addressed in the declaration as it relates to the prosecution history. 09:55:44
BY MS. ALLOR:
Q I don't think that was my question though.
My question was: If we apply this first construction and you look at the -- the language of the claim, there's a data networking engine implementing -- or implemented in a first circuit and then we've got a cable modem implemented -- a cable modem engine implemented in a second circuit, and then we have got a data bus that connects the 09:55:54 09:56:11

Page 41

data networking engine to the cable mode engine.
So my question is: If we're applying the definition of circuit that says any path that can carry electrical current, can you not identify where the first circuit and the second circuits are? 09:56:25
A You're question implies that you have a system and you're attempting to apply the claim against that system.
While there might be examples of systems where you could identify a first circuit and a second circuit, the problem with using that definition of circuit, a person of skill in the art is not able to determine with reasonable certainty what the scope of the claim is with respect to what constitutes the first circuit and what would constitute the second circuit. And that's particularly problematic when there's a claim requirement that the second circuit be separate from the first circuit. 09:56:48 09:57:00
What the claim -- the patent doesn't specify what's required for that separateness to be achieved and so that has an impact on how you apply or what could constitute a first or a second circuit. 09:57:16
Q If we look at the second definition (as read): 09:57:38

Page 42

"A combination of electric components interconnected to perform a particular task," ignoring the second half of that, if the Court were to apply that definition, would the 09:57:51
term -- would the term in a first circuit and in a second circuit still be indefinite too?
MR. BENYACAR: Object to the form.
THE DEPONENT: The phrases as to a first 09:58:06
circuit that includes at least one processor and then continues from there and then a cable modem engine implemented in a second circuit and that it be separate from the first and second circuit, I think it would be separate even if person skilled in 09:58:26
the art even attempting to apply that second definition would recognize there's uncertainty with respect to what the scope of the claim should be.
BY MS. ALLOR:
Q So a POSITA wouldn't be able to read the 09:58:41
specification and understand that the first circuit, the data networking engine, would be implementing tasks differently or different tasks from the cable modem engine that's implemented in the second circuit? 09:59:00

Page 43

A So two things. Reading the specification, there's no description of what a circuit is. I don't think the term "circuit" is used anywhere except in the claims.
With respect to a person of skill in the art 09:59:10
understanding what the functions are, certainly there are exemplary functions for each of those two engines, but that doesn't help inform a person of skill in the art as to what the scope of the circuit would include. 09:59:33
And even applying the second definition that says (as read):
"A combination of components interconnected to perform a particular task," there's no context 09:59:41
provided in the specification as to where -- where that circuit would end especially where those two circuits have to also be separate.
And so it becomes problematic to understand 09:59:59
what the scope of the claim is with respect to what would constitute the required circuits and the required separateness.
Q You said there's no description of what a
circuit is in the specification. 10:00:18

Page 44

Is that -- is that fair?
A I don't believe the specification uses the term "circuit." So I don't know that it provides any context for how that term should be understood in the specification or the... 10:00:34
Q But you would agree that a POSITA at the time of invention in 2003, someone with three years of experience and an undergraduate degree in electrical engineering would understand what a circuit is?
A They would understand -- they would 10:00:55
understand that there's definitions of circuits that are quite broad and non-specific as to what the scope of a circuit would include.
As the definition says, it could -- there's a lot of different levels at which you could determine 10:01:13
what a circuit would be, and the patent doesn't provide any guidance on which of those levels to use.
And so it's unclear what the scope of a circuit would need to be in order to meet the 10:01:26
requirements of Page 18 and 19.
Q But they would at least have an understanding of the different types of circuits, correct?
A I think a person of skill in the art would understand that there are many different levels at 10:01:44

Page 45

which circuits can be identified, and it requires context to understand which level is appropriate in describing what a circuit is and that the specification doesn't provide any guidance on what level the claims should be understood to be read at. 10:02:02
Q Would a POSITA understand a processor to be a circuit?
A I think a POSITA would understand that in some context a processor could be a circuit. That's one of the levels that is possible, but then that 10:02:23
creates problems in the context of how the specification in the invention is described. I think I've identified some of those in the declaration.
Q Would a POSITA view a computer as a circuit? 10:02:36
A I think at one level it could be -- a computer could be a circuit. A chip, a board, a set of transistors, all of those are different levels that could be considered a circuit.
And it's unclear which -- 10:03:04
Q So --
A -- which of those levels to apply in the context of Claims 18 and 19.
Q So it's your opinion that because there are
multiple possibilities for how to define a circuit 10:03:14

Page 46

that makes it indefinite?
A No. It's not a question of multiple definitions. It's that the definition includes multiple levels.
And the different levels create ambiguity and uncertainty with respect to which of those levels the claims are requiring. One level, multiple levels any level, it wouldn't be clear to a person of skill in the art what the scope of the claim is supposed to include with respect to what level of circuit the claims are talking about. 10:03:27 10:03:49
Q If you look at Paragraph 69 of your declaration here, you've included an annotated version of Figure 1 from the '775 patent.
A Yes. 10:04:29
Q And you've included -- one, two, three, four, five, six -- six red boxes.
Do you see that?
A Yes.
Q And if we look at the red box at the top that's around the data networking engine 120, that includes ARM No. 3. 10:04:49
Do you see that?
A It does include ARM No. 3. It's a box around the entire Box 120 of which ARM 3 is part of that 10:05:04

Page 47

box.
Q And you would agree that is a processor included in the data networking engine?
A I think the ARM 3 is a processor and it would be part of the data networking engine. 10:05:22
Q Would you agree that that is showing that there is a circuit in the data networking engine?
A When you say "that is showing," it's unclear what you are referring to.
Q The box that you've drawn. Is your box that you've drawn around the data networking engine which we've just agreed include the processor, would you agree that that box is surrounding a circuit? 10:05:45
A At one level of what a circuit could be, that box could be a circuit. And consistent with some of the rest of the figures, all sorts of other things could be circuits. 10:06:06
And that ambiguity, the patent not describing what it means by a circuit, means it could be all sorts of different things all of which have different meanings and all of which affect the scope of the claims and create unreasonable certainty. 10:06:23
Q But you would agree there's at least one -- one circuit being disclosed for the data networking engine? 10:06:40

Page 48

MR. BENYACAR: Object to the form.
THE DEPONENT: Could you repeat the question?
BY MS. ALLOR:
Q So earlier you -- you stated that you agreed with me that a processor is a circuit. 10:06:49
Is that fair?
MR. BENYACAR: Object to the form. Misstates testimony.
THE DEPONENT: No. I said, applying the definition of a circuit, all sorts of different things could be circuits, and it's unclear which of those levels is -- the claim is talking about. 10:07:00
So I think to be clear and so it's not taken out of context, Paragraph 69 is saying if the level is interpreted to be something related to its own specialized tasks, then that's one way that you could draw the set of circuits. 10:07:18
There's a paragraph after it that shows a different level of the circuit. So a different meaning of the circuit. 10:07:38
And then there's also a paragraph before where it's -- the whole thing is also a circuit. And so there's this ambiguity with respect to what the inventors intend to be the right level of the circuit. 10:07:54

Page 49

Is it the example that is shown above Paragraph 68? Is it the one above Paragraph 70? Is it the one above Paragraph 72? Is it the one above Paragraph 74?
And these all have different scopes with respect to then what has to be separate, and so that's why there's no reasonable certainty with respect to what the claims describe. 10:08:11
BY MS. ALLOR:
Q But the fact that you can draw a box around the data networking engine that contains a processor, you can identify at least one circuit with that box. 10:08:34
Is that right -- is that fair?
A No. I don't think it's fair. The fact that you can do it one time doesn't mean that there's all sorts of other ways that can you draw the box that leads to no reasonable certainty as to what the scope of the claims mean. 10:08:48
Just because you can do it once ignores the fact that there are others, and it's the existence of the one and the others and the uncertainty that exists that creates the problem. 10:09:01
Q A POSITA looking at the specifications for the '775 patent, would they understand what was 10:09:41

Page 50

meant by a data networking engine implemented in a first circuit that includes at least one processor?
A. I don't understand the question.
Q. Did they understand what -- the electrical components that are being used for the -- for the data networking engine implemented in a first circuit that includes at least one processor? 10:10:10
A. The uncertainty that I have with your question is when you say "would they understand." If -- if you're asking by "would they understand," would they understand the scope of what that is referring to, then the answer is no because there's no reasonable certainty as to what that would include. 10:10:31
Q. So when you are faced with a cable modem that contains a data networking engine and a cable modem engine, as a POSITA, would you understand what function each of those engines are performing? 10:10:50
A. It becomes somewhat circular. If -- if I was told what functions they were performing or if I had some -- some evidence that described what functions they were performing, then I would know what functions they were performing. 10:11:43
But if you just handed me a cable modem, first of all, it's not clear to me what would be 10:12:05

Page 51

considered the circuit for the data networking engine and the circuit for the cable modem engine and how they would be separate.
It depends, again, on what level you consider the circuit to be and whether or not they are separate. But with respect to the functions, if I knew what the functions were, I could say what the functions were. 10:12:27
Q. Doesn't the specifications describe what the functions of the data networking engine are? 10:12:43
A. For the data networking engine, my recollection is there were some examples of what was described at least with respect to the data networking engine.
Q. And what about with respect to the cable modem engine? 10:13:05
Does the specification describe exemplary functions that that would be performing?
A. Yeah, so that's part of the next problem, which is for both the DOCSIS controller and the DOCSIS MAC processor, there are examples of functions that are described. I think it's described as examples, and then they tend to be overlapping with respect to what those functions are. 10:13:24 10:13:39

Page 52

So it's unclear, at least based on the specification, what the set of functions are that would constitute the DOCSIS controller and what set of functions there would be for the DOCSIS MAC processor. 10:13:57
Q. If we look at Figure 2 of the '775 patent, Figure 2 is described as a functional block diagram implementing the cable modem architecture of Figure 1.
A. I see that. 10:14:29
Q. And you see that the box at the top is labeled DNE-120?
A. Yes.
Q. Would you agree that the DNE includes a processor to perform the function being shown there? 10:14:46
A. My recollection is that DNE is described as having a processor to perform functions. I understood Figure 2 -- if you're saying that the DNE performs exactly the functions that are shown in Figure 2 and not other functions and that's what the invention is, then I certainly think DNE is showing that specific set of functions. 10:15:25
Q. I think we can agree that the specification is describing exemplary functions that the DNE-120 performs. 10:16:03

Page 53

Is that fair?
A. Right.
So then it's kind of an open-ended list as to what the DNE is supposed to be performing. There are some examples, but there's not some constraint as to what functions the DNE is not supposed to be performing. 10:16:11
Q. Well, if we use the definition of circuit that's included in the Microsoft dictionary that you included with your declaration, would you agree that the DNE includes at least one circuit? 10:16:32
A. Applying that definition, it either is a circuit, is composed of many circuits, or is part of a circuit.
Applying that definition, the specification doesn't say that the DNE is a circuit. So it -- like I said, it could be -- it could have lots of circuits. It could itself be a circuit, a self-contained circuit, or it could be part of a larger circuit. 10:17:03 10:17:25
There's no guidance in the specification as to how to apply the definition of a circuit with respect to what's required of the DNE.
Q. So you would agree there's at least one circuit being described in the DNE in Figure 2? 10:17:55

Page 54

MR. BENYACAR: Object to the form. Misstates the testimony.

THE DEPONENT: I -- it depends on what level of circuit you're applying.

Like I said, it could either be lots of circuits in the DNE, the DNE could be one circuit or it could be lots of other circuits or it could be part of one larger circuit. There's no guidance as to which of those it is. 10:18:09

BY MS. ALLOR: 10:18:29

Q So the second box in Figure 2 is the -- it's label CME, and that's the cable modem engine 110.

Do you see that?

A Yes.

Q And would you agree that the CME- 110 includes at least one processor? 10:18:41

A As described in 110, 110, I wouldn't say it's described as at least one processor. There's at least two processors in 110.

Q So at least one includes a possibility of two, would you agree? 10:19:11

A I would agree that that's what at least one means, but I don't think that's what 110 is showing.

Q You don't think it's showing two processors?

A No. I think 110 shows at least two 10:19:35

Page 55

processors, and in Figure 1, which is the same 110 box, it is showing the DOCSIS controller is ARM No. 1 and the DOCSIS MAC is ARM No. 2.

Q Is there any reason those couldn't be implemented in a single processor? 10:19:58

A That's not what the invention is described as. It's -- if you implemented it as a single processor, it's unclear how you would meet the requirements of the Claim 18 and 19 with respect to the requirement of being to able bypass the DOCSIS 10:20:25 controller to be able to send PDU packets and forward them directly to the data networking engine without the involvement of the DOCSIS controller.

The invention is described as being a processor for the DOCSIS controller and then a 10:20:47 separate processor for the DOCSIS MAC processor.

Q And couldn't those be implemented into processors that are part of the same circuit?

A So your hypothetical as to could they be, it depends on the constraints of the hypothetical. If 10:21:08 the constraint of the hypothetical is implemented in a single processor in such a way that would be able to meet the requirements of Claim 18, I don't think so.

Or that would be implemented in a way that's 10:21:24

Page 56

described with respect to the invention, the only embodiment that's described in the '775 patent, I think the answer would also be no.

Q So two processors can't be part of the same circuit? 10:21:45

A Your question is a hypothetical with no context to it. So removing any context associated with the '775, I can envision instances where you can implement functionality formerly implemented on two processors on a single processor. 10:22:05

That's not what's taught on a '775 patent and it's -- so would make meeting all of the limitations of Claim 18 essentially impossible.

Q Okay.

I think this might be a good time for a break. 10:22:23

THE VIDEOGRAPHER: Going off record, 10:22 a.m.

(Recess.)

THE VIDEOGRAPHER: We're back on record. 10:34:27 10:34 a.m.

BY MS. ALLOR:

Q Dr. Almeroth, before we went on break, we were talking about your Appendix C, the Microsoft Computer Dictionary definition of circuit. 10:34:45

Page 57

If you could just look at that again.

A Sure.

Q So you understand that, you know, the outcome of this process is, you know, that the judge is going to construe terms in the patent, and one of 10:35:00 the terms that you are looking at is first circuit and second circuit.

Do you understand that?

A Generally, I do.

Q So if the Court decides to construe circuit 10:35:14 according to this definition that you have provided in the Microsoft dictionary, any path that can carry electrical current, is it your opinion that the claim would be indefinite?

A Yes. 10:35:35

Q So you would disagree with the Court adopting a definition for circuit?

A No. The Court can adopt that definition for circuit, but it still creates unreasonable -- I would say unreasonable certainty. What I mean is no 10:35:53 reasonable certainty with respect to what the scope of the claim is and what's actually being claimed as the circuit.

Q So if the Court adopts that definition, that first definition, you wouldn't be able to perform a 10:36:07

Page 58

infringement analysis.
Is that -- is that fair?
A The question of indefiniteness is not a test of whether or not you could perform an infringement analysis. Somebody like Dr. Kramer could draw boxes however they wanted. 10:36:22
But with respect to a person of skill in the art attempting to develop a system that they believed wouldn't infringe because they either didn't want to have a first or second circuit or they didn't want them to be separate, it would -- there's no reasonable certainty on how to -- how to implement that functionality. 10:36:37
Dr. Kramer could still come back and draw boxes however he wanted in order to say that the first circuit and the second circuit were separate. So there's no -- there's no guidance or scope of the claim that would exist that would allow a person of skill in the art to determine with reasonable certainty what the -- what the claim means, what the scope of the claim is. 10:36:54 10:37:12
Q So we're, you know, looking at this definition and applying it to a cable modem. One way to not infringe would to be to have this one single processor. 10:37:38

Page 59

Is that fair?
A It would depend. Maybe there's an expert who would say, "Well, a circuit could be any path that can carry electrical current."
So I'm going to draw a box around some of the processor and another box around another part of the processor and say that those are separate circuits. 10:38:02
Q But the claim requires two separate processors, right, Claim 18?
A Claim 18 requires a data networking engine implemented in the first circuit. That includes at least one processor and a cable modem engine implemented in a second circuit that includes at least one processor. 10:38:23
That's what the claim language says. So with respect to drawing boxes around circuits or transistors or pads or boards, a person of skill in the art wouldn't know how to implement a system that wouldn't meet the requirement. 10:38:47
Now, your focus was also on the requirement of whether or not you had a processor in the circuit or not. But the ambiguity is with respect to whether or not you had two circuits that were separate from each other.
You might be able to do something else to not 10:39:07 10:39:21

Page 60

meet another part of the claim, but if you had two different processors, again, it becomes a box drawing exercise that it's not clear to a person of skill in the art what the scope of the claim would be. 10:39:36
Q Are you saying it's not clear from the claim language whether two processors are required?
A That's not what I'm saying.
Q Well, my question was, if there was only one processor in your cable modem system, would you meet the claim? 10:39:51
A I would have to see what that system looked like. It likely would not, but it depends.
I mean, maybe there's some aspect of the way that's designed or some DOE argument that the plaintiff would make. I would have to give it some thought. 10:40:11
Q But you haven't given the opinion that the term processor is indefinite, have you?
A In this declaration I have not. 10:40:24
Q So I want to go back to a question that you didn't actually answer earlier. So my question earlier was if the Court applies the No. 1 construction from the Microsoft Computer Dictionary to circuit, any path that can carry electrical 10:40:48

Page 61

current, is your opinion that you then would not be able to apply this -- the claims to an accused product and determine whether there is infringement or not?
A I believe I did answer that question. And my question -- my answer was with respect to whether or not you could determine infringement, I'm sure someone could draw boxes however they wanted and start checking off limitations. 10:41:03
But then I continued to say, the question of indefiniteness is not with respect to whether or not you can't find an example of a system that would fit within the scope of the claims. 10:41:22
The question is with respect to whether or not a person of skill in the art could determine the scope of the claims with reasonable certainty. 10:41:40
And so it's not an infringement analysis that determines definiteness. It's whether a person of skill in the art would understand the scope of the claims. 10:41:57
Q Well, if the Court construed circuit in the claims to mean that second definition under the Microsoft Computer Dictionary, so if a circuit means a combination of electrical components interconnected to perform a particular task, are you 10:42:16

Page 62

saying that the claims would be indefinite and you would not be able to determine whether there's infringement?
A So at first observation that's not all of the second definition. 10:42:33
MR. BENYACAR: I was on mute when I was trying to object. I apologize. That was the basis for my objection.
Go ahead.
THE DEPONENT: So there's that observation. 10:42:42
The second is, my answers would parallel the same kind of answers that I gave if the Court adopted definition 1.
And to briefly summarize those, the question of indefiniteness is not with respect to whether or 10:43:05 not you can find an example of a system that would be within scope of the claims.
The question of definiteness would be with respect to determining what the scope of the claims are to a person of skill in the art without 10:43:21 reasonable uncertainty.
BY MS. ALLOR:
Q So you would find the claim to be indefinite if the Court adopted either of those definitions in the Microsoft Computer Dictionary and you would not 10:43:43

Page 63

be able to determine the scope of the claim.
Is that fair?
A Right.
Regardless of which definition for circuit a person of skill in the art would use, there would 10:44:04 still be unreasonable certainty -- or there would be no reasonable certainty with respect to what the scope of the claims would be.
Q And so if either of those definitions get adopted, it's your opinion that you couldn't do an 10:44:20 infringement analysis because the claims would be indefinite; is that fair?
A No. That's not what my opinion was.
Q What does it mean for two circuits to be separate? 10:44:53
A I -- I don't think there is a clear distinction or understanding as to what they would need to be in order for them to be separate. That -- that's part of the problem that's illustrated in the prosecution history. 10:45:08
Q And if we look at the -- the claim language of 18, it says (as read):
"A data bus that connects the data networking engine to the cable modem engine where the cable modem functions 10:45:26

Page 64

formed by the cable modem are completely partitioned from the home networking function performed by the data networking engine."
Do you see that? 10:45:36
A Yes.
Q So what does it mean to be completely partitioned?
A I don't think there's a clear understanding as to what that would mean in the context of this 10:45:48 claim, and in light of the intrinsic record.
Q Did you consider any dictionary definitions of partitioned?
A I don't recall that I did. To the extent I did, they would be included in the declaration. 10:46:09
The question of indefiniteness doesn't revolve what the -- the definition of partitioned is.
Q Do you have an understanding of what the definition of partitioned is? 10:46:25
A Partitioned, I don't have some dictionary definition I can give you to off the top of my head. I think partitioned means partitioned.
Q So what does it mean to you as a POSITA?
A Again, I don't have a dictionary definition 10:46:45

Page 65

off the top of my head to give you. Whatever plain and ordinary meaning for partitioned would be.
Q So I'm introducing Exhibit 4.
MR. BENYACAR: How do I get access to the exhibits? Did I log on the wrong way? 10:47:10
MS. ALLOR: Did you -- can we go off the record for a minute?
MR. BENYACAR: Sure.
THE VIDEOGRAPHER: Going off record at 10:47 a.m. 10:47:23
(Recess.)
THE VIDEOGRAPHER: On the record at 10:49 a.m.
(Exhibit 4 was marked for identification and is attached 10:49:32 hereto.)
BY MS. ALLOR:
Q So, Dr. Almeroth, I just introduced as Exhibit 4 some excerpts from a Microsoft Computer Dictionary, 3rd Edition. 10:49:42
If you look at Page 3 of the PDF, it shows the copyright date of 1997.
A I see that on the page.
Q So if we go to the fourth page of the PDF, it's Page 90 of the dictionary, you'll see a 10:49:59

Page 66

definition of circuit there.
Do you see that?
A I see that.
Q And this is the same definition that was included in the Microsoft dictionary that you included as your exhibit; is that fair? 10:50:10
A It does look to be the same.
Q Okay.
I don't want to look at that. I want to actually go to the next page. I just want you to know that I didn't have access to the one that you had, so I have a 1997 version. 10:50:20
A Okay.
Q If we go to the last page, 355.
A Okay. 10:50:39
Q So there's a definition of partition there and it says (as read):
"A logically distinct portion of memory or a storage device that functions as though it were a physically separate unit." 10:50:47
Do you see that?
A I see that.
Q Is that a fair definition of partition?
A In this context of the '775 patent, I don't 10:51:00

Page 67

think it is.
Q And why not?
A The definition of partition from the Microsoft dictionary looks to be in the context of a storage device or -- or memory. 10:51:18
So you create a partition on your hard drive, like a C drive and a D drive, and so it's -- it's a portion of memory or storage that's being divided here. The -- the completely partitioned in Claim 18 and 19 is referencing cable modem functions performed by the cable modem engine completely partitioned from the home networking functions. 10:51:44
So that definition of partition of how you are dividing up memory I don't think would inform a person of skill in the art as to how you're partitioning functions of engines. 10:52:03
Q Are you saying this definition is not consistent with what a POSITA would understand at the time of invention in 2003?
A I -- I don't think this definition would help a person of skill in the art understand what Claim 18 and 19 meant with respect to completely partitioned, especially in the context of the intrinsic record that's present as it relates to this portion of Claim 18 and 19. 10:52:26 10:52:41

Page 68

Q So in the context of this definition of partition and the discussion that you just had right before this question, would that be only applicable to a hard drive having, you know, two separate logical drives within that single hard drive? 10:53:05
A I don't understand the question.
Q Well, so you said that this definition is not referencing being completely partitioned from the home networking function; the cable modem engine being completely partitioned. 10:53:24
So -- so what is this definition referring to? Is it referring to a single piece of hardware having only function partitions?
A Sorry. When you say "this definition," I don't understand if you are referring to Exhibit 4 or something in Claim 18. 10:53:43
Q I'm -- I'm referring to the definition of partition in Exhibit 4 that's the dictionary.
So I asked you if that was consistent with the '775 patent's use of partitioning. 10:53:58
You told me no; is that fair?
A I am not sure how to judge consistency. They are talking about two different things.
I -- I think they are talking about two different things. I don't think that the definition 10:54:13

Page 69

from Exhibit 4 is relevant or would inform a person of skill in the art as to how the term completely partitioned was used in the context of Claim 18 and 19, especially in the context of the intrinsic record of the '775 patent. 10:54:36
Q If we put the -- the claim language aside and patent aside, and we look at just the definition from the 1997 dictionary, it says (as read):
"A logically distinct portion of memory or storage device that functions as though it were a physically separate unit." 10:54:48
Is it your position that that definition only applies to logical partitioning and not physical partitioning? 10:55:00
A I am not sure how to answer that question. I guess maybe the answer is it depends.
Q Can something be partitioned based on this definition in the Microsoft dictionary, can it be both logically distinct and not physically separate? 10:55:30
A Again, I'm not sure what that question is really asking or what it means.
Q Do you understand what this definition means?
A I do.
Q So my question is: When you're applying this 10:55:53

definition in the real world in the time of a POSITA, would you understand that only to be applicable to partitioning logical hard drives or logical functions and not physical hard drive?

The partitioning will be between the logical step and not the physical hard drive. 10:56:17

A. I don't understand the question. You have used terms like logical hard drive, you've -- you've mixed and matched hard drive with functions. I'm not sure what a logical function would be or how a function would be relevant to the definition. 10:56:36

Your question just doesn't really make any sense. I'm sorry.

Q. Could you partition a single hard drive?

A. I guess there's two parts of the question. Could you and would that use of the term make sense in that context. 10:57:11

The one example that comes to mind is where you have a hard drive in a PC and you can partition it so that there's a C drive and a D drive. That's a typical way in which I would expect that term to be used. Maybe there's other contexts in which it could be used. 10:57:25

Q. And so that is partitioning portions of the hard drive into, as you said, a C drive and a D 10:57:47

drive. That's the function being partitioned, right?

A. No. I disagree with your characterization.

Q. So that's a physical partition?

A. I disagree with that characterization. 10:58:03

Q. So what kind of partitioning is it?

A. I mean, I'm not sure what types of partitions there could be. I mean, it's -- the example I have provided is it's a partition. I'm not sure what adjective I would use to modify partition in that sense. 10:58:28

Q. Well, you said that this definition of partition is not the same as what's being used in the '775 patent. So I'm trying to understand what this definition means. 10:58:43

A. The definition means what it says it means. I can -- I gave you one example and I'm not sure what else you're asking at this point.

Q. So how is the use of partition in the '775 patent inconsistent with this definition in the Microsoft dictionary? 10:59:03

A. It's a hard question to answer. I'm not sure, you know, if you're comparing apples and oranges how or -- how is the comparison inconsistent. I mean size, shape, color for apples 10:59:21

and oranges.

I guess in this case partition is referencing distinct portions of memory whereas Claim 18 and 19 are referencing complete partitioning of cable modem engines functions and home networking functions. The cable modem engine and the data networking engine. 10:59:50

Q. So is it your opinion that in your hard drive example drive C and drive D could not share connecting circuitry data paths or memory devices and still be partitioned? 11:00:19

A. I am not even sure how to apply claim language to that particular scenario. Again, I think because the terms are talking about different things, it's -- it's again kind of apples and oranges. I think also in the context of the '775 patent there's prosecution histories, part of the intrinsic record that help explain what the applicant considered or thought or stated with respect to completely partitioned. 11:00:37 11:00:59

Q. Can two circuits be separate but still share circuitry, data path, or memory devices?

A. Can you repeat the question?

Q. So can two circuits be separate but still share connecting circuitry, data path, or memory 11:01:43

devices?

A. I would have to give some thought to that hypothetical. I mean, you're -- you're using the term "separate," and then with respect to what they're sharing and you're not really asking in the context of Claim 18 or considering the intrinsic record. 11:02:09

So I'm a little uncertain as to what the context of the question is and how to evaluate the requirements of your question versus kind of the incomplete hypothetical. 11:02:26

Q. What does it mean for two circuits to be separate?

A. I think that's part of the problem with the indefiniteness of the claim. It's not clear what the scope of the claim is for the required separation and for the functions to be partitioned, especially given the intrinsic record. 11:02:46

Q. So you don't know what it means for two circuits to be separate? 11:03:10

A. Not in the context of how that term is used in Claim 18 and 19, given what the applicant said during prosecution. It's not clear to me with any reasonable certainty as to what that term means or what the scope of the claim would be when it uses 11:03:27

Page 74

that term.
Q. Are you familiar with SOCs that have various circuits on a single chip?
A. Yes.
Q. Would you consider the components of the SOC to have separate circuits? 11:03:48
A. It would be the same kind of answer.
Applying separate as it's used in the context of Claim 18 and in light of the prosecution history, I don't think I have the ability to answer that question one way or another. 11:04:11
Q. So as a POSITA, understanding what a SOC is, if there was a single chip with various circuits on it, would you say that all those circuits are separate? 11:04:30
A. Same answer.
Q. Can those circuits have separate functions even though they are connected on the single chip?
A. Can they have separate functions?
It seems like you are using that term different than how it's used in the context of the requirements of Claim 18. 11:04:54
I think in an unbounded hypothetical certainly circuits on a chip can have separate functions. I mean it -- again, it depends on if' 11:05:08

Page 75

you're trying to apply the language of Claims 18 and 19 to that hypothetical or not.
Q. Well, I was not applying it to the claim terms. I was just asking about a SOC that is a single chip and that has various circuits on it. 11:05:35
Would those be considered separate?
A. You would have to tell me what the test for separateness is.
Q. What's your understanding as a POSITA of the term "separate" with respect to an SOC that has various circuits on it? 11:05:58
A. I think the understanding of a POSITA would be it's -- it's not a term with a specific enough definition that I can answer your question yes or no. 11:06:12
And in one context maybe it is separate and another context maybe it is not separate. It depends on -- on what specific definition of separate you want me to apply in evaluating whether or not your hypothetical has separate functions or circuits. 11:06:32
Q. Wouldn't a POSITA have been familiar with an SOC?
A. Yes, but familiarity with an SOC doesn't provide the context for how you want me to apply the 11:06:47

Page 76

test for separateness in your hypothetical.
Q. Well, wouldn't you -- as a POSITA, wouldn't you be familiar with seeing circuitry depicted as a series of separate blocks on a block diagram?
A. It would be the same answer. 11:07:06
You're -- you're not giving me a definition of what separateness requires or allows for, so I can't say whether or not circuits, chips are separate on an SOC or not.
And that's, again, all divorced from any particular meaning or understanding in the context of Claim 18 and 19 of the '775 patent. 11:07:26
Q. So if we look at Claim 18 of the '775 patent, is it your position that the cable modem engine and the data networking engine can't share any connecting circuitry or data path? 11:07:54
A. It is not clear what the scope of the claims allows for given what the applicant said as part of the prosecution.
There was a pretty clear example in the prior art where there were components that were shared between the two and there's examples identified in Paragraph 61 of things like a memory controller and a bus that seemed to be shared between the two processors that are used as a basis for 11:08:23 11:09:07

Page 77

distinguishing Brooks and saying that it -- it shared circuitry and therefore were not separate circuits.
Q. So I don't think you answered my question.
My question was: Does Claim 18 of the '775 patent, is it your position that the cable modem engine and the data networking engine can't share any circuitry or data -- any connecting circuitry or data path? 11:09:30
MR. BENYACAR: Objection; asked and answered. 11:09:45
THE DEPONENT: I absolutely answered it, so I stand by the answer I just gave on the record.
BY MS. ALLOR:
Q. How do they communicate with each other?
A. I don't understand the context of the question. What are the they and what the hypothetical is. 11:09:57
Q. How does the cable modem engine in Claim 18 communicate with the data networking engine?
A. I don't understand the question. 11:10:12
Are you asking about a system that would implement Claim 18? I mean, because with respect to -- I mean, it's a long limitation. I'm -- I'm trying to see where there's a specific requirement in Claim 18 that the cable modem engine and the data 11:10:37

Page 78

network engine communicate with each other.
Q So could you have a functioning cable modem system that didn't have communication between the data networking engine and the cable modem engine?
A I would have to give that some thought. I'm not -- I'd have to think about how you could implement a system under those constraints and if it would -- would operate. 11:11:04
Q So you don't know whether in a functioning cable modem, you know, one of -- maybe the accused products, whether they need to communicate between the data networking engine and the cable model engine? 11:11:23
MR. BENYACAR: Object to the form.
THE DEPONENT: So your question about how a system would work if they didn't communicate versus a description of an example of a system where they do communicate seems to be two different things. 11:11:37
So I -- I don't understand your -- your last question being asked in the context of the previous question. So maybe you could restate it so that I understand it. 11:11:54
BY MS. ALLOR:
Q There were two separate questions, so I -- I'll ask each of them again. 11:12:06

Page 79

So my first question was: If it's your position that the cable model engine and the data networking engine in Claim 18 cannot share any connecting circuitry or data path, how would they communicate with one another? 11:12:22
A Okay. So that question presumes that I've offered the opinion that they can't share anything.
What I have said is based on what the applicant said during the prosecution history and the lack of disclosure in the specification, it's not clear how to -- what the scope of the claims is with any reasonable certainty as to how the circuits can be separate from each other, how the functions can be completely partitioned, given statements that the applicant made during prosecution. That leads to the indefiniteness. 11:12:45 11:13:02
And so with respect to asking me to assume that to be the case, I can then answer the rest of the question which is how you would implement a system if that were to be the assumption and the hypothetical, and that's what I answered to you previously as I haven't given thought to what the structure of a hypothetical system would look like sufficient to meet the assumptions in your question about a hypothetical. 11:13:27 11:13:41

Page 80

Q If you could turn to Paragraph 74 of your declaration.
And above that paragraph there is an annotated copy of Figure 1 from the '775 patent? Do you see that? 11:14:08
A Yes.
Q And you put a purple box around the cable modem engine 110; is that correct?
A Yes.
Q So why do you say the specification doesn't explain what this box is? 11:14:21
A Why do I say that? I say that in the context of going back to understanding what a circuit is and the point that there's Box 110 that's described as the cable modem engine but there's no description or explanation as to whether that box is a circuit board on which all of the components of the CME are placed or if it means something else, kind of consistent with the rest of what Paragraph 74 says. 11:14:48
Q So your issue with this figure and with the specification is that it doesn't identify how the CME is physically implemented? 11:15:08
A I think that is an inaccurate characterization of what my indefiniteness opinions are. 11:15:35

Page 81

Q Well, your Paragraph 74 says the specification doesn't explain what this box is, meaning the purple box, but the purple box is clearly labeled as the cable model engine. Is it not? 11:15:50
A It has that label but it doesn't inform a person of skill in the art as to what the circuit is supposed to be. And there's multiple possible meanings that I go through with respect to Paragraph 74. And then understanding Paragraph 74 in the context of all of the other ways in which Figure 1 can be -- can have boxes drawn on it demonstrates that even if you had a definition of circuit, it doesn't tell you at what level the claim is supposed to be claiming a circuit at. 11:16:07 11:16:27
And the point of Paragraph 74 when it says it doesn't explain what this box is, is referring to it doesn't explain how this box would inform a person of skill in the art as to what the scope of circuit would be as it's required in the claims. 11:16:48
Q But you would agree that this box, the purple box around the cable modem engine 110, it includes at least one processor?
MR. BENYACAR: Objection; asked and answered.
THE DEPONENT: No. It includes two 11:17:07

Page 82

processors.
BY MS. ALLOR:
Q Isn't two processors at least one?
A Asking if this box shows at least one processor, it shows exactly two processors. So it doesn't show one processor or three processors. 11:17:27
Q Does it need to show one single processor to meet the claim limitation of at least one processor?
A With respect to whether or not that would be a necessary or a sufficient requirement to explain what the claim means when it said one or more processors for the cable modem engine, it -- there'd have to be something. 11:17:59
Whether it's shown in this figure or an explanation provided, the fact that the limitation says one or more processors creates an issue with respect to, if you only had one processor according to the claim, how you would be able to have a DOCSIS controller and a DOCSIS MAC processor on a single processor and be able to meet the requirements of the claim where you have -- packets are forwarded directly to the data networking engine without the involvement of the DOCSIS controller. 11:18:21 11:18:56
So that's another indefiniteness problem as it relates to Claims 18 and 19. 11:19:18

Page 83

Q Is it your opinion that you couldn't meet the claim limitations by having two processors on the cable modem engine?
A You know, I think -- I think the point is the opposite of that. The disclosed invention has two processors in the cable modem engine, and that's what's disclosed, the DOCSIS MAC processor and the DOCSIS controller. Having one processor creates problems in the claim for the reasons I just described. 11:19:55 11:20:18
Q Where in the claim language is -- does it require that the first circuit and the second circuit be on separate circuit boards?
MR. BENYACAR: Object to the form.
THE DEPONENT: I don't think it says that's a requirement of the claims explicitly, but because it doesn't say what the first circuit and second circuit are or can be, there's no guidance to a person of skill in the art how they can be separate and how you can have functions that are completely partitioned creates the indefiniteness problem. 11:20:35 11:21:11
BY MS. ALLOR:
Q Are you -- are you saying that if you had two circuits on a single circuit board you wouldn't consider those to be separate? 11:21:34

Page 84

There would be no way for them to be separate?
A As to -- there are two parts of that question. Whether or not I would consider them to be separate, there's no guidance in the claim for whether or not they would be separate or not because there's no guidance as to what level of circuit is claimed. 11:21:43
With respect to the second part of the question, there would be no way for them to be separate. It would depend on how they're implemented. It would depend on the level of separateness that was required. 11:21:56
And that's -- that's the problem. Because the claim doesn't provide a person of skill in the art what the scope of the claim would be, it creates uncertainty as what that scope of the claim would be in a scenario like what you described. 11:22:09
Q If you could look at the '775 patent, Column 4, Line 58 to 62. 11:22:34
A Yes.
Q So there the specifications describe a single chip; is that correct?
A No.
Q So you don't think it describes implementing 11:22:57

Page 85

cable modem system 100 on a single chip?
A No.
Q What does it describe then?
A It says (as read):
"A chip implementing cable modem system 100 will only have a small incremental hardware cost or function over standalone cable modem chips. The major cost difference relative to current chips is the addition of another R940-type processor to the chip." 11:23:11 11:23:25
So it's describing the addition of the DNE as the additional chip, which would be the required functionality that's shown for cable modem 100, and then it's also describing in the context of current standalone cable modem chips, which in the context of cable modem system 100 is the ARM1 for the DOCSIS controller and ARM2 for the DOCSIS MAC processor. 11:23:39
Q Right. 11:24:03
But it says in addition to the chip, you could add another processor. So wouldn't that be referring to multiple processors on a single chip?
A It -- it's referring to the cable modem system 100 which is described -- I mean, it's 11:24:33

Page 86

referring to that embodiment, and in that embodiment there are three chips -- I'm sorry, there are three processors, not three chips.

Q But you would agree it's discussing adding a processor for the DNE to the chip? 11:24:59

A And if it's -- it's adding another processor to the two that are already there to create cable modem 100.

Q Right.

And all three processors are on a single 11:25:19 chip, correct?

A With respect to the relationship between a processor and a chip, it's whether it's in -- the chip is an SOC or not. It doesn't really say. So there isn't some description of what a chip is as it 11:25:35 relates to what the processors are.

Q Your answer earlier was it's adding another processor to the two that are already there to create cable modem 100.

Is that a fair recitation of your answer? 11:25:56

A Yes.

Q So wouldn't you agree that in that scenario of what's being described here, cable modem 100 has three processors on a single chip?

A It is using the term "chip" but not tying it 11:26:11

Page 87

specifically to how that relates to a processor or any requirement for separateness.

Q I'm -- I'm not saying anything about the separateness requirement.

I'm simply asking you whether a current 11:27:08 standalone cable modem chip has two processors and this is describing adding an additional processor to that chip to get to the cable modem system 100 being described there.

A Yeah, I think the focus of Figure -- Figure 11:27:26 1, Box 100 is with respect to the inclusion of the three processors as to what the chip is referring to in that scenario.

That is not -- doesn't tie that chip to the relationship of the three processors. 11:27:54

Q That wasn't my question.

My question was simply, this is describing a possibility that this cable modem system 100 can be implemented on a single chip with at least three processors? 11:28:10

A It is saying that you would have cable modem system with three processors. I would agree with that.

With respect to what --

Q Okay. 11:28:26

Page 88

That was not --

A -- would be part of the chip versus not, it doesn't say.

Q That wasn't my question. So -- thank you.

So with respect to a system (indecipherable) 11:28:41 chip, the processors would be on that single chip; is that correct?

A That's the --

MR. BENYACAR: Object to form.

THE DEPONENT: That's the part you 11:28:49 interrupted me on. It doesn't say.

BY MS. ALLOR:

Q So you interpreted the word "chip" to not mean a chip?

A That's not what my answer was. 11:29:07

Q Are you familiar with the concept of virtual decoupling?

A In a general sense, it's something of a broad term, so it again depends on the context.

Q Well, what does it mean to you as a POSITA? 11:29:32

A It depends on the context.

Q Well, if you look at the '775 patent, the Column 3, Line 58 to 62.

A Okay.

Q It's describing the ability to virtually 11:30:05

Page 89

decouple the cable modem engine 100 from the data networking engine 120.

Is that fair?

A Sorry.

Could you repeat the question. 11:30:20

Q I said, this portion of the specification is describing virtually decoupling the data networking engine 120 from the cable modem engine 110.

Do you see that?

A I do see where it says those words. 11:30:36

Q And what is your understanding of what that would mean?

A I think it says in the previous sentence -- because the sentence that you read says as a result and then it's using virtually decoupling to 11:31:06 characterize the sentence that appears before.

So that sentence says (as read):

"In one implementation the entire embedded portal service, PS, functionality of the cable home 11:31:18 specification, is contained within data networking engine 120 with a cable home functionality being completely decoupled from the packet cable and DOCSIS functionality 11:31:32

provided by cable modem 110."
Q Right.
So the sentence after it is describing that that decoupling is a virtual decoupling.
Do you agree with that? 11:31:46
A It is using the term "virtual decoupling" to refer to what I just read.
Q And what is your understanding of virtual decoupling?
A It's what I just read. I'll read it for you again. 11:31:59
It says (as read):
"In one implementation the entire embedded portal services functionality of the cable home specification is 11:32:08 contained within data networking engine 120 with a cable home functionality being completely decoupled from the packet table and DOCSIS functionality provided by cable 11:32:19 modem engine 110."
Q Is this describing that the function of the two engines, the data networking engine and the cable modem engine, they are operating separately?
A It does not make that characterization. 11:32:38

Q So how would you be able to independently upgrade software to one engine, so say the data networking engine, without impacting the functionality of the cable modem engine?
A I would have to give that question some 11:33:14 thought. I haven't tried to answer what the design of a cable modem would look like that would accomplish that functionality under those constraints.
Q So would you be able to independently upgrade 11:33:29 the software of one engine if they were not functioning separately?
A I would have to give that some thought, whether or not you could implement a hypothetical system under that constraint. 11:33:46
Q In context of this portion of the specification, what is it describing?
A I don't understand the question. It's describing exactly what it says. So I'm not sure what you're asking about beyond the description 11:34:07 that's in the words of the sentences.
Q Is it describing the functions of the cable modem engine as operating separately from the functions of the data networking engine?
A I don't see where it says that. I'm sorry. 11:34:26

Actually maybe repeat your question because it was the words at the end that I think you were asking whether or not that concept was conveyed or not.
Q So the last part of that Column 3, Lines 58 to 62 is describing (as read). 11:35:01
"As a result of the virtual decoupling."
So my question is, the virtual decoupling, isn't that describing that the functions of the cable modem engine are operating separately from the 11:35:14 functions of the data networking engine such that you can separately upgrade the software of each without -- without affecting the functionality of the other.
MR. BENYACAR: Object to the form. 11:35:31
THE DEPONENT: I see where it says (as read):
"As a result of the virtual decoupling" that you've asked me about a couple times what you're able to do.
But with respect to what you're able to do 11:35:46 having further implications about what that virtual decoupling is describing, I don't see where -- for example, it's -- it just says that the functionality is being completely decoupled as opposed to any sort of condition as it relates to operation. 11:36:10

And so to your hypothetical about, well, it says decoupling functions, doesn't that mean it has to decouple operation in order to achieve independently software upgrading, I don't think that that necessarily follows from decoupling 11:36:31 functionality.
BY MS. ALLOR:
Q Do you understand what the term "MAC" means?
A Yes. You mean the acronym for medium access control, yes. 11:37:06
Q Yes.
So what does MAC -- besides the acronym, what does it actually mean?
A I think I had a definition from one of the dictionaries. Let me find go find the paragraph for 11:37:21 you.
It's paragraph 46. (As read):
"MAC functions relate to accessing shared physical transmission medium by network attached devices." 11:37:29
Q So you rely on the dictionary definition for that term?
A I do. To provide --
Q Would a POSITA have an understanding of what MAC means in the time period of the '775 patent? 11:37:47

Page 94

A With respect to how I have described it in Paragraph 46, I think a person of skill in the art would understand at that level.
Q Why did you choose the dictionary definition for MAC that you included? 11:38:17
A Because I thought it was a fair description of how I describe MAC functionality.
Q I'm introducing as Exhibit 5 -- I'm introducing Exhibit 5 for you, and this is Webster's New World Computer Dictionary 10th Edition. I 11:39:05 believe the date on it is 2003.
(Exhibit 5 was marked for identification and is attached hereto.)
BY MS. ALLOR: 11:39:11
Q There is -- are you able to see that exhibit?
A Yes, I downloaded. I have it open.
Q Okay.
If we turn --
MR. BENYACAR: Wait. I haven't. Hold on. 11:39:19 I'm trying to get it. I apologize.
Okay.
Sorry, go ahead.
BY MS. ALLOR:
Q So here is a definition on Page 4 for the 11:39:33

Page 95

media access control, MAC.
Do you see that?
A Yes.
Q Is that acronym, media access control, is that equivalent to the medium access control map you 11:39:48 included in your appendix?
A Generally it is the same.
Q So is that a fair definition for MAC?
A Let me look. The second sentence (as read):
"A protocol is needed to prevent 11:40:35 data collisions which occur when two work stations begin broadcasting simultaneously."
Whether or not that function needs to be present or not depends on the protocol. 11:40:48
Q Would a POSITA in the context of the '775 patent have an understanding of what a MAC processor is?
A No.
Q Why not? 11:41:17
A It's not a term of art, so it's unclear what functions a MAC processor would have to perform.
Q So how would a POSITA determine whether a processor was able to perform the MAC functions described in these two definitions, your definition 11:41:39

Page 96

and the one I provided to you?
A I don't think they would be able to.
Q So a POSITA wouldn't know how to implement the functions described under MAC with a processor?
A No. That's not what my opinion is. The 11:42:02 challenge in the '775 patent is it has a MAC processor and a DOCSIS controller and it's not clear how to divide functionality between those two processors.
Your question kind of ignores the required 11:42:27 distinction of a DOCSIS MAC processor and a DOCSIS controller in the invention and in the claims.
Q And my question was not tied to the DOCSIS MAC -- MAC processor or the DOCSIS controller. It was simply asking you about a MAC processor. 11:42:52
Would a POSITA understand what a MAC processor is?
A That's a term in the claims. And as I said and as it says in Paragraph 45, a DOCSIS MAC processor doesn't have a plain and ordinary meaning. 11:43:16 So it's not clear what functions a DOCSIS MAC processor would have to perform especially in the context of understanding it versus a DOCSIS controller.
Q So if a processor was implementing the MAC 11:43:37

Page 97

functions, would a -- would it be reasonable for a POSITA to refer to that as a MAC processor?
A If a POSITA wanted to define a MAC processor that way, then they could say that's the definition that I'm using for a MAC processor. 11:44:12
Q So if you saw the term "MAC processor," would you understand that to be a processor that is implementing MAC functions?
A That's really just reordering the words of the terms. So it doesn't tell me what it is or what 11:44:46 it does, and that level of specificity is required to understand what the scope of the claims are.
Q Will you agree there can be different types of processors that implement MAC functions for things such as Ethernet or Wi-Fi? 11:45:21
A Certainly theoretically you can have different processors implement functionality associated with one or more different kinds of data link layer protocols.
Q And you can have one processor that 11:45:49 implements MAC or Ethernet, and you can have one processor that implements MAC or Wi-Fi; correct?
A So then that characterization becomes vague and it's that vagueness that becomes an issue when you try and understand how those terms are used in 11:46:17

the context of the '775 patent.
So designing a hypothetical system or processor and saying, this is a processor that implements the functionality required to communicate via Ethernet, you're essentially saying what that Ethernet processor is or does. 11:46:32
The problem in the patent becomes in understanding the difference between a DOCSIS controller and a DOCSIS MAC processor.
Q. Do you understand what a controller is? 11:46:55
A. It's one of those terms that depends on what the context is as to what its specific meaning is. So it depends on the context.
Q. So you don't know what a controller is?
MR. BENYACAR: Object to the form. 11:47:16
THE DEPONENT: That's not what I said.
BY MS. ALLOR:
Q. Well, you didn't answer my question of asking you what a controller is?
A. I believe I did. 11:47:25
Q. You said it depends on context. So can you give me your understanding based on the '775 patent?
A. Sure.
The '775 patent doesn't say what a DOCSIS controller is. It identifies some exemplary 11:47:43

functions but doesn't provide any guidance for understanding four functions related to DOCSIS, whether it's a DOCSIS controller function or a DOCSIS MAC processor function.
In fact, it seems to suggest overlapping 11:48:07
functions across those two processors.
Q. So you added in DOCSIS controller. I was asking you: What is your understanding of a controller?
A. Sorry. I thought you asked -- last question 11:48:23
asked in the context of the '775 patent.
Back to your original question as to what a controller is, it's going to be the same answer I gave you before. It depends on what the context of that term is. 11:48:37
Q. So is it your opinion that the only controller discussed or described in the specification of the '775 patent is a DOCSIS controller?
A. It's my opinion that there's only the DOCSIS 11:48:51
controller Box 116 that uses that term in the context of a label in Figure 1. And I'm not sure if it the specification calls anything else a controller.
Q. So as a POSITA, you are being asked to put 11:49:11

together a cable modem system with a controller.
What would you understand that controller to be?
A. I would need clarification as to what kind of controller you're asking about. 11:49:40
Q. What kind of controllers are out there?
A. There's all sorts of controllers. I mean, it depends, again, on the context. Depends on what functionality you would define for a controller. There isn't some dictionary definition of a 11:50:05
controller for -- that applies in all contexts as it relates to what particular functionality is associated with that controller or not.
And, in fact, if you look at the specification of the '775 patent, it describes an 11:50:27
open-ended set of functions for the DOCSIS controller that overlap with functions that are described for the DOCSIS MAC processor which -- that creates the issue.
Q. Would you agree with me that a controller is 11:50:44
a device on which other devices rely for access to a computer subsystem?
A. That seems like a pretty high-level engineering definition. It probably can apply in at least some scenarios as to what a controller is. 11:51:24

Q. So taking that definition of controller, would you agree that a controller is not necessarily a processor?
A. I think that question needs to be clearly articulated. Well, my understanding of that 11:51:56
question is you're not asking about a controller that's in any way related to the '775 patent.
And then without that context, it's kind of a vague hypothetical. I'd have to give it some thought, probably depends on what you would consider 11:52:16
a processor as opposed to an embedded circuit. It would -- depends.
Q. As a POSITA you don't understand whether a controller can be a processor?
A. Your question is too vague to answer it one 11:52:48
way or another. I could answer it if you gave me more information, but as stated it is too vague to answer.
Q. In context of claims of the '775 patent in your opinion that you have given, is it fair to say 11:53:10
that it's your opinion that the DOCSIS MAC processor and the DOCSIS controller has to be implemented on separate processors?
A. So two things. That's how the invention is described at least in the specification. 11:53:47

Page 102

With respect to the requirements of the claim, it's not clear how something different than that, for example, a DOCSIS controller and a DOCSIS MAC processor implemented on the same processor, could meet the other requirements of Claims 18 and 19, for example, without the involvement portion of the claim. 11:54:16

Q So it's your opinion that Claim 18 requires that the DOCSIS controller and the DOCSIS MAC processor be implemented on separate processors? 11:54:44

A That's not what I just answered. That's not my opinion.

Q Well, I asked you if they could be implemented on the same processor, and I believe your answer was the specification and the claims say they have to be on separate processors, right? 11:55:09

A No. That was not my full answer.

Q Again, I'm asking: Can they be implemented on the same processors?

A Then it would be the answer I gave you the first time you asked that question. 11:55:40

Q If you could turn to Column 2 of the '775 patent, Lines 55 to 59 -- I'm sorry -- 58. It says (as read):

"Cable modem engine 110 implements the entire DOCSIS cable modem functionality and is further divided into three functional blocks: DOCSIS PHI layer 112, DOCSIS MAC processor 114, and DOCSIS controller 116." 11:56:05

Page 103

What is your understanding of the functional block of it being divided to three functional blocks?

A It's describing as one of the functional blocks the DOCSIS MAC processor 114 and the DOCSIS controller 116. So those functional blocks are then described as processor 114, which in Column 3 it says (as read): 11:56:54

"In one implementation that processor is an ARM9 TDMI RISC-based processor." 11:57:12

And then with respect to the DOCSIS controller, it describes that starting at Column 21. And I'll not read the rest into it.

It says (as read): 11:57:45

"In one implementation controller 116 is an ARM940-based RISC processor."

And then it goes on from there. So those functional blocks are then defined in terms of the 11:57:57

Page 104

processors for each of block 114 and block 116.

The DOCSIS PHI layer 112 doesn't use the term "processor" so we can review what the specification then says about that aspect.

Q Would a POSITA reading that passage understand when it refers to three functional blocks that it could be implemented on a single processor? 11:58:39

A That's not how the invention is described. So with respect to could you implement that functionality in one processor and deviate from the way the invention is described, possibly a person of skill in the art would think that. 11:59:04

Q And a POSITA would be familiar with blocked diagrams that show these separate functions and three separate blocks? 11:59:36

A Well, there's certainly the concept of functional blocks and functions, you know, potentially consistent with Figure 2.

And I think a person of skill in the art would also be consistent -- would understand the teachings of the '775 patent with respect to describing the invention from the processor perspective as conveyed both in Figure 1 and in Column 3. 11:59:50

Q Is it reasonable for a POSITA to interpret 12:00:08

Page 105

this portion of the specification as implementing those three separate functional blocks in the same physical hardware?

A In the same physical hardware is vague. It depends on -- I mean, does physical hardware mean the same form factor, the same overall cable modem? Does it mean the same processor, the same board, the same set of circuits? 12:00:40

That question is too vague to give you an accurate answer. 12:00:59

Q Would they read that passage and think that all three functional blocks could be implemented in a single processor?

A It's hard to say what a person of skill in the art would understand just based on looking at that paragraph. 12:01:14

Understanding the specification as a whole, I don't see where they would understand the invention to be implementing the functional blocks as described here of 114 and 116 with a single processor. 12:01:36

Q If you look at Column 4 of the '775 patent at Lines 13 to 19, it describes functional partitioning.

A Yes, I see that. 12:01:56

Page 106

Q And it says -- at Line 16 it says (as read):
"This is accomplished by localizing data networking functions in the data networking engine processor single and localizing cable modem function in the cable modem engine processor,"
single -- singular not plural.
Would you agree with that?
A I think that's what it says. But I don't think the use of those words there are consistent with how the invention is described or what's being described in Figure 1 which is what that paragraph is referring to. 12:02:09 12:02:26
Q But you agree it does describe a possible embodiment where there is a single processor for the cable modem engine? 12:02:50
A No. That is not correct. This isn't an embodiment that's separate from what's described for cable modem 100. So cable modem 100 is what this paragraph is talking about. 12:03:06
I agree that for the data networking engine it's described as having one processor, but with respect to the cable modem engine, the cable modem 100 that's described in the invention is implemented using two processors. 12:03:25

Page 107

I don't think that the use of the word "processor" after "cable modem engine" at Line 19 is supposed to be teaching that there's yet some other embodiment where the cable modem engine can be implemented with one processor. 12:03:44
It's either a typo, or it's just referring to the cable modem engine of the invention as described in Figure 1.
Q I think this passage is consistent with the claim language which says at least one processor for the cable modem engine, right? 12:03:59
A I disagree that it's consistent with the claim language because, again, as I testified, if you had a -- just one processor, then it's not clear how you would meet the requirements of the limitation where packets are directed to the data networking engine without the involvement of the DOCSIS controller. 12:04:16
If the CME is implemented in one chip, then every packet would be handled by the processor implementing both DOCSIS controller and DOCSIS MAC processor functionality, and so it wouldn't ever be possible to forward packets directly to data network engine without the involvement of the DOCSIS controller. 12:04:36 12:04:58

Page 108

And that's --
Q Do you think it's not -- I'm sorry.
A Sorry. That's part of what makes the claim indefinite, and I suspect that if that is being described as a viable option for the claim scope, or if it's determined that that's a viable option for the claim scope, there certainly is no written description for how you could accomplish that functionality without the involvement of the DOCSIS controller if it's all in the same processor. 12:05:09 12:05:31
Q Well, I think it describes it with the heading right there, functional partitioning, which means the functions are partitioned on a single processor, wouldn't you agree?
A No. The functional partitioning that it's describing is the functional partitioning between the data network engine and the cable modem engine. 12:05:51
Q But it's also referring to the ability to functionally partition the functions that are part of the cable modem engine? 12:06:10
A I don't think it's saying that.
Q I believe your opinion relating to the MAC processor is that it has to be the ARM9 TDMI-based RISC processor that's listed in the specification.
Is that -- is that fair? 12:06:56

Page 109

A You have to point me to where I say that in the declaration. I don't believe that's what I say.
Q I think in Paragraph 47, I'm testing you, you describe how there are certain ARM processors described in the specification. 12:08:14
Let me see if I -- so if you could turn there.
A Yes, I see those two paragraphs. I don't think they say what you say I said.
Q Well, earlier when we were talking about the ARM1, the ARM2, you pointed me to the specification where you said that ARM2 was the ARM9 TDMI-based RISC processor, and I believe you pointed to Column 3 when you made that statement? 12:08:39
A Right. 12:09:08
So I think what Paragraphs 47 and 50 say is, I think, at least for processor 114, it is described as an ARM processor.
As to the further detail, it's an ARM9 TDMI-based RISC processor. That is under the description where it says (as read): 12:09:40
"In one implementation."
So in one implementation it's an ARM9 TDMI-based RISC processor, but in the rest of the specification, it says that it's an ARM processor. 12:10:02

Page 110

Q Okay.
So it's not limited to that processor, is what you were saying?
A I don't think that it's -- at least in Claims 18 and 19, it's not limited to an ARM9 TDMI-based RISC processor because that's described as an embodiment, but it is more generally defined in the invention as being an ARM processor. 12:10:18
MS. ALLOR: Okay.
I think this might be a good time for a break. 12:10:39
THE DEPONENT: Okay.
THE VIDEOGRAPHER: We're off the record. 12:10 p.m.
(Whereupon, at the hour of 12:10 p.m., a luncheon recess was taken, the deposition to be resumed at 12:47 p.m.) 12:11:49

Page 111

Santa Barbara, California; Friday, April 28, 2023
12:47 p.m.

THE VIDEOGRAPHER: On record. 12:47 p.m.

KEVIN ALMEROTH, PH.D.,
having been previously duly sworn, was examined and testified as follows:

EXAMINATION (RESUMED) 12:47:12

BY MS. ALLOR:
Q Welcome back, Dr. Almeroth.
Before we went on lunch, we were talking at great detail about the '775 patent. I just have a couple more questions on that. 12:47:23
If you could look at Claim 18.
A Okay. Got it.
Q So you see that the last element of Claim 18 is a data bus that connects the data networking engine to the cable modem engine. 12:47:41
Do you see that?
A I do.
Q And earlier when we were talking about, you know, your opinion that there has to be two processors -- at least two processors in the cable 12:47:54

Page 112

modem engine, you were pointing me to Figure 1.
Is that fair?
A I was saying that in -- in the invention as described in Figure 1 there are two processors, ARM1 and ARM2 described. 12:48:17
Q And it's your opinion that the fact that there's a data bus between the cable modem engine and the data networking engine, that's why it's indefinite to you.
Is that -- is that fair? 12:48:29
MR. BENYACAR: Object to the form.
THE DEPONENT: No. I don't think that characterization is wholly accurate.
BY MS. ALLOR:
Q If you look at Paragraph 79 of your opinion 12:49:12 in your declaration, it says -- it recites Claim 18 of the data bus element that we just talked about. It says (as read):
"This limitation renders a claim indefinite as the wherein clause is 12:49:27 incompatible, the requirement that a data bus connects the DNE and the CME."
A Right.
Q So is it the fact that there is a data bus 12:49:37

Page 113

present, that that is why you believe the claim is indefinite?
A The claim is indefinite for the -- the part that you didn't read. It's -- it's -- the wherein clause is incompatible with the requirement that the 12:49:59 data bus connect the DNE and CME because of what the applicant said during prosecution and identified the data bus in Brooks as being one of the reasons why there was no separation between the first circuit and the second circuit. 12:50:20
Q But you would agree that the claim described the data bus and that Figure 1 shows the data bus?
A The claims do require a data bus, and Figure 1 does show a data bus, but in light of what the applicant said during prosecution, I think that 12:50:51 the statements made during prosecution create a significant problem for a person of skill in the art to understand what the claims would actually cover.
Q So it's your position that the data bus connecting the cable modem engine, the data 12:51:16 networking engine result in them not being completely partitioned?
A It's my opinion that's what the applicant said. Actually, so to be clear, the completely partitioned -- yes. It's my opinion that that's 12:51:38

Page 114

what the applicant said during prosecution.
And so if that's correct, then that creates an indefiniteness problem in the claims.
Q So when you say that that's what the applicant said, the applicant did not say that you couldn't have a data bus. 12:52:04
The data bus was in the claim element, was it not?
A What the applicant said -- and probably the most appropriate paragraph there is Paragraph 61 -- that the applicant identified what was part of 102 and 104, kind of what the analogous identified CME and DNE were and said because they were sharing the same data paths and sharing the same direct memory access controller and then there's the parenthetical that includes ASB 210, which in the Brooks figure which is included on the next page, that ASB 210 is the data bus, the applicant said, because there is that shared data path between them, that Brooks didn't disclose the claim. 12:52:15 12:52:53 12:53:25
So that seemed pretty clear to me as to what the basis was for why Brooks was described by the applicant as not meeting the limitation.
Q Putting aside your opinion on the prosecution history, is the claim on its own indefinite because 12:54:28

Page 115

there's a data bus connecting the cable modem engine and the data networking engine?
A First part is it's a little hard for me to separate out and ignore the intrinsic record and create a hypothetical where the intrinsic record is not to be considered in understanding what a person of skill in the art would understand about the claims. 12:55:11
But in attempting to do so, the challenge still becomes with respect to the wherein clause of the data bus limitations where you have the cable modem engine and the home networking functions of the data networking engine being completely partitioned and having separate circuits when how a circuit is to be interpreted by a person of skill in the art in the context of the '775 patent is not reasonably certain. 12:55:28 12:55:54
Q But isn't it your opinion -- and we've discussed this a lot today -- that you can't tell me what the meaning of circuit is with respect to the '775 patent? 12:56:13
MR. BENYACAR: Object to the form. Misstates testimony.
THE DEPONENT: Yeah. It's not about whether or not there's a definition. It's -- the 12:56:24

Page 116

definitions are all -- that it's a broad term and you have to have some context for it.
I think the testimony revolves around there being a lot of different levels, and if you considered different possible levels, even some introduced by Dr. Kramer, as additional levels, then it makes the claim not reasonably understandable or reasonably certain to a person of skill in the art. 12:56:36
BY MS. ALLOR:
Q But you are aware the examiner never issued any indefiniteness rejections, right? 12:57:16
A I would have to go back and check. I thought there was an indefiniteness before the claims were amended. Maybe I'm misremembering. But I think the -- the prosecution history... 12:57:36
Q Well, the examiner doesn't issue an indefiniteness rejection at the -- you know, after the claims were amended and prior to allowance?
A Right. And I thought about that. And I think what happened is in terms of coming up with a reason to traverse Brooks the applicant made statements that distinguished the claims from Brooks but there wasn't really a consideration for the totality of the impact of those statements as it relates to how a person of skill in the art would 12:57:58 12:58:21

Page 117

actually understand as to what the scope of the claims -- the resulting scope of the claims would be and that's, I think, in part when you do start to think of the scope of the claims as understood by a person of skill in the art, it becomes clear that they are not reasonably certain because of what the applicant said -- or at least one of the reasons. 12:58:44
Q So if you look at your Paragraph 62 where you reproduced Figure 2, Brooks.
A Yes. 12:59:28
Q Is it your understanding that the examiner mapped processor 1, which is No. 102, with a data networking engine and processor 2, which is No. 104, to the cable modem engine?
A That is my recollection. I'd have to go back and double-check. I think that's -- that's correct. And then I think the applicant came back and said, no, there's some additional things, components that needed to be considered. Those are in Paragraph 61. So it's also blocks 114, 118, 224 and 228. 12:59:51 01:00:05
Q So wasn't the real issue that the CMAC, which is 224, that the examiner was attributing cable modem engine functionality to both processor 2 No. 104, and the CMAC?
A You know, I -- I don't think that is 01:00:47

Page 118

accurate. More importantly, I think it's pretty clear in that quote in Paragraph 61 -- and it's the italicized portion -- it's what the applicant said. So kind of -- I know there's been some statements from Dr. Kramer about, well, the applicant was uncertain what the examiner was saying and they are a little bit hard to parse.

He's almost saying, like, I think the applicant was thinking the examiner was thinking.

But ultimately the important point is when the applicant identified what was part of the DNE and the CME, it identified additional numbered parts of the figure that's reproduced as being something that shares the same data path and the same direct memory access controller and pointed to the data bus, ASB 210 and said that was an example where the data paths between the CME and the DNE were shared.

And that's -- that pretty clear description is what I think creates the indefiniteness problem as it relates to the data bus portion of the claim.

Q Did you look at the rest of the file history and the rest of the arguments regarding Brooks?

A Yes, I did.

And I even considered what Dr. Kramer said about other portions of the file history and, you know, I've looked through each of the things that he said about the file history.

And it ultimately doesn't change my opinion with respect to what the applicant wrote and that I've cited in Paragraph 61.

Q So you don't think that the applicant argument that the processor 1, No. 102, that handled some cable modem function so you don't think that's relevant at all?

A No. Didn't say that.

Q So I'm going to turn to Paragraph 80 of your declaration, the '690 patent, and let's add the '690 patent as an exhibit for you.

(Exhibit 6 was marked for identification and is attached hereto.)

BY MS. ALLOR:

Q You should have Exhibit 6 now in your folder.

A I have it downloaded and open.

It's on my phone. I put it on.

Q So when you prepared your declaration, with respect to the '690 patent, what was the priority date that you applied?

MR. BENYACAR: I think you're on mute.

THE DEPONENT: I assumed for purposes of the provisional -- the provisional was the earliest priority date, December 15, 2008.

Q And in Paragraph 80 you're quoting some lines from -- from the '690 patent at Column 1, 48 to 63.

Do you see that?

A I am.

Q Is that -- is that language directed to the '690 patent -- the invention of the '690 patent or is it directed to prior art?

A This particular sentence would apply to both. The distinction becomes as the '690 patent would allow for allow for is instead of using a fixed predetermined probe that a dynamic probe can be determined.

Q And where are you reading that from?

A So the first part of the answer with respect to the idea that between nodes of the network that probes are sent into predefined format, that's applicable to both the prior art and the '690 patent.

With respect to what the '690 patent is supposed to innovate on, that's at the bottom of Column 1 where sending kind of a fixed predetermined probe reduces the amount of the flexibility of the characterization process.

And so the summary of the invention would be allow -- to create the ability to send a probe pattern that's based on what the requirements of the invention in the claim are.

Q We should look at Claim 1 of the '690 patent.

A Yes.

Q Is it your position that Claim 1 requires a receiving node to be the node that initially sends the probe request?

A Sorry. Could you repeat that?

Q So Claim 1 -- and also I'm looking at your opinion in Paragraph 83. So I'm trying to understand what it is that your opinion is and whether it's -- the fact that you believe Claim 1 requires that the receiving node be the node that initially sends the probe requests.

A So consistent with Figure 4 the thing that's receiving the probe request is the first node, and the first node would be the probe transmitter.

So it's receiving a request for a probe from the probe receiver, and then it's going to determine the second plurality of parameters and then generate the probe and then transmit the probe.

I mean, that's kind of consistent with how Figure 4 is describing the invention.

Page 122

Q Where in the claim language does it say that the requesting node is the same as the receiving node?

A I think maybe it would -- Figure 4 in the context of Claim 1, so you said the receiving node. So I'm assuming you're asking about receiving in a first node. Okay. 01:11:29

So that's -- the first node is receiving, and then it says a probe request. So there's a first node that receives a probe request. 01:11:46

And I'll stop there. The -- there's an idea of -- the question of who's going to be transmitting the probe request. That's shown in Figure 4 is coming from the probe receiver.

It doesn't say where the probe request is coming from in Claim 1, but I think, based on Figure 4 as to what the invention is and kind of the goals of the invention and how it's described, it would be understood that that probe request is coming from the probe receiver. 01:12:11 01:12:31

And so the probe receiver is not the first node. It would be some other node.

Q You use the word "requesting node" in your Paragraph 83. I didn't say that was in the claim language at all. 01:12:57

Page 123

A Okay.

Q So I was trying to understand your opinion in 83 and where in the claim language of number -- Claim 1, where do you see the requirement that the receiving node be the node that initially sends the probe requests? 01:13:13

MR. BENYACAR: Objection; asked and answered.

THE DEPONENT: Maybe I understand your confusion. In Paragraph 83 it says (as read):

"Wherein the receiving node." 01:13:36

And you're interpreting that to refer to Limitation 1A that says receiving in a first node. And that receiving node and receiving in a first node are the same thing. And that's -- that's not the case. 01:13:54

So to kind of use the terminology of Figure 4 and the claim in Paragraph 83, let me try and resolve it.

So the way that this works is there's a probe request that's sent from what's called the probe receiver, and it's a little bit confusing because you send -- send a request from a receiver. 01:14:09

But the idea is that the probe receiver tells the probe transmitter, "Hey, this is a first plurality of parameters," and the rest of the 01:14:26

Page 124

language.

The probe transmitter receives that, generates the probe, and there's a second set of parameters, and then sends the probe.

And now the probe receiver gets it, and using the pattern it's received is able to tell something about the communication path. 01:14:41

So the probe -- receiving in a first node is actually the probe transmitter. In Paragraph 83 when I said "wherein the receiving node," and it says in parentheses, which can also be referred to as the requesting node, that's the probe receiver. 01:14:58

So 1A is talking about the probe transmitter as being the first node. And I'm talking about in the first sentence of 83, the probe receiver, the thing that receives the probe. 01:15:16

BY MS. ALLOR:

Q So with respect to Claim 1, receiving in a first node, you're referring to that in your Paragraph 83 as the receiving node; is that correct? 01:15:41

A No. No.

Q You're referring to that as the problem transmitter of Figure 4?

A In the first sentence of 83, that's correct.

Q So where in the claim language does it say 01:16:03

Page 125

that the second node, which is if we map that to Figure 4, is, in your opinion, the probe receiver, where does it say that the second node has to be the same node that transmitted that initial request?

A That's all the invention ever describes it as. That's the only thing that would make sense in the context of the invention. 01:16:28

Q If you look at specification at Column 7, Lines 12 to 13, it says --

A I did. 01:16:57

Q (As read):

"In other embodiments the probe request might be transmitted by a different probe than the probe receiver." 01:17:07

Do you see that?

A On a different node but otherwise I think you read it correctly, and I see it.

Q So doesn't that say that it does not have to be set up the way you just argued that Claim 1 is? 01:17:18

A I see that embodiment with respect to who does the transmitting of the probe request.

You are right. It doesn't say that it has to come from a second node. It could come from a third node. 01:18:47

Page 126

There's no as of yet second or third node identified in Claim 1. That doesn't -- that's not the point of the first sentence, though, I see your point.

Q Okay. 01:19:01

And, in fact, dependent Claim 6 actually adds that requirement, that probe request be generated by the second node.

So would you agree with me that claim differentiation means that the dependent claim has 01:19:15 to add something to the independent claim, and so the probe request does not need to be generated by the second node in Claim 1?

A I see that I'd have to look at claim differentiation in Claim 6. I haven't looked at it 01:19:37 so far.

I'd have to give it a little bit more thought, but that seems right as least with respect to who can generate the probe request.

Q So if we look at the rest of your 01:19:56 Paragraph 83, you say that both Claims 1 and 9 require a first plurality of parameters and a second plurality of parameters.

Do you see that?

A I see that. 01:20:15

Page 127

Q In your --

A Let me back up.

Can you repeat the question? Because I'm trying to -- I just want to double-check the language you used in your question. 01:20:37

Q So in your Paragraph 83, you say that Claims 1 and 9 require or have a first plurality of parameters and a second plurality of parameters.

Do you see that?

A I see that. 01:21:04

Q And if we look at Claims 1 and Claim 9, we see the language showing up in both of them, a first plurality of parameters and a second plurality of parameters.

Is that fair? 01:21:23

A Yes.

Q So my question is, is it your understanding that in Claims 1 and in Claims 9 that the first plurality of parameters are specified in the probe requests? 01:21:38

A That's what it says, a probe request specifying the first plurality of parameters at least in Claim 1. I think there's something similar in Claim 9, the probe request specifying a first plurality of probe parameters for a physical layer 01:21:59

Page 128

probe.

Q And then you would agree that the claim language specifies or states that the second plurality of parameters are determined, for example, in the node that generates the probe? 01:22:25

A I know Claim 9 explicitly says (as read):

"The second plurality of parameters are determined by the second node."

That's at the very end of the claim. In Claim 1 it doesn't say what determines a second 01:22:58 plurality of parameters associated with generation and transmission of the probe.

It could be, for example, the second node. I think -- that's not shown -- I don't think that's discussed in the specification, to my recollection. 01:23:27 I don't think there's much of a discussion of the second plurality of parameters.

Q We can just focus on Claim 9 then because my question is, what is the difference between specifying the parameters with respect to the first 01:23:53 plurality and determining the parameters with respect to the second plurality?

A I'm not sure I can articulate a difference between the two. I think in the way in which they are used provides some guidance so the probe request 01:24:19

Page 129

has to specify.

So the probe request would, for example, be a message, and so that would have to specify in the message.

The determining would be more about creating 01:24:31 those second plurality of parameters, determining what they are.

Q So if we go back to look at Claim 1 there it uses the language dictated by the first plurality of parameters. 01:25:17

Do you see that? Wherein the form -- wherein the probe has a form dictated by the first plurality of parameters?

A Yes.

Q And if we look at Claim 9, it says (as read): 01:25:30

"Wherein the probe is generated in accordance with the first plurality of parameters" -- oh, sorry. I meant to read (as read):

"Comprising a form for the probe." 01:25:48

So I want to compare in Claim 1 wherein the probe has a form dictated by the first plurality of parameters to Claim 9 where it says (as read):

"The first plurality of probe parameters comprising a form for the 01:26:10

Page 130

probe."
And my question is, what is the difference in the claim language there?
A I'm not sure what you're asking. I mean, I see that -- the different words. 01:26:27
If you're asking me to compare and contrast the claim scope between the two of those, I'm not sure how you would want me to do that even if that's what you're asking.
So maybe you have to provide a better worded 01:26:48 question.
Q Well, in Paragraph 84 you -- you make the statement that those are similar.
And my question is, how are they similar and if they -- if it is your opinion that they are 01:27:01 similar, I want to understand how come you think they are similar?
A The claims -- they are similar. The claims appear to both cover the form of the probe being determined only by the parameters sent by the 01:27:32 requesting node, by what's included in the first plurality of parameters.
Q In your opinion, there's no difference in those phrases?
A I didn't say there were any differences. You 01:27:59

Page 131

asked about the similarities.
I identified -- that sentence is identifying the similarities that doesn't lead to a conclusion that there's no differences.
Q How would you determine the term "parameter" 01:28:10 from the prospective of a POSITA?
A I don't have a particular dictionary definition that I've offered. I believe there are some examples of what parameters would be in the patent. 01:28:41
I think it's around Column 2 about Lines 10. It talks about what parameters can include.
Q Are there other kinds of parameters besides those listed in Column 2?
A There could be as long as they meet the 01:29:12 requirements of -- of both what the claims require, right? It does -- in Column 2, it says (as read):
"Accordingly the probe request specifies a plurality of parameters associated with the generation and 01:29:35 transmission of a probe, including the content of the payload of the probe."
And then it goes on to say -- in one embodiment it talks about what some of those examples would be. So I think consistent with the 01:29:48

Page 132

way the patent talks about what the parameters would be, that would define how that term is used in the claims.
Q Is there information that's included in the creation of the probe so in the message that's being 01:30:17 sent besides just the parameters?
A That question is vague with respect to in the creation of the probe.
Q Well, I believe you said that the parameters are specified in the probe request. Is there other 01:30:43 information that's included in that probe request?
A I don't understand the question as to whether or not you're asking whether or not there could be a hypothetical system where there are messages that include additional information in the probe request 01:31:04 or whether or not the claims require it, allow for it.
Your question is not specific.
Q So you pointed me to some parameters in Column 2, and I'm just asking if there's other 01:31:23 information that could be transmitted in the probe request besides the parameters that are described there.
A That question does not resolve the ambiguity I had with the previous question. 01:31:38

Page 133

Q In the context of a CMTS and a cable modem, wouldn't you agree that the purpose of the probe is to communicate information and measurements from the cable modem back to the CMTS?
A No. 01:32:05
Q So what is the purpose of the probe?
A Well, the probe is what would get sent from the CMTS to the cable modem, I think, consistent with the DOCSIS describes a probe.
So that would have -- whatever the particular 01:32:34 pattern that would be identified in the probe, cable modem would receive that and could potentially generate some results based on having received that probe.
But I think what you described in your 01:32:51 question was something different than what the probe would be.
Q What information is being transmitted from the cable modem to the CMTS?
A Again, your question is vague with respect to 01:33:15 what it says in the specification, what the claims require, what's identified in DOCSIS in some accused system, some hypothetical system.
Your question doesn't provide any context.
Q So as a POSITA you can't explain to me what 01:33:29

information is being sent back from the cable modem?
MR. BENYACAR: Object to the form.
THE DEPONENT: It would be the same answer. I could if you told me information sufficient to answer the question. 01:33:47
BY MS. ALLOR:
Q So isn't it true that the node that receives the probe request, that that node is what's determining the information to include in the probe?
A Your -- again, your question isn't really specific to -- you're talking about the patent, the claim. I can assume one or you can tell me which one. 01:34:26
Q Well, if you look at Claim 1, it says (as read): 01:34:46
"Receiving in the first node a probe request."
And so my question is in that first node that's receiving the probe request, it is then specifying the responsive information and measurements that it's going to include in the transmission of a probe. 01:35:05
Is that correct?
A No.
Q Okay. 01:35:20

Why not?
A You said, information and measurements? That's -- that's not what would go into a probe.
It's not what -- the specification describes, for example, in Figure 4, generating -- (as read): 01:35:45
"Generate probe according to specified parameters."
And then transmitting the generated probe signal. That's not information and measurements.
Information is vague, but consistent with, I think, how you started the discussion of this whole patent, that's supposed to be whatever sequence of information that's been created. 01:35:57
So instead of a predetermined probe, it's now a probe whose form is determined -- well, then the claim says it's supposed to be dictated by the first plurality of parameters, and that creates the indefinite issue in Claim 1 and Claim 9 because that form is actually determined by the first and second plurality of parameters. 01:36:17
So it's not information and measurement -- measurements. 01:36:41
Q It's a plurality of parameters, parameters being the described in the specification.
A There's multiple pluralities of parameters 01:37:04

described in the claims and in this specification. Well, there's at least the first plurality of parameters that's described in the specification. The claims have two pluralities.
Q I'm introducing as Exhibit 7 the '682 patent. 01:37:18
(Exhibit 7 was marked for identification and is attached hereto.)
BY MS. ALLOR:
Q Let me know when you have it. 01:38:21
A I have downloaded it and I have it open. Exhibit 7.
Q Okay.
Great. The portion of your declaration that addresses the '682 patent, it starts with Paragraph 85. 01:38:38
Do you see that?
A Yes.
Q When you were preparing your declaration, what priority date did you assume for the '682 patent? 01:38:48
A For purposes of evaluating this patent, I assumed it was the earliest provisional that was filed.
I believe it's July 23, 2012, and just to be 01:39:05

clear, that's the assumption I made.
I didn't do any analysis to determine if -- the provisional support, the priority date, et cetera.
Q That's -- that's fine. I mean, I'm just asking because you don't have a date listed anywhere. 01:39:22
So I was just trying to get your understanding of what time your opinions are based in. 01:39:29
A Understood.
Q So if you could turn to Paragraph 90 of your declaration.
A Okay.
Q So here you've annotated Figure 2B? 01:39:47
A Yes.
Q Why have you labeled each step of this graph as an individual cable modem?
A So the reason for that is at -- by Paragraph 90 we now have this hypothetical service group. 01:40:08
So we've gone through the limitations of Claim 1 where the CMTS has assigned each cable modem among a plurality of service groups.
So now what I'm trying to describe is this 01:40:27

Page 138

composite worst case S&R profile.
And so that composite worst case S&R profile is for each of the cable modems in this hypothetical service group and for each of the sub-frequencies that are identified, there is going to be a worst case S&R value among the members of the service group. 01:40:47
And so the reason why you look at the worst case S&R profile or the worst case S&R at each of the frequency sub-bands is to understand among the service group what the worst case S&R is. 01:41:11
And so the -- the labeled version of 2B shows that the composite at each of the sub-frequencies is to pick among the S&R values at each sub-frequency what's the worst case S&R. 01:41:38
And so the reason that kind of description is contained in Paragraph 90, the sentence that transitions from Page 40 to 41 says I've annotated that figure to show those particular examples.
And so CMA has the worst -- sorry, CMA, cable modem A, has the worst S&R at sub-carriers 2, 5 and 7. CMB is at sub-carrier 1. And then, et cetera. 01:42:02
And then that's kind of the modified version of 2B that's shown after Paragraph 90.
Q. Okay. 01:42:26

Page 139

I believe you said that this is the composite worst case S&R for each of these cable modems?
Is that -- that what you said?
A. No.
Q. You said (as read): 01:42:50
"And so that -- the composite worst case S&R profile is -- these are the cable modems in this hypothetical where -- at the sub-frequencies you're identifying." 01:43:04
A. Right. That last part you didn't add.
So the composite is a combination, and so at each sub-frequency, you look at the S&R values from each of the five cable modems in the hypothetical service group, and you pick the worst case S&R value. 01:43:18
And that becomes the worst case S&R value for that particular sub-frequency.
And the profile then is the worst case S&R value at each of the sub-frequencies and the composite is for the collection of the five cable modems as measured across the five cable modems in the hypothetical service group. 01:43:38
Q. So are you saying that -- so the figure that you have there shows -- if I start at the top of the 01:44:08

Page 140

left corner, you have CMB. So is that cable modem B?
A. Yes.
Q. And then we move down, and we've got cable modem A -- 01:44:18
A. Yes.
Q. -- at sub 2.
So my question is, you show cable modem A three times.
A. Right. 01:44:30
Q. So are those -- are those -- are you identifying what's the worst case -- or, sorry, what's the worst cable modem at each step?
A. So the worst case S&R among the set of five cable modems at each step. 01:44:49
Q. Okay.
So if -- if our service group was cable modem A, B, C, D, E, you're saying at sub-frequency 1, cable modem B has got the worst S&R. At sub-frequency 2, cable modem A has the worst case S&R? 01:45:07
A. That's correct. That would be the composite worst case S&R value for each sub-frequency. So when you do all of the sub-frequencies together, that makes a profile. 01:45:32

Page 141

Q. Okay.
I think I understand what you are saying.
So if we turn to Paragraph 94, the first -- the first sentence -- well, sorry, the second sentence, you said (as read): 01:45:52
"Since the worst case S&R is always an S&R of zero, a POSITA seeing the term "worst case S&R profile" would likely assume" -- "well, would most likely assume and is an S&R profile containing only zeros." 01:46:05
Do you see that?
A. I do.
Q. So where did you get your opinion that the worst case S&R is always an S&R of zero? 01:46:14
A. So this is on the point that a worst case S&R profile without understanding what that means in the context of the invention and what the set of values are that this -- claims in the patent describes as being the basis for selecting the worst case S&R profile to build a composite, just saying you have a worst case S&R profile. 01:46:38
It would be a -- the worst case for signal-to-noise ratio is a zero signal, so a zero.
The point of this paragraph is to show that 01:47:00

Page 142

what this is really referring to when you talk about a worst case S&R profile is there has to be a set of S&R values or -- for one sub-frequency or an S&R profile across multiple frequencies against which you have to pick the worst case. 01:47:23

So it's like saying if I had five number -- if I said, what's the lowest possible number, you would say, well, it's zero, assuming non-negative numbers. So it's always going to be zero. 01:47:39

If I said, what's the -- the lowest value among 2, 3, 8, 7, and 10, you would say, oh, okay, well, in that sense it's 2. It's the lowest value among that set of values.

So the point I'm making in the first couple 01:47:52 of sentences of Paragraph 94 is this term doesn't have a plain and ordinary meaning because if -- if you look at the plain and ordinary meaning, it's always going to be zero. You have to look at what the claim in the specification says when it refers 01:48:09 to a worst case S&R profile.

And so it's referring to the composite worst case S&R profile, the composite being the combination of those values in the set to make the value meaningful. 01:48:25

Page 143

Q If I look at Figure 2B, isn't it true that Line 224 is the minimums and that's not set at zero?

A So 224 is described once, so that's saying the S&R needed for receiving the message 202 may be the Line 224. So in order to determine what 224 is, 01:49:41 it has to be less than all of the values at 222.

And that's -- that's not actually a worst case value if it's -- even if you're asking about the worst case to be able to successfully transmit, that's a worst case -- I mean, it would depend on 01:50:26 the sub-frequency. It would actually be just below each of those sub-frequencies which would be what's described in the next figure, Figure 2C, as the solid line, 226.

There's also a difference in the line at 224 01:50:52 where it looks to be taking a worst case value of all of the sub-frequencies and identifying something below that for all of the sub-frequencies. So if you compared 224 to 226.

So that's -- 224 is something different than 01:51:21 226.

Q Well, wouldn't you agree that if the signal ratio, the S&R was a zero, you wouldn't be able to receive and accurately measure the S&R profile?

A You wouldn't be able to do much with an S&R 01:51:47

Page 144

of zero, which is why just saying a worst case S&R profile, a person of skill in the art, seeing that term in the claim, would look to the specification to understand what it means by a worst case S&R profile, and what the specification described is 01:52:05 when you have a worst case, in the context of an S&R profile, it's talking about a composite worst case.

You're figuring out the lowest value among the set of values. If you don't have the context for the set of values, then it's just going to be 01:52:24 zero. It's back to my example of what's the smallest number possible.

Without -- it finding a set of values over which to evaluate that condition, it's just going to be zero. So I think your question goes to why it 01:52:37 has to be something other than just zero, and I agree, I think a person of ordinary skill in the art would accept that and look to understand what the patent means when it says a worst case S&R profile, and that would be the composite. 01:53:01

Q Right.

But if there was a cable modem in the service group that was at zero, and they set the composite at zero, that cable modem would not be receiving and transmitting -- I'm sorry, receiving and accurately 01:53:29

Page 145

measuring S&R.

A That's an interesting hypothetical. If you had a cable modem with an S&R of zero, it logically would not be in the service group. I mean, the whole point of what the patent is describing here is 01:53:40 for each service group being able to identify a worst case S&R sufficient to meet all the requirements of the cable modems in the service group.

Q I know we have been talking about S&R. Just 01:54:16 for clarity's sake, what does S&R mean to you?

A It stands for signal-to-noise ratio.

Q What is the noise part of the S&R?

A It's usually the noise that's introduced on a channel, can come from a variety of sources, 01:54:31 interference, cross-talk, signal fade, those kinds of things.

Q Is there such thing as harmonic noise in a cable communications system?

A I would have to double-check. I think there 01:54:46 can be a variety of sources of noise in a cable TV system. I don't have the set of noise sources memorized.

Q Have you heard of first noise?

A Yes. 01:55:02

Page 146

Q And what about electromagnetic interference noise?
A I did mention interference as a source of noise already.
Q Okay. 01:55:18
A It depends on the system whether or not those are the kinds of noises -- noise sources that you are trying to adjust for.
Q So you are not sure if the '682 patent is describing measurements of those types of noises? 01:55:36
A Tying it back to the '682 and what the '682 patent covers, I don't have the list of noise sources contemplated in the invention and according to the claims memorized. I would have to go through and see if there are certain noise sources that are 01:55:57 included or excluded based on what it says. That's not an analysis I've yet done.
Q And how is S&R measured?
A It depends on the system.
Q Do you know how it's measured with respect to 01:56:33 the system described in the '682 patent?
A I don't know that the system of the '682 patent describes a particular way. I'd have to go back and check the specification. It's not a question I tried to answer, so maybe there are 01:56:52

Page 147

limits within the invention or in the claims, but I'd have to look and see.
Q Why don't we take a short break?
MR. BENYACAR: Okay.
THE VIDEOGRAPHER: Going off record at 01:57:16 1:57 p.m.
(Recess.)
THE VIDEOGRAPHER: We're back on record. 2:09 p.m.
BY MS. ALLOR: 02:09:57
Q Dr. Almeroth, before we breaked (sic), we were talking about measuring S&R.
Do you have an example of a system that's used to measure S&R?
A I remember a paper that we worked on. It was 02:10:11 more in the wireless context than cable TV. At least in that context, when we were sending signals over the air, we would compare probe requests and particular patterns of bits that were sent to what was received, and we'd have to do it kind of at the 02:10:47 physical layer for the signal itself to be able to try and determine the difference between what was transmitted and what was actually received in our case to try and develop the noise profile so that we could make determinations about the status of the -- 02:11:06

Page 148

in that case, again, wireless channel.
Q What does the phrase "S&R metric" mean to you as a POSITA?
A I think there's a discussion of S&R metric versus profile. I don't think an S&R metric has a 02:11:33 specific meaning to a person of skill in the art, but with respect to how that term is used in the '682 claims, I believe there's a discussion about the similarity between metric and profile, and I think that there's a citation that points to 02:12:01 essentially where they are used interchangeably.
Q If we look at Claim 1 on the '682 patent.
A I'm there.
Q So it says (as read):
"Generating -- generating by the 02:12:31 CMTS for each one of said plurality of service groups a composite S&R-related metric based at least in part on a worst case S&R profile of said S&R related metrics corresponding to said 02:12:49 one of said plurality of service groups."
Do you see that?
A I do.
Q I believe this is the element that is in your 02:12:59

Page 149

opinion that you say this element is the reason that, you know, the claim is indefinite. I think he points you to a few other things as well.
But focusing on this element, I think one of your positions is that the composite S&R-related 02:13:14 metric is the same as the worst case S&R profile; is that accurate?
A I mean, that's close. When trying to understand what the worst case S&R profile is, you have to look at -- that's the part that says, well, 02:13:36 that's actually a composite worst case S&R profile for the reasons that I think we talked about in Paragraph 94.
Then with respect to a composite S&R related metric, the first kind of analysis is looking at 02:13:54 what a metric is versus a profile. That's the first part of 95.
And then if it's a composite S&R-related profile, the composite that the patent described is a composite of the worst case. 02:14:10
And I know Dr. Kramer said, oh, well, it could be the best case or some other case. But that's -- that doesn't make any sense in the context of the invention or what's described specifically as the invention. You are looking for the worst case. 02:14:26

Page 150

So when you understand that the composite S&R-related metric based at least in part on worst case S&R profile, would mean to a person of skill in the art that you are talking about a composite worst case S&R-related profile be based on the same thing. 02:14:43
that's part of -- that's the first argument as it relates to this limitation and indefiniteness.
The second is also in that limitation as it relates to an antecedent basis point, and that's in Paragraph 97. 02:15:02
Q So I think you're inserting the word "composite" -- or sorry -- yeah, "composite into the claim term worst case S&R profiles. And I'm not sure where you're getting that from. So maybe you could explain to me why your calling the composite 02:15:18
the worst case composite S&R profile?
A It's -- I'm saying the worst case S&R profile doesn't have a meaning in the art. This is all in Paragraph 94.
And I think it's where you started, but I'll 02:15:36
try and re-describe it again. I'll summarize, and you can look to Paragraph 94 for details.
It doesn't have a plain and ordinary meaning to the extent that you do -- that you do look at it. Then there's no context for it, that it would just 02:15:51

Page 151

be zero.
So you have to look at -- you're really trying to figure out as a worst case among a set of values. Otherwise, if you have no values, it would all be zero; right? 02:16:05
And I gave you an example of no set of values at zero, and then the other case you look at numbers like 3, 4, 5 and 10. It would be the worst case, so it will be 3.
So when a person of skill in the art, reading 02:16:18
that portion of the limitations sees worst case S&R profile, the specification supports that it's actually talking about a composite worst case S&R profile.
So that's why I believe that's what a person 02:16:33
of skill in the art would understand it to mean. Moreover, the language itself says a worst case S&R profile of said S&R-related metrics corresponding to set 1 of said one service groups. So setting aside the antecedent basis, it says that it's a composite 02:16:52
of the S&R-related metrics for at least one of the groups. And so it's saying it's a composite value based on the worst case that following S&R profile.
Q And you would agree with me that the claim language says that the composite S&R-related metric 02:17:14

Page 152

is only based in part on a worst case S&R profile. So there -- it could be based on something else as well.
Would you agree with that?
A I see the language of the claim. When you 02:17:27
look at what it actually means, it's not saying what else it's based on. But the idea that something is based at least in part on itself and then being open-ended creates the no reasonable certainty that, I think, creates the first indefiniteness problem. 02:17:57
In addition to not being able to describe how something is based on itself would make any sense in the context of the claim.
Q Well, I don't agree with your statement that it's based on itself because if you turn to Column 4 02:18:11
and you look at, you know, from Lines 40 down, it's discussing S&R profiles, and it's also discussing a composite S&R profile as a different component.
There's a different item that it determines.
And so I would disagree, and I would ask you 02:18:40
to point me to where you -- in the specification where you find support that the worst case S&R profile has to be the composite S&R profile?
A So, I mean, look at the claim language itself. You're ignoring the prepositional phrase 02:19:00

Page 153

that comes after it. It's worst case S&R profile of said S&R-related metrics.
And said S&R-related metrics are metrics that are collected from the cable modem. So it's a worst case profile of that set. 02:19:18
In the context of the specification, that's the composite worst case S&R profile. Moreover, if you are saying that you are going to just use a worst case S&R profile and you want to ignore the rest of the claim language, a worst case S&R profile 02:19:39
is always zero.
So you -- in order to consider something that's meaningful in the context of the claim for what a worst case S&R profile of said S&R-related metrics would be, it's a composite. You're looking 02:19:56
at the worst case, and it's a profile so the worst case among the set of cable modems at each sub-frequency.
That is exactly described in the specification as a composite worst case S&R profile. 02:20:12
So to suggest -- I mean, if there's -- if you are saying it's something else -- there's just nothing else that's described in this specification. You have pointed to Column 4, I think it was, around Line 40. And that's going through and saying, okay, 02:20:34

Page 154

first of all, you generate a S&R-related metric for each cable modem, and now that you have that, you assign the cable modems to a corresponding -- to a service group. So now that they are in the service group, you have the set of modems and you want to 02:21:01
build a worst case -- composite worst case S&R profile, which is kind of the first profile because it's all sub-frequencies.
It's a composite because your taking the worst case for each cable modem in the service group 02:21:17
at each sub-frequency. It's a worst case as opposed to any other case because you're trying to establish the minimum required transmission parameters so that you can reach all of the cable modems without significant error in that group. 02:21:40
So, I mean, this goes to kind of the second part why it has to be a worst case as opposed to a best case or some alternative. It's really the only interpretation that makes any sense in the context of the invention as it's described in the 02:21:54
specification.
Q So, again, I would point you back to the claim language and say that the claim language itself says that the composite S&R-related metric is based at least in part, not -- not wholly on worst 02:22:13

Page 155

case S&R profile.
So, again, I guess I'm not seeing how you're making these two equivalent when the specification discusses them separately, and the claim itself says it's only based in part on that worst case S&R? 02:22:31
A No, the reason why they're the same thing is not based on the based on language. It's by looking at what the term worst case S&R profile and said S&R related metrics means to a person of skill in the art in the context of the specification. 02:22:51
That's Step 1, and that's in Paragraph 94. That worst case S&R profile, when you work through the analysis included in 94, and you look through the specification, that is actually describing a composite worst case S&R profile. 02:23:09
And the reasons for that are in Paragraph 94.
Okay.
So now turning to the term "composite S&R related metric" there's two steps there. One is what's a metric as opposed to a profile? 02:23:23
Does the claim make any sense if you're looking at a metric versus a profile? And that's the first part of Paragraph 95 where it's really using -- that the metric is a profile, and there's a cite to that in the specification. 02:23:39

Page 156

And so what it's really talking about is a composite S&R-related profile. Now, the next question is, well, a composite of what S&R-related profiles, and you turn back to the specification to understand what it is saying and the composite 02:24:01
S&R-related profiles that are described are where you are talking a composite of the worst case.
And I know Dr. Kramer said, oh, well, it doesn't say worst case so it could be best case or -- or any other kind of case. 02:24:16
Well, let's take as an example the best case. So you're going to transmit to everyone in a service group so that only the person with the best network connection can hear you. I mean, that makes zero sense. The system doesn't work in that sense. 02:24:31
So supported by the specification, the only thing that makes sense for a composite S&R-related metric is a composite worst case S&R-related profile. So now that term is understood by a person of skill in the art is the same -- the same thing as 02:24:49
what comes after based at least in part on.
So you have A is at least based in part on A, and that creates no certainty with respect -- or it's not unreasonably certain with respect to how a person of skill in the art would understand how you 02:25:12

Page 157

can have the same things being based on each other.
Q So when you were discussing S&R-related metrics is the same as an S&R-related profile, I wanted to point you to the description of Figure 2 at the bottom of Column 3, and here it talks about 02:25:39
there being one or more measured performance metrics.
So I'm not sure I agree or understand how you're having a one-to-one equivalency of an S&R profile to an S&R-related metric. So I guess if you 02:25:56
could point me to somewhere in the specification where it makes that equivalency argument, and explain where your getting this one-to-one relationship...
MR. BENYACAR: Well, I'm going to object. 02:26:13
This question has been answered numerous times now.
But go ahead.
THE DEPONENT: Column 4, Line 47 through 49. And that's --
BY MS. ALLOR: 02:26:23
Q Oh, I'm sorry. Sorry.
Column 3, the Figure 2A. That's where I was reading from. I apologize.
A Okay.
So the portion -- 02:26:31

Q Sorry. At the bottom of Column 3, it says (as read):

"As shown in Figure 2A, determine one or more measured performance metrics." 02:26:43

A I see that. And at a particular frequency, S&R over a range of frequencies and S&R profile. There's also -- I mean, that's -- that exactly says that the metric -- the profile is metrics at each frequency value. Also Column 4, Lines 47 through 49, it says (as read): 02:27:15

"The CMs assigned to that service group, e.g., composite S&R profile for the CMs of the service group."

And it's talking about each CM's respective metrics, e.g., each CM's S&R profile, and in the context of Claim 1, when it's talking about generating by said CMTS for each one of said plurality and service groups, a composite S&R-related metric for the service group. 02:27:36 02:27:58

So that -- again, composite S&R-related metric for the service group would be for each CM at each frequency.

So it's -- in the claim language, when it's referring to a composite S&R-related metric, I kind 02:28:18

of walked through the steps for why it's referring to a composite worst case S&R-related profile, and the reasons, those exact steps are described in Paragraph 95.

Q Would you agree that the claim covered more than one S&R-related metric? 02:28:46

A I'm not sure what that question is asking.

Q So you said to me that the passages are in Column 3 that I pointed you to supporting your opinion that S&R profile is a number of S&R metrics, and that's why they are the same. 02:29:13

A No. It's not that -- it's an S&R value at each sub-frequency consistent with what's shown in Figure 2 -- actually it's in all of them 2B, 2C. It shows as the x-axis, that there's a sub-band frequency across the whole spectrum. 02:29:38

So those are each of the frequencies at which there is an S&R metric value that's being considered, and you are trying to find the worst case at each one of those sub-frequencies so you know what the performance parameters -- sorry, the one or more physical layer communication parameters should be at each of those sub-frequencies. 02:29:57

Q Would you agree with me that when a claim such as Claim 1 refers to a plurality of service 02:30:35

groups or a plurality of a plurality, that it's referring to more than one?

A Usually plurality means two or more.

MS. ALLOR: Okay. I have don't have anymore questions for you. I'll turn it over to David if you would like any redirect. 02:31:12

MR. BENYACAR: No, I have no questions for Dr. Almeroth.

THE DEPONENT: Okay. Thank you all.

THE VIDEOGRAPHER: All right. Going off the record at 2:31 p.m. This concludes today's testimony given by Dr. Kevin Almeroth. 02:31:24

(Whereupon the deposition was concluded at 2:31 p.m.)

///

///

I, KEVIN ALMEROTH, PH.D., do hereby declare under penalty of perjury that I have read the foregoing transcript; that I have made any corrections as appear noted, in ink, initialed by me, or attached hereto; that my testimony as contained herein, as corrected, is true and correct.

EXECUTED this _____ day of _____, _____, at _____, _____
(City) (State)

_____
KEVIN ALMEROTH, PH.D.
VOLUME I

I, the undersigned, a Certified Shorthand Reporter of the State of California, Registered Professional Reporter, Certified Live Note Reporter, do hereby certify:

That the foregoing proceedings were taken before me at the time and place herein set forth; that any witnesses in the foregoing proceedings, prior to testifying, were duly sworn; that a record of the proceedings was made by me using machine shorthand which was thereafter transcribed under my direction; that the foregoing transcript is a true record of the testimony given.

Further, that if the foregoing pertains to the original transcript of a deposition in a Federal Case, before completion of the proceedings, review of the transcript [ ] was [ ] was not requested.

I further certify I am neither financially interested in the action nor a relative or employee of any attorney or party to this action.

IN WITNESS WHEREOF, I have this date subscribed my name.

Dated: May 3, 2023

MELISSA M. VILLAGRAN
CSR No. 12543 RPR

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102 114:11 117:12 119:7
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10:22 56:18
10:34 56:21
10:47 65:10
10:49 65:13
10th 5:21 94:10
110 30:8 54:12 54:15,17,17,19 54:23,25 55:1 80:8,14 81:22 89:8 90:1,21 102:25
112 30:15 103:4 104:2
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12:47 110:18 111:2,4
13 105:23 125:9
136 6:5
15 5:11,13 120:2
16 106:1
162 1:25
17 31:18
18 39:13 40:4,8 44:21 45:23 55:9,23 56:13 59:9,10 63:22 67:9,22,25 68:16 69:3 72:3 73:6,22 74:9,22 75:1 76:12,13 77:5 77:18,22,25 79:3 82:25 102:5,8 110:5 111:16,18 112:16
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2008 120:2

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APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/956,889	**08/18/2023 01:33:48 PM ET**	**28427US16**

Title of Invention

SYSTEM AND METHOD FOR RECEIVING A TELEVISION SIGNAL

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8470	FILED BY	Laura Foley
PATENT CENTER #	62640002	FILING DATE	09/30/2022
CUSTOMER #	23446	FIRST NAMED INVENTOR	Madhukar Reddy
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Wayne Bradley

Documents

TOTAL DOCUMENTS: 23

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
NPL_1_part_6.pdf	75	Non Patent Literature	12878 KB
NPL_2_part_4.pdf	57	Non Patent Literature	15363 KB
NPL_3_part_1.pdf	56	Non Patent Literature	14039 KB
NPL_2_part_2.pdf	75	Non Patent Literature	24493 KB
NPL_2_part_1.pdf	75	Non Patent Literature	21327 KB
NPL_2_part_3.pdf	75	Non Patent Literature	24493 KB
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NPL_1_part_3__.pdf	75	Non Patent Literature	17453 KB
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NPL_1_part_4A.pdf	40	Non Patent Literature	12548 KB
NPL_1_part_4B.pdf	35	Non Patent Literature	13902 KB
NPL_4_part_1B.pdf	35	Non Patent Literature	13597 KB
NPL_4_part_1A.pdf	40	Non Patent Literature	15895 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Monitoring Module

The monitoring module **154** may be operable to analyze the band C_{x-1} that it receives from the channelizer **102** to measure/determine characteristics such as, for example, signal power level vs. frequency, delay vs. frequency, phase shift vs. frequency, type and/or amount of modulation, code rate, interference levels, signal to noise ratio, a transfer function of the channel of over which the signal was received, an impulse response of the channel over which the signal was received, and/or any other characteristic that may help assess characteristics of the channel over which the signal was received, assess characteristics of the transmitter that sent the signal and/or any otherwise be pertinent to performance of the communication system. The monitoring module may also be

'008 Patent, 3:33-45

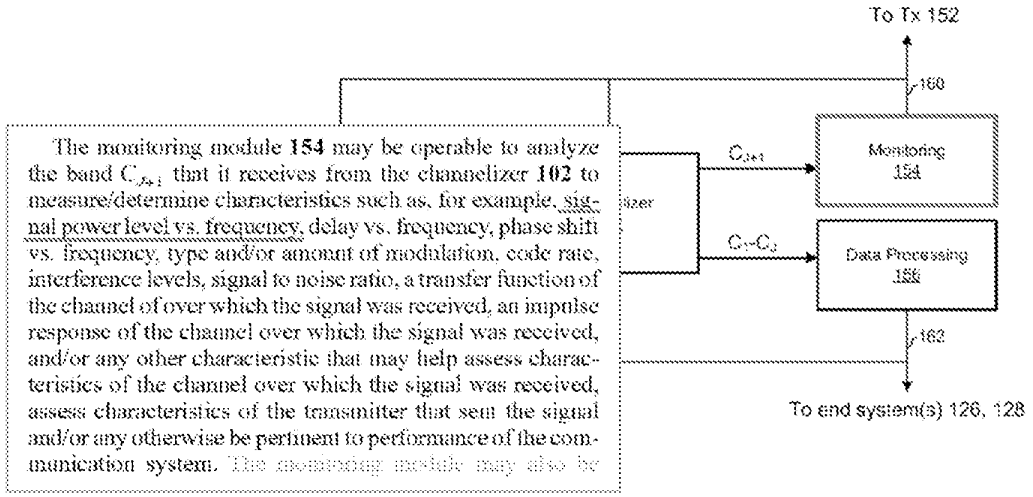


FIG. 1B

36

As the specification explains, one example of a characteristic that the monitoring module can determine is signal power level versus frequency.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Monitoring Module

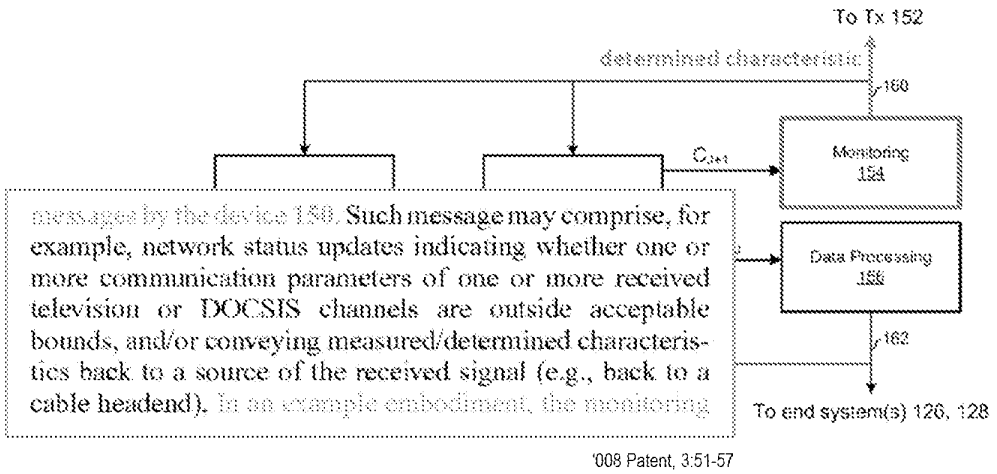


FIG. 1B

37

After the monitoring module determines a characteristic of the frequency band, it can send that determined characteristic back to the headend.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Monitoring Module

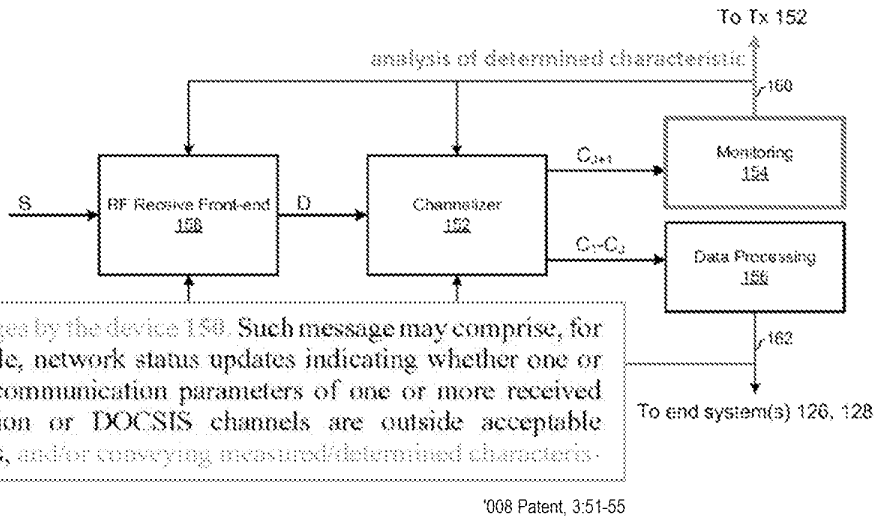


FIG. 1B

38

Alternatively, the monitoring module can analyze the determined characteristic and send that analysis back to the headend.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Monitoring Module

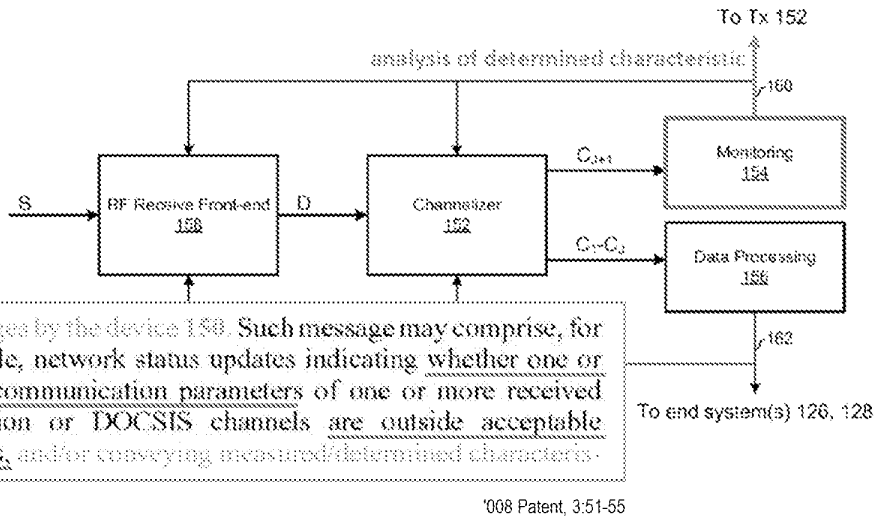
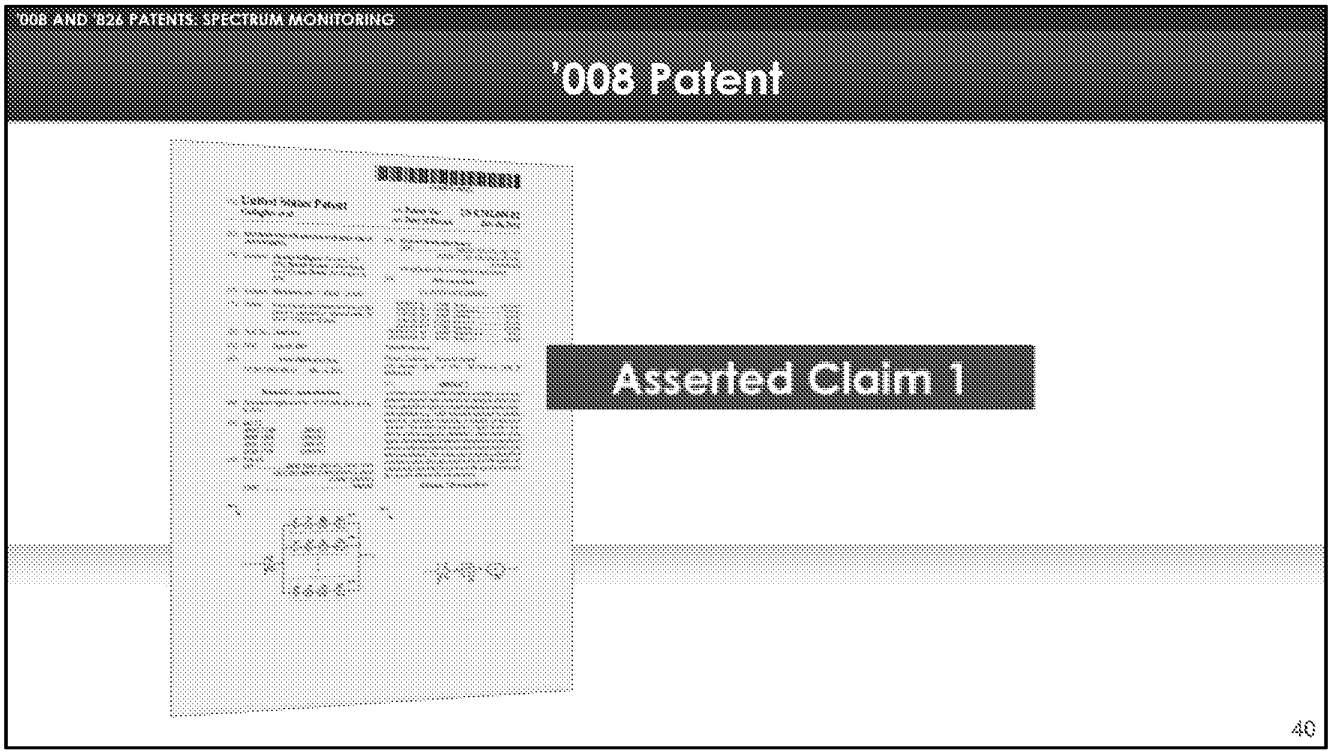


FIG. 1B

39

In the specification, the example given is an analysis of whether communication parameters of the received channels are outside acceptable bounds.



Now we'll take a brief look at some select claim limitations. Claim 1 is the only asserted independent claim in the 008 patent, so that's the claim we'll look at.

'008 AND '824 PATENTS: SPECTRUM MONITORING

'008 Patent, Claim 1

1. A system **comprising:**

an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;

a signal monitor operable to:

analyze said digitized signal to determine a characteristic of said digitized signal; and

report said determined characteristic to a source of said received signal;

a data processor operable to process a television channel to recover content carried on the television channel; and

a channelizer operable to:

select a first portion of said digitized signal;

select a second portion of said digitized signal; and

concurrently output said first portion of said digitized signal to said signal monitor and said second portion of said digitized signal to said data processor.

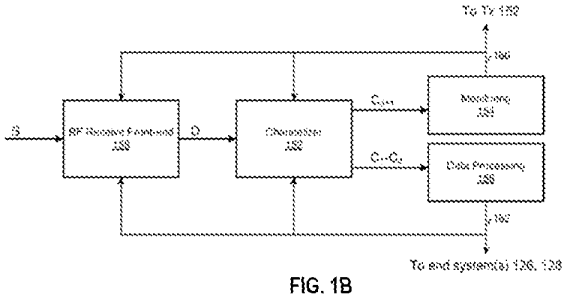


FIG. 1B

41

Claim 1 of the 008 patent is a system claim.

'008 AND '826 PATENTS: SPECTRUM MONITORING

'008 Patent, Claim 1

1. A system comprising:

an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;

a signal monitor operable to:

analyze said digitized signal to determine a characteristic of said digitized signal; and

report said determined characteristic to a source of said received signal;

a data processor operable to process a television channel to recover content carried on the television channel; and

a channelizer operable to:

select a first portion of said digitized signal;

select a second portion of said digitized signal; and

concurrently output said first portion of said digitized signal to said signal monitor and said second portion of said digitized signal to said data processor.

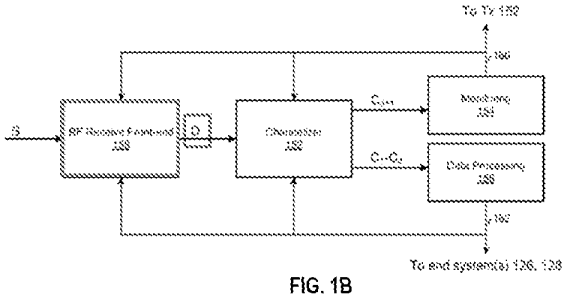


FIG. 1B

42

The first element of claim 1 is directed to an analog to digital converter, which corresponds to the RF Receive Front End 158 in figure 1B.

'008 AND '826 PATENTS: SPECTRUM MONITORING

'008 Patent, Claim 1

1. A system comprising:
an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;

a signal monitor operable to:
analyze said digitized signal to determine a characteristic of said digitized signal; and

export said determined characteristic to a source of said received signal;
a data processor operable to process a television channel to recover content carried on the television channel; and
a channelizer operable to:
select a first portion of said digitized signal;
select a second portion of said digitized signal; and
concurrently output said first portion of said digitized signal to said signal monitor and said second portion of said digitized signal to said data processor.

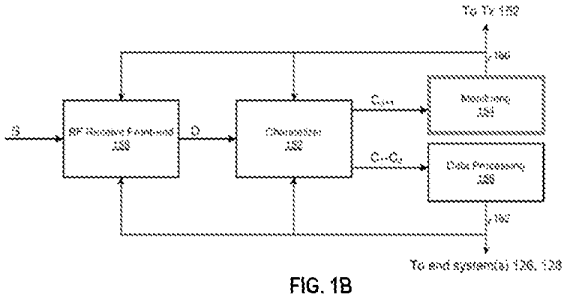


FIG. 1B

43

Next, the claim requires a signal monitor. The claimed signal monitor corresponds to the monitoring module 154 in figure 1B.

The claimed signal monitor is said to be operable to perform 2 functions.

'008 AND '826 PATENTS: SPECTRUM MONITORING

'008 Patent, Claim 1

1. A system comprising:

an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;

a signal monitor operable to:

analyze said digitized signal to determine a characteristic of said digitized signal; **and**

export said determined characteristic to a source of said received signal;

a data processor operable to process a television channel to recover content carried on the television channel; and

a channelizer operable to:

select a first portion of said digitized signal;

select a second portion of said digitized signal; and

concurrently output said first portion of said digitized signal to said signal monitor and said second portion of said digitized signal to said data processor.

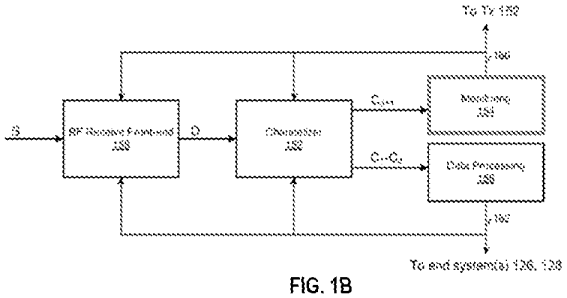


FIG. 1B

44

First, it is operable to determine a characteristic of the digitized signal.

'008 AND '826 PATENTS: SPECTRUM MONITORING

'008 Patent, Claim 1

1. A system comprising:
an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;
a signal monitor operable to:
analyze said digitized signal to determine a characteristic of said digitized signal; and
report said determined characteristic to a source of said received signal;
a data processor operable to process a television channel to recover content carried on the television channel; and
a channelizer operable to:
select a first portion of said digitized signal;
select a second portion of said digitized signal; and
concurrently output said first portion of said digitized signal to said signal monitor and said second portion of said digitized signal to said data processor.

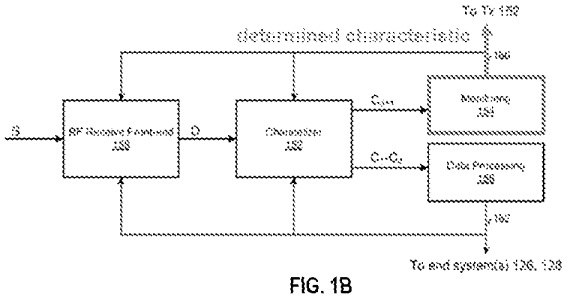


FIG. 1B

45

Second, the signal monitor reports that determined characteristic.

So in this claim, it is the determined characteristic itself that is reported back, not some analysis of the characteristic.

'008 AND '826 PATENTS: SPECTRUM MONITORING

'008 Patent, Claim 1

1. A system comprising:
an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;
a signal monitor operable to:
analyze said digitized signal to determine a characteristic of said digitized signal; and
export said determined characteristic to a source of said received signal;
a data processor operable to process a television channel to recover content carried on the television channel; and
a channelizer operable to:
select a first portion of said digitized signal;
select a second portion of said digitized signal; and
concurrently output said first portion of said digitized signal to said signal monitor and said second portion of said digitized signal to said data processor.

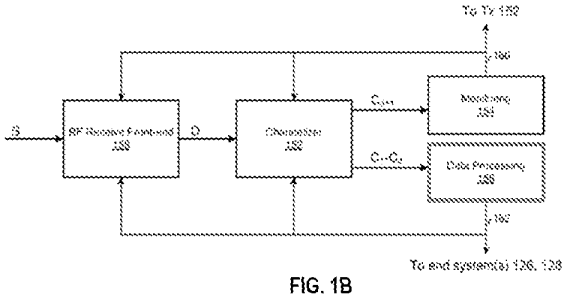


FIG. 1B

46

Next, the claim recites a data processor. This would correspond to the data processing module 156 in FIG. 1B.

'008 Patent, Claim 1

1. A system comprising:

an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;

a signal monitor operable to:

analyze said digitized signal to determine a characteristic of said digitized signal; and

export said determined characteristic to a source of said received signal;

a data processor operable to process a television channel to recover content carried on the television channel; and

a channelizer operable to:

select a first portion of said digitized signal;

select a second portion of said digitized signal; and

concurrently output said first portion of said digitized signal to said signal monitor and said second portion of said digitized signal to said data processor.

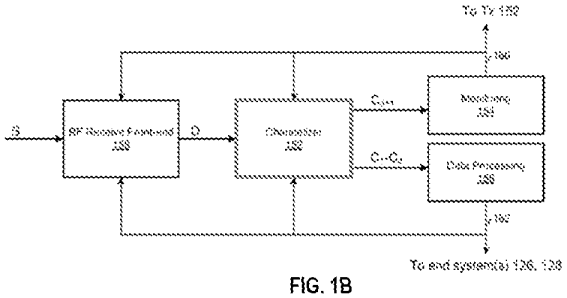


FIG. 1B

47

And finally, the claim requires a channelizer, which corresponds to channelizer 152 in Figure 1B.

The claimed channelizer is said to be operable to perform three tasks.

'008 AND '826 PATENTS: SPECTRUM MONITORING

'008 Patent, Claim 1

1. A system comprising:

an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;

a signal monitor operable to:

analyze said digitized signal to determine a characteristic of said digitized signal; and

report said determined characteristic to a source of said received signal;

a data processor operable to process a television channel to recover content carried on the television channel; and

a channelizer operable to:

select a first portion of said digitized signal;

select a second portion of said digitized signal; and

concurrently **output said first portion of said digitized signal to said signal monitor** and said second portion of said digitized signal to said data processor.

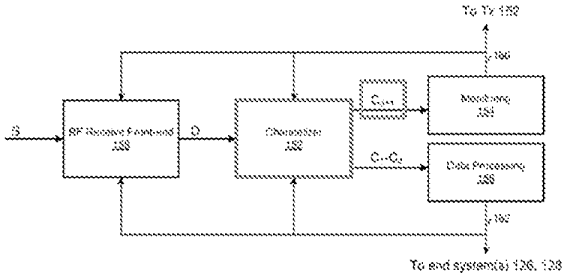


FIG. 1B

48

First, the channelizer selects a first portion of the digitized signal to output to the signal monitor.

'008 AND '826 PATENTS: SPECTRUM MONITORING

'008 Patent, Claim 1

1. A system comprising:

an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;

a signal monitor operable to:

analyze said digitized signal to determine a characteristic of said digitized signal; and

report said determined characteristic to a source of said received signal;

a data processor operable to process a television channel to recover content carried on the television channel; and

a channelizer operable to:

select a first portion of said digitized signal;

select a second portion of said digitized signal; and

concurrently **output** said first portion of said digitized signal to said signal monitor and **said second portion of said digitized signal to said data processor.**

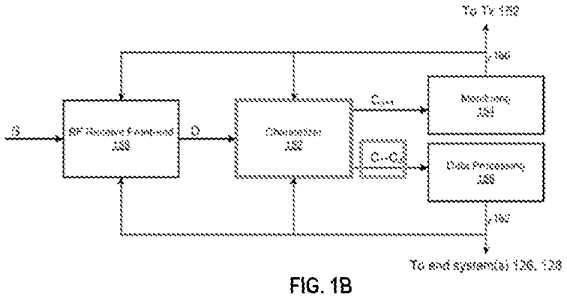


FIG. 1B

49

Second, the channelizer selects a second portion of the digitized signal to output to the data processor.

'008 AND '826 PATENTS: SPECTRUM MONITORING

'008 Patent, Claim 1

1. A system comprising:

an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;

a signal monitor operable to:

analyze said digitized signal to determine a characteristic of said digitized signal; and

report said determined characteristic to a source of said received signal;

a data processor operable to process a television channel to recover content carried on the television channel; and

a channelizer operable to:

select a first portion of said digitized signal;

select a second portion of said digitized signal; and

concurrently output said first portion of said digitized signal to said signal monitor and said second portion of said digitized signal to said data processor.

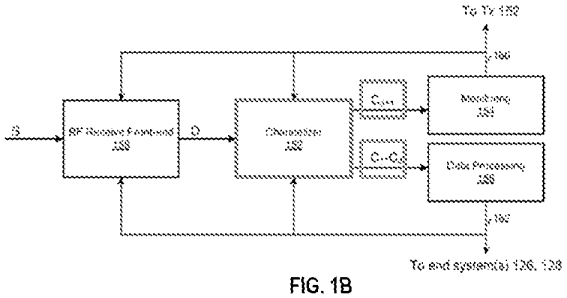
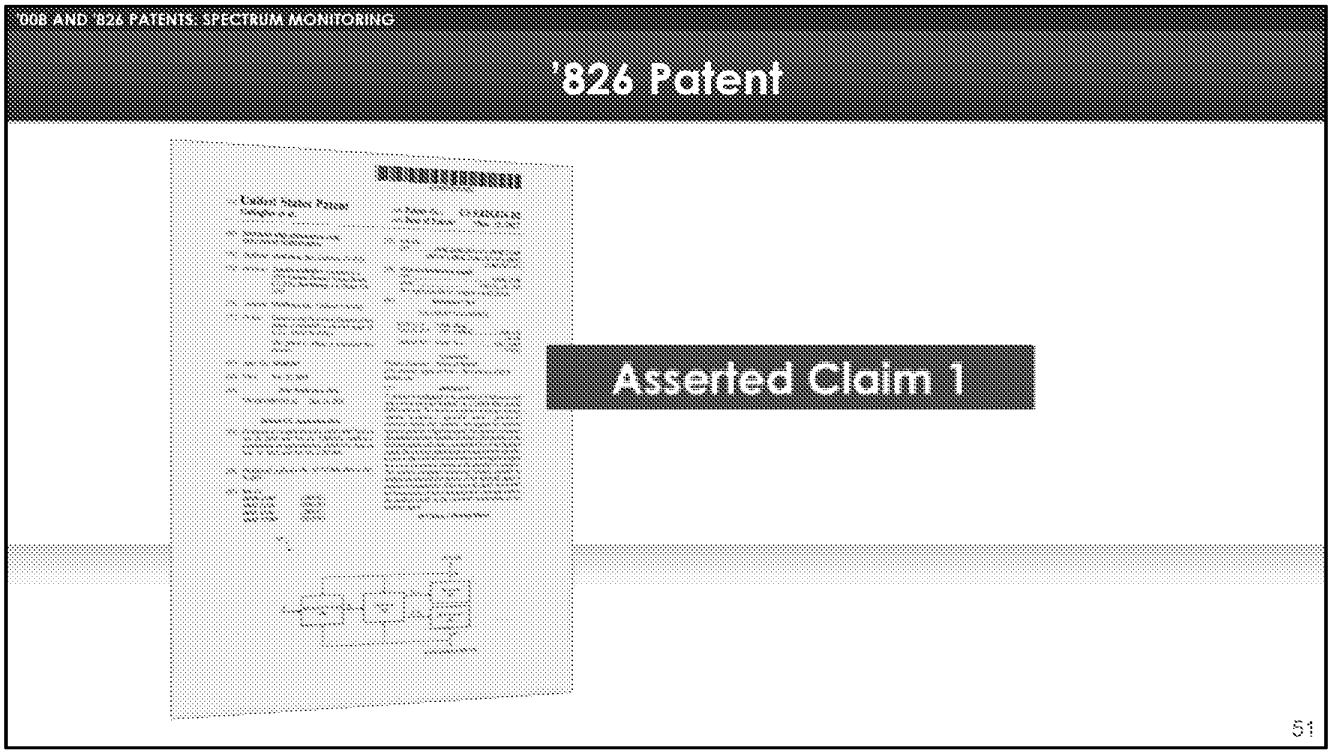


FIG. 1B

50

And third, the channelizer concurrently outputs the selected first portion and second portion to the signal monitor and the data processor, respectively.



Now we'll take a brief look at one specific limitation of claim 1 of the 826 patent.

'008 AND '826 PATENTS: SPECTRUM MONITORING

'826 Patent, Claim 1

1. A method comprising:

performing by one or more circuits of a receiver coupled to a television and data service provider headend via a hybrid fiber coaxial (HFC) network:

receiving, via said HFC network, a signal that carries a plurality of channels, wherein said channels comprise one or both of television channels and data channels;

digitizing said received signal to generate a digitized signal;

selecting a first portion of said digitized signal;

selecting a second portion of said digitized signal;

processing said selected second portion of said digitized signal to recover information carried in said plurality of channels;

analyzing said selected first portion of said digitized signal to measure a characteristic of said received signal; and

controlling the transmission of network management messages back to said headend based on said measured characteristic of said received signal, wherein said measured characteristic is different than said network management messages.

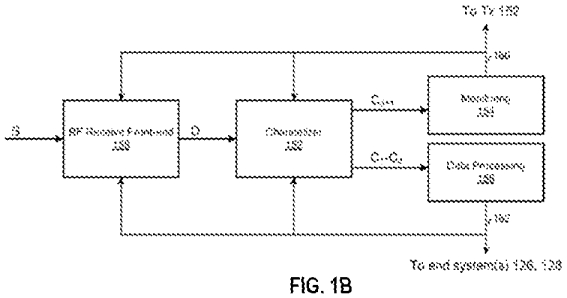


FIG. 1B

52

Claim 1 of the 826 patent is a method claim. In many respects, it simply recites the functions performed by the system claimed in the 008 patent.

'826 Patent, Claim 1

1. A method comprising:

performing by one or more circuits of a receiver coupled to a television and data service provider headend via a hybrid fiber coaxial (HFC) network:

receiving, via said HFC network, a signal that carries a plurality of channels, wherein said channels comprise one or both of television channels and data channels;

digitizing said received signal to generate a digitized signal;

selecting a first portion of said digitized signal;

selecting a second portion of said digitized signal;

processing said selected second portion of said digitized signal to recover information carried in said plurality of channels;

analyzing said selected first portion of said digitized signal to measure a characteristic of said received signal; and

controlling the transmission of network management messages back to said headend based on said measured characteristic **of said received signal,** wherein said measured characteristic is different than said network management messages.

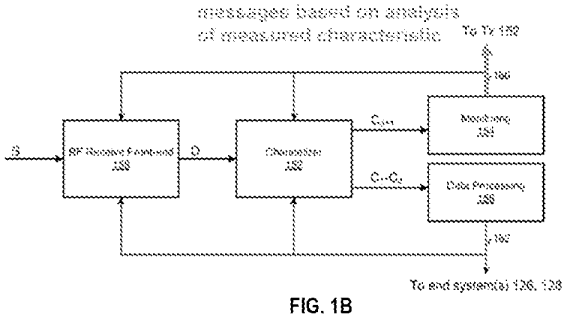
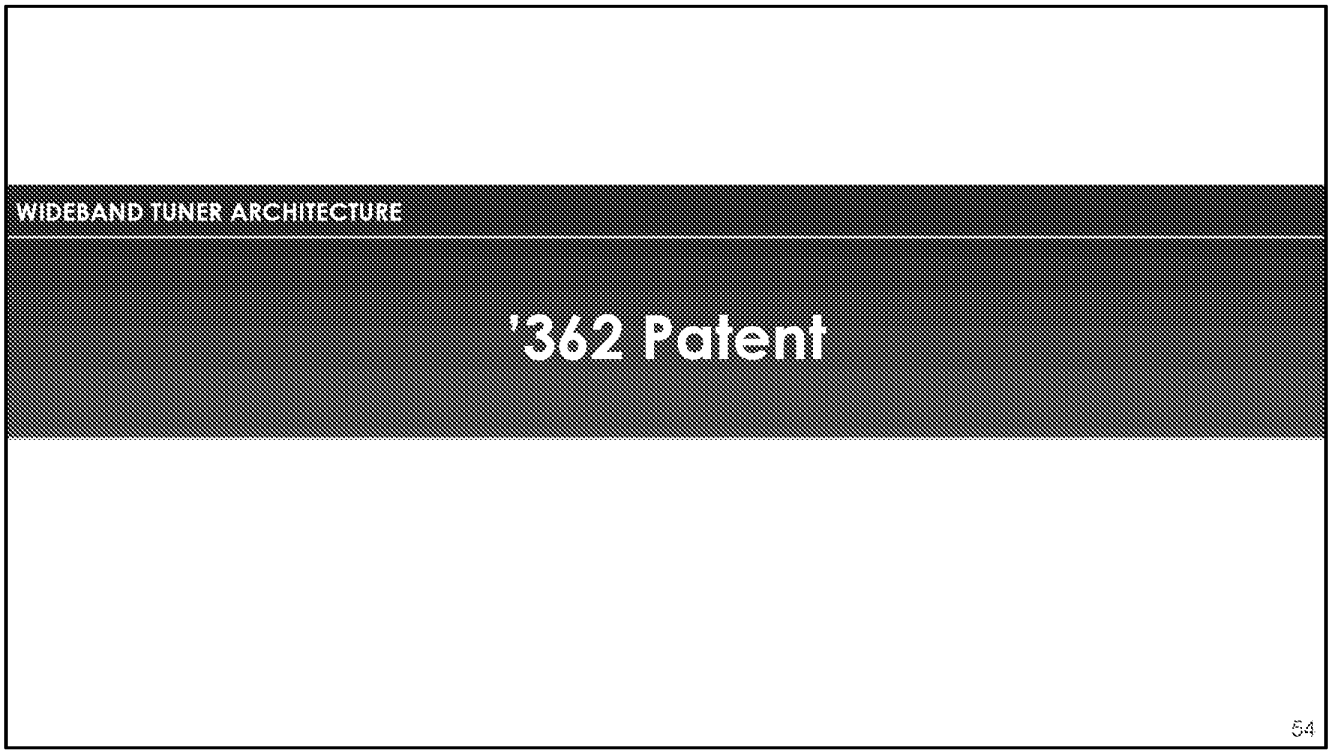


FIG. 1B

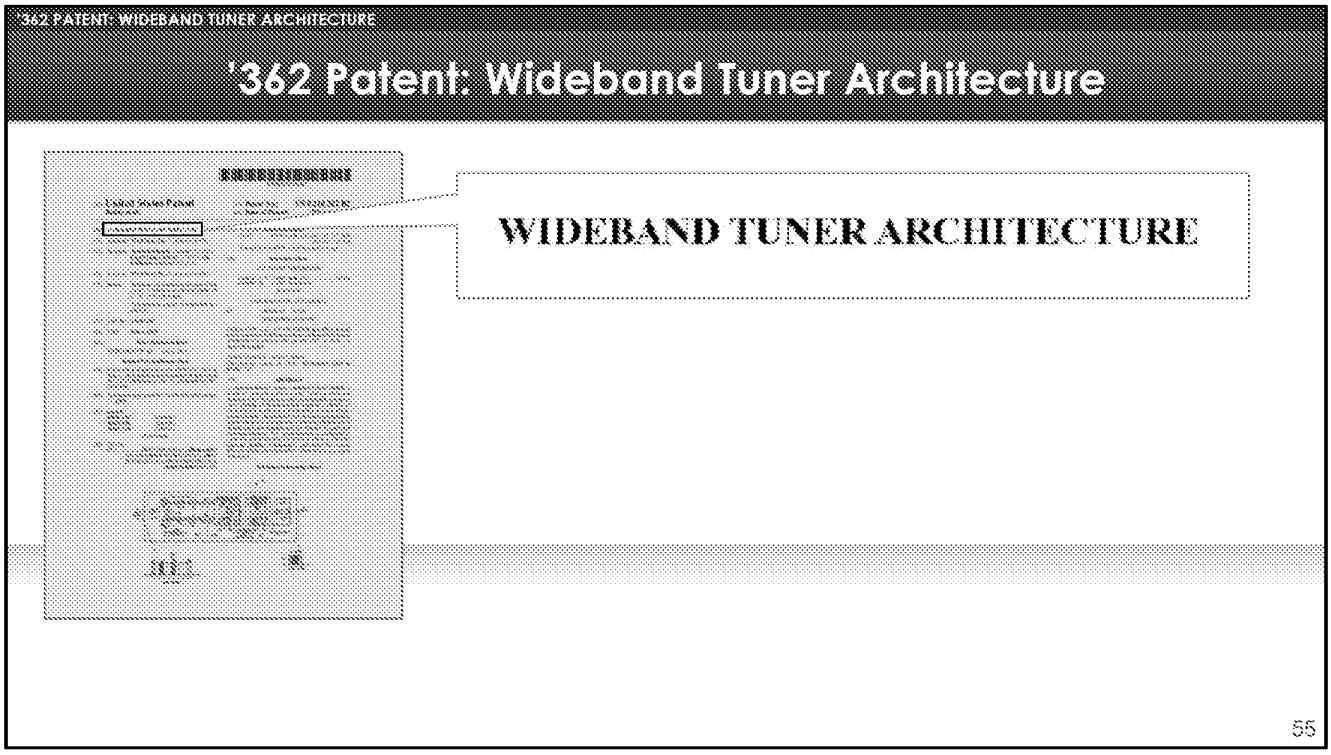
53

However, one important difference between this claim and claim 1 of the 008 patent is reflected by the last step of this claim, which we've annotated in green. In this claim, after measuring a characteristic of the signal, what is reported back to the headend is not the measured characteristic itself as in the 008 patent, but instead network management messages that are different than the measured characteristic.

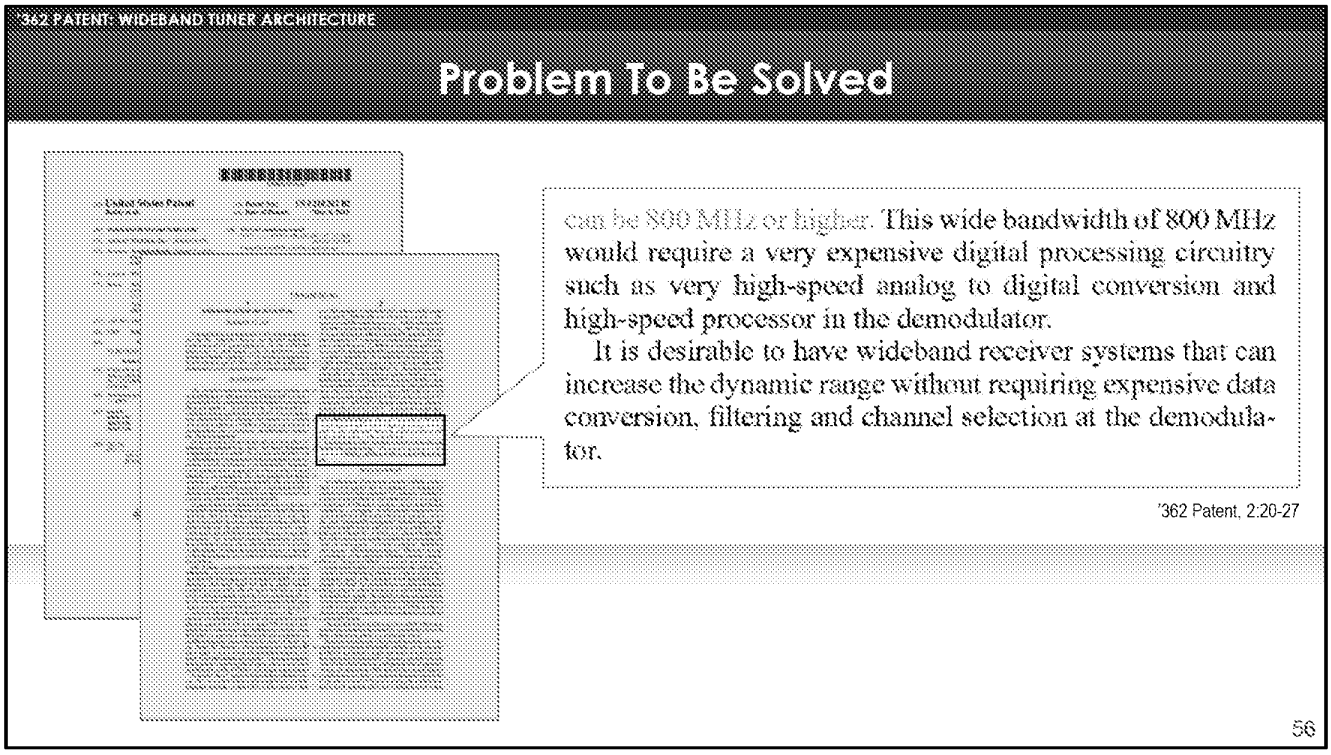
In other words, this claim is directed to the disclosed embodiment where the monitoring module performs an analysis of the measured characteristic and reports the results of that analysis back to the headend.



Now we'll turn to the 362 patent.



As I mentioned earlier, the 362 patent is directed to an allegedly novel architecture for a wideband tuner.



According to the patent, existing wideband tuners required expensive analog to digital converters because of the wide bandwidth of the signal that had to be converted.

The objective of the 362 patent is to reduce the bandwidth of the signal to be digitized so that expensive analog to digital converters are not required.

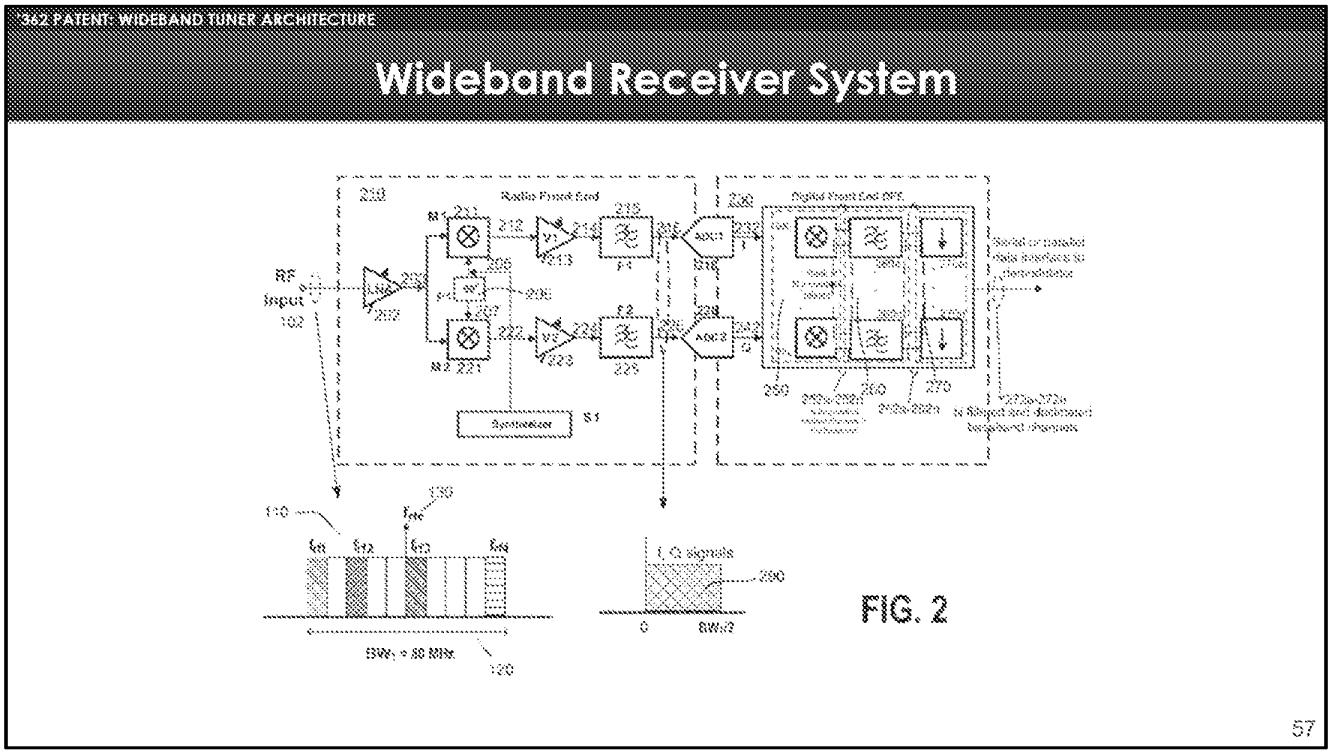


Figure 2 of the 362 patent depicts a wideband receiver system architecture which allegedly solves this problem.

Wideband Receiver System

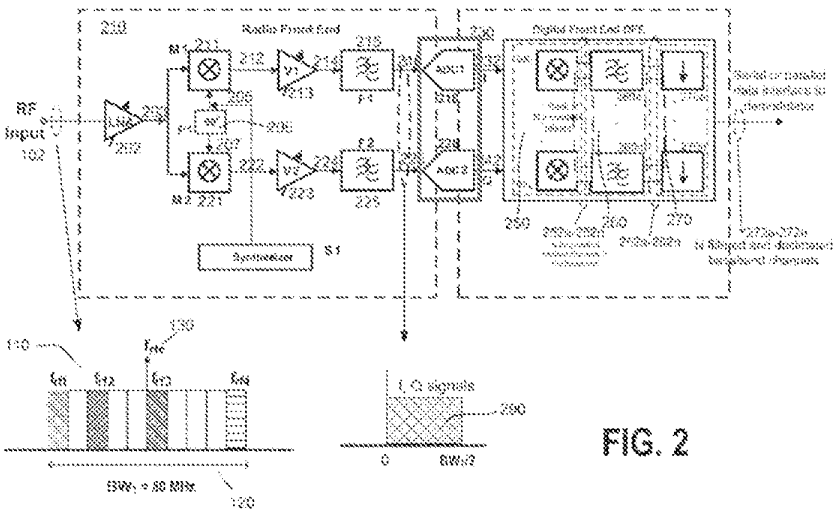


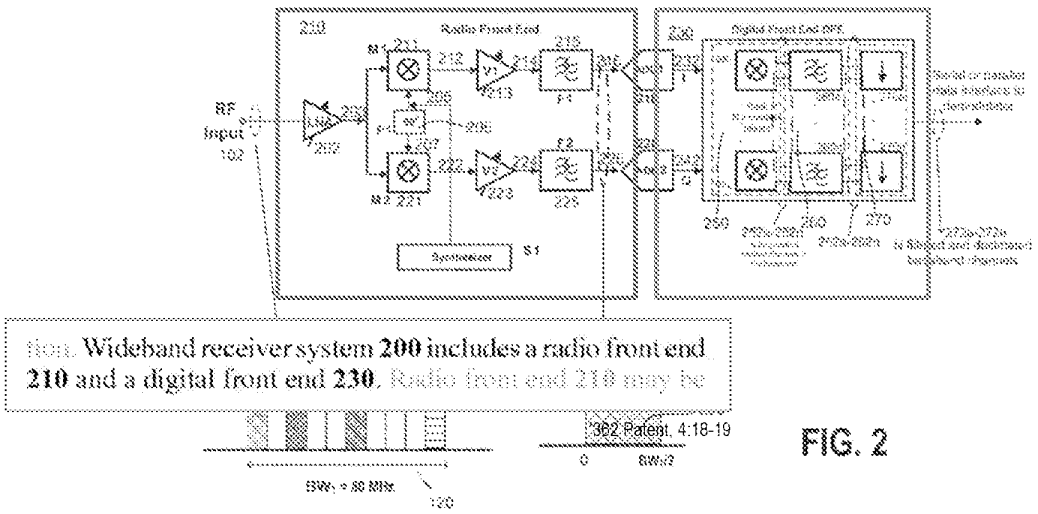
FIG. 2

We've put a red box around the analog to digital converters in question. The objective of the alleged invention is to reduce the bandwidth of the signal to be supplied to these converters.

We'll now look at how that is done.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

Radio Front End / Digital Front End



tion. Wideband receiver system **200** includes a radio front end **210** and a digital front end **230**. Radio front end 210 may be

362 Patent, 4:18-19

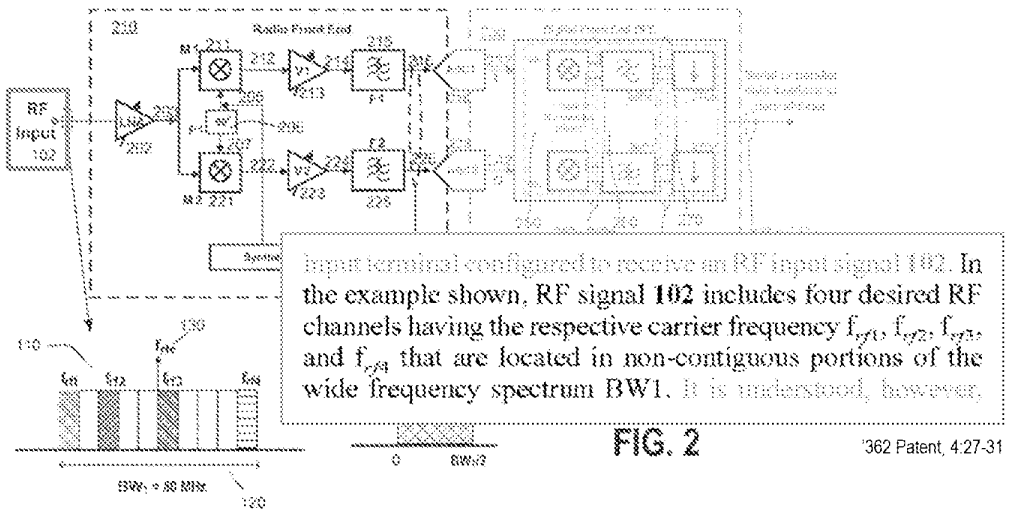
FIG. 2

59

The analog to digital converters sit between two so-called front end components of the wideband receiver -- a radio front end which we've annotated in red, and a digital front end which we've annotated in green.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

Incoming Signal Contains Non-Contiguous Desired Channels



Input terminal configured to receive an RF input signal **102**. In the example shown, RF signal **102** includes four desired RF channels having the respective carrier frequency f_{ch1}, f_{ch2}, f_{ch3}, and f_{ch4} that are located in non-contiguous portions of the wide frequency spectrum BW1. It is understood, however,

FIG. 2

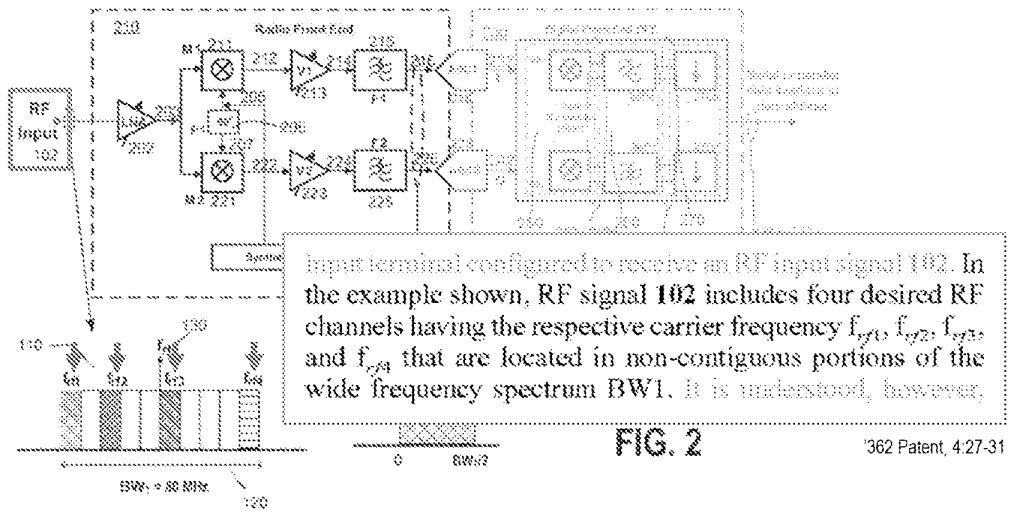
'362 Patent, 4:27-31

60

The incoming signal is received into the radio front end at the left of the figure. This signal is referred to as the RF input.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

Incoming Signal Contains Non-Contiguous Desired Channels



Input terminal configured to receive an RF input signal 102. In the example shown, RF signal **102** includes four desired RF channels having the respective carrier frequency f_{ch1}, f_{ch2}, f_{ch3}, and f_{ch4} that are located in non-contiguous portions of the wide frequency spectrum BW1. It is understood, however,

FIG. 2

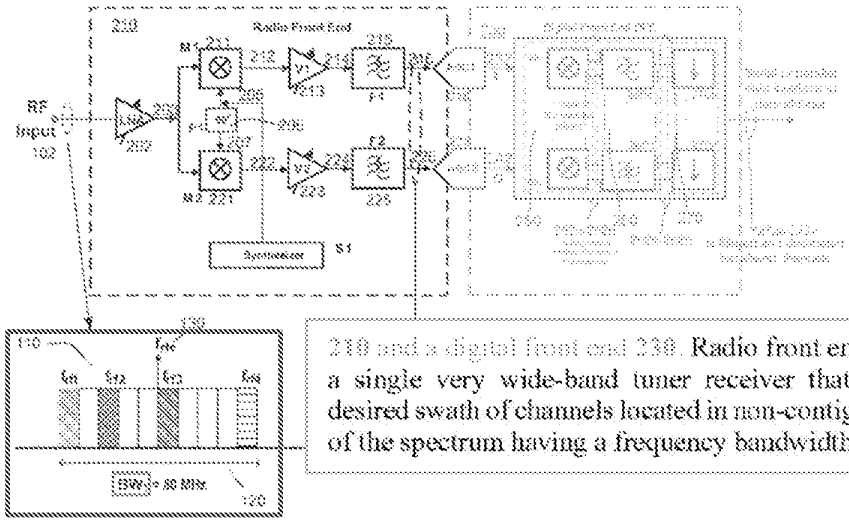
'362 Patent, 4:27-31

61

The incoming signal in this example contains 4 desired TV channels. That is, 4 channels the customer might like to view. We have indicated those 4 channels in red. Notice that those 4 channels are not next to each other. They are not contiguous.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

Initial Bandwidth: BW_1



210 and a digital front end 230. Radio front end **210** may be a single very wide-band tuner receiver that captures the desired swath of channels located in non-contiguous portions of the spectrum having a frequency bandwidth BW1 120. In

'362 Patent, 4:19-22

62

According to the specification, the radio front end somehow captures a swath of channels that includes the desired channels. We've annotated that swath in blue. This desired swath of channels has a bandwidth B W 1, which we've annotated in green.

Low Noise Amplifier

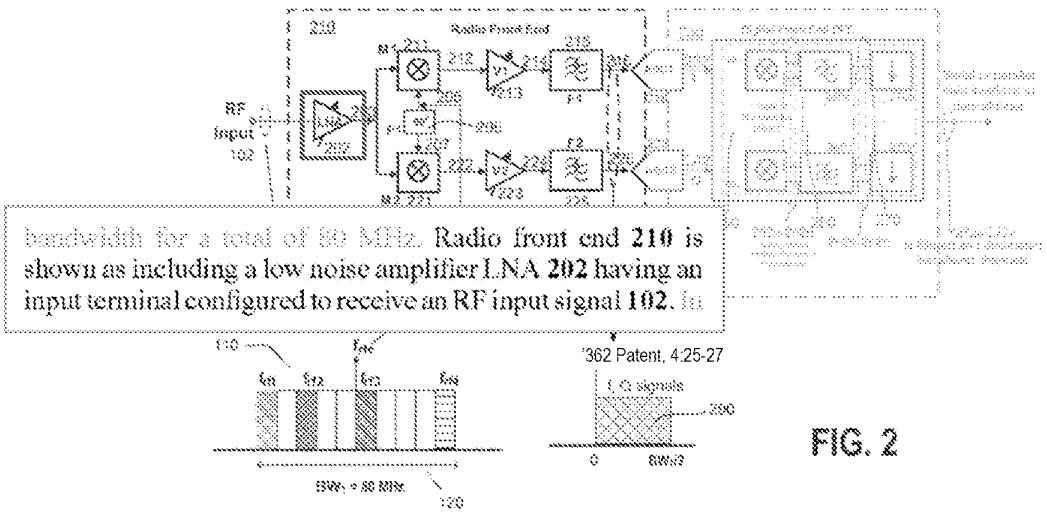
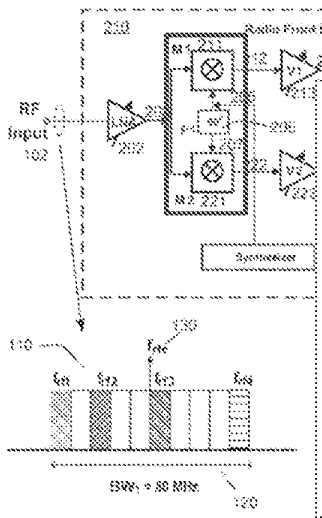


FIG. 2

This desired swath of channels is first sent to a low noise amplifier annotated in blue.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

Mixer Module



Mixers M1 **211** and M2 **221** may be conventional mixers formed using, for example, differential Gilbert cells. Each of the mixers **211** and **221** multiplies (mixes) an amplified RF signal **203** with a respective first oscillator frequency signal **205** and a second oscillator frequency signal **207** to generate an in-phase signal **212** and a quadrature signal **222** that have a phase shift of 90° degree between them. Mixers **211** and **221** are identical so that the amplitude of the in-phase signal **212** and quadrature signal **222** are the same. The first and second oscillator frequencies **205** and **207** are identical and have a 90° degree phase shift generated through a 90° degree phase shifter P1 **206**. Synthesizer S1 may be a single local oscillator operable to generate the oscillator frequency **205** for converting the receive RF signal **102** to a zero-IF or low-IF band.

'362 Patent, 4:40-53

64

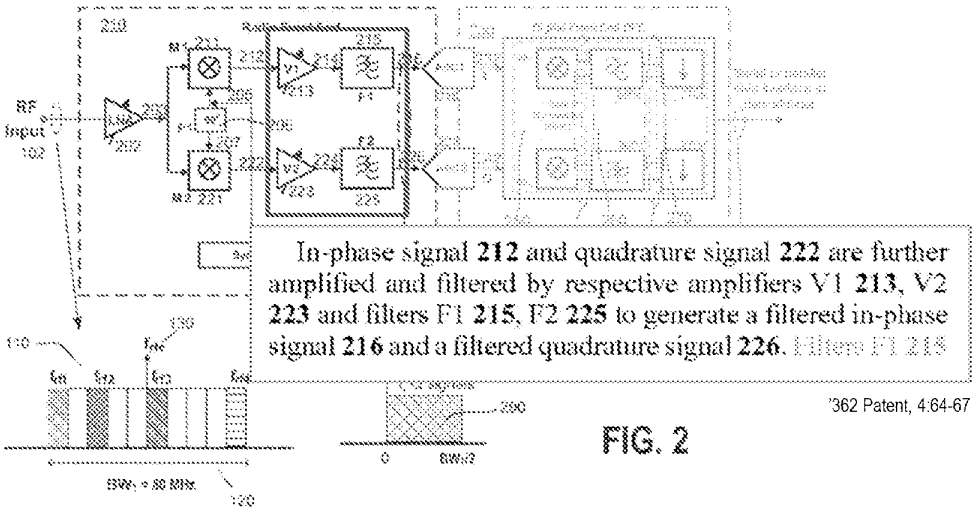
Next, the amplified signal is provided as input to a mixer module, annotated in purple. The mixer module performs two functions:

First, the signal is "down-converted," meaning the received signal is shifted to a lower range of frequencies. This is described in the language from the specification we've highlighted in green.

Second, the mixer module generates I and Q signals. The details of I and Q signals are beyond the scope of this technology tutorial, but they refer to in-phase and quadrature components of the signal.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

Amplifiers/Filters



'362 Patent, 4:64-67

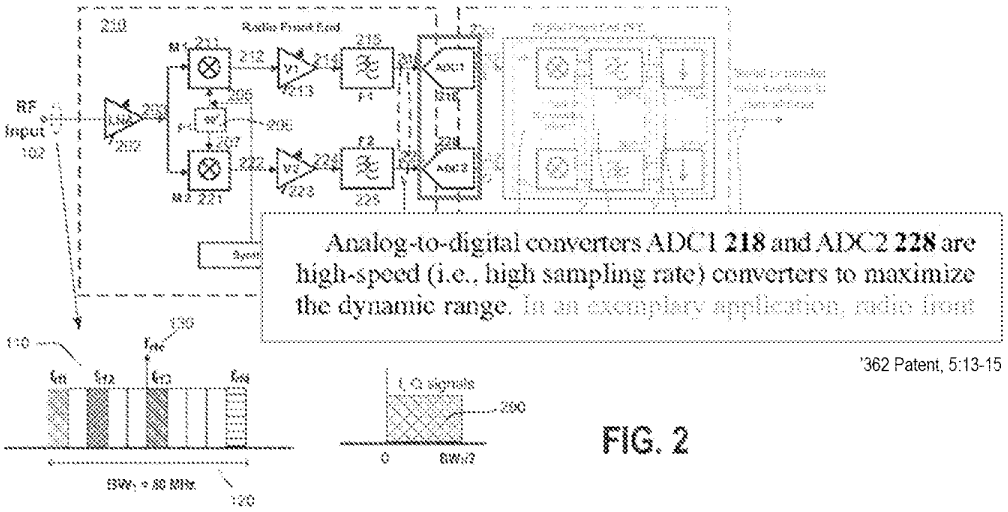
FIG. 2

65

Next, the signals are sent to amplifiers and filters.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

A-D Converters



'362 Patent, 5:13-15

FIG. 2

66

And after this, the signals are provided as input to the analog to digital converters we discussed earlier.

Bandwidth Reduced by Half

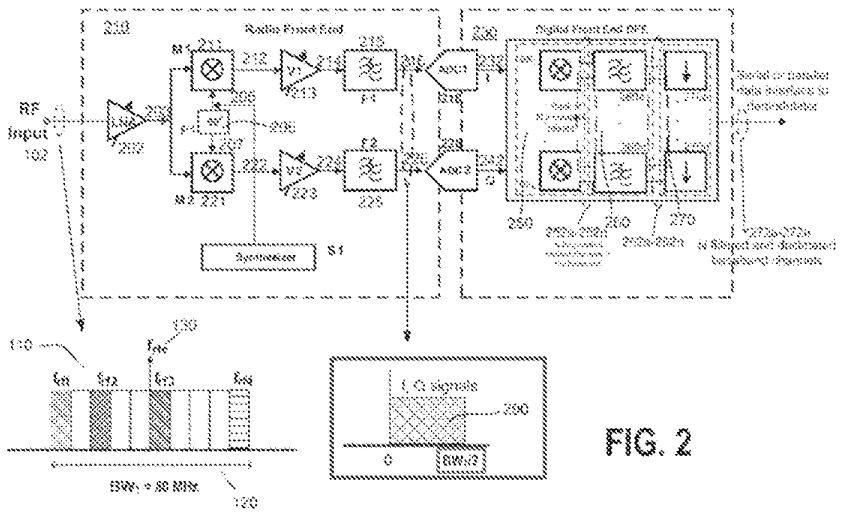


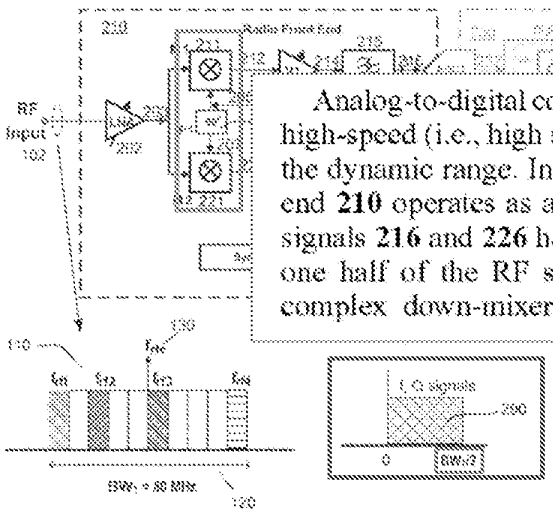
FIG. 2

Notice, as we have annotated in red in figure 2, that that bandwidth of the signal supplied to the analog to digital converters is one half of the initial bandwidth BW 1.

That is the reduction in bandwidth which allows less expensive analog to digital converters to be used.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

Mixer Module 211 Achieves the Bandwidth Reduction



Analog-to-digital converters ADC1 **218** and ADC2 **228** are high-speed (i.e., high sampling rate) converters to maximize the dynamic range. In an exemplary application, radio front end **210** operates as a nominal zero-IF down-mixer so that signals **216** and **226** have a nominal bandwidth **290** equal to one half of the RF signal bandwidth BW1 thanks to the complex down-mixer architecture. In other embodiment,

'362 Patent, 5:13-19

FIG. 2

68

And as the specification explains, it is the mixer module 211 annotated in green, that achieves this reduction in bandwidth.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

Mixers to Extract Desired Channels

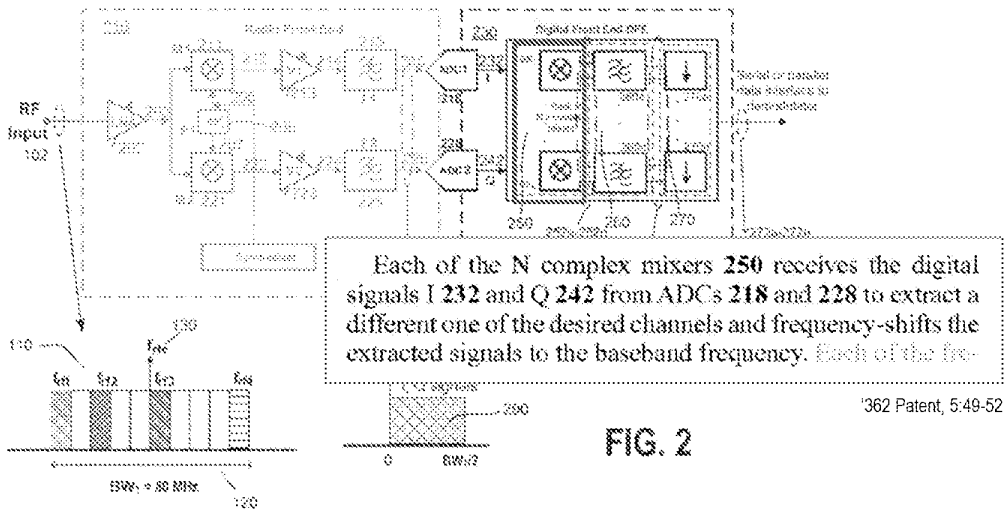


FIG. 2

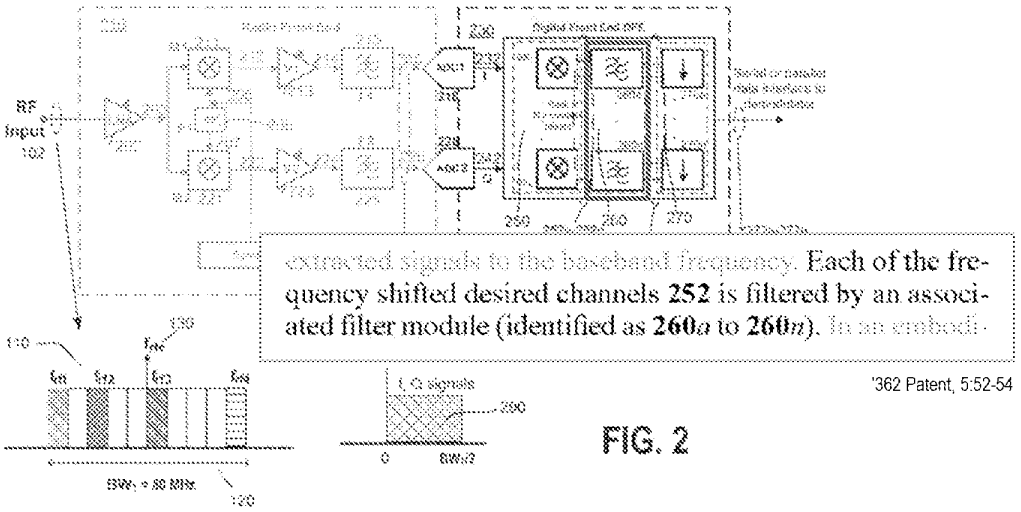
69

After analog to digital conversion, the digitized signals are sent to mixers which extract the desired channels.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

Filter Module

Filter Module



extracted signals to the baseband frequency. Each of the frequency shifted desired channels **252** is filtered by an associated filter module (identified as **260***a* to **260***n*). In an embodi-

'362 Patent, 5:52-54

FIG. 2

70

Once extracted, each of the desired channels is provided to a filter module.

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

Demodulators

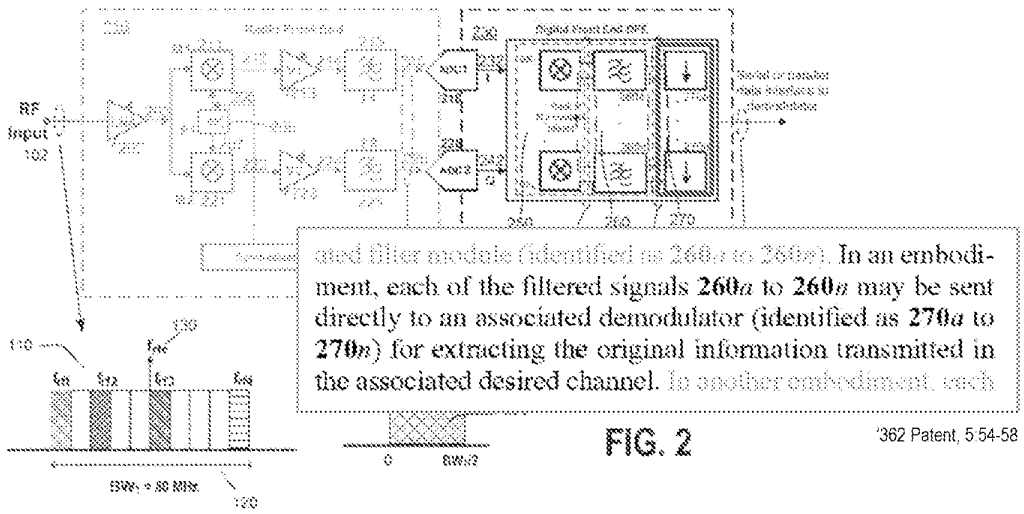
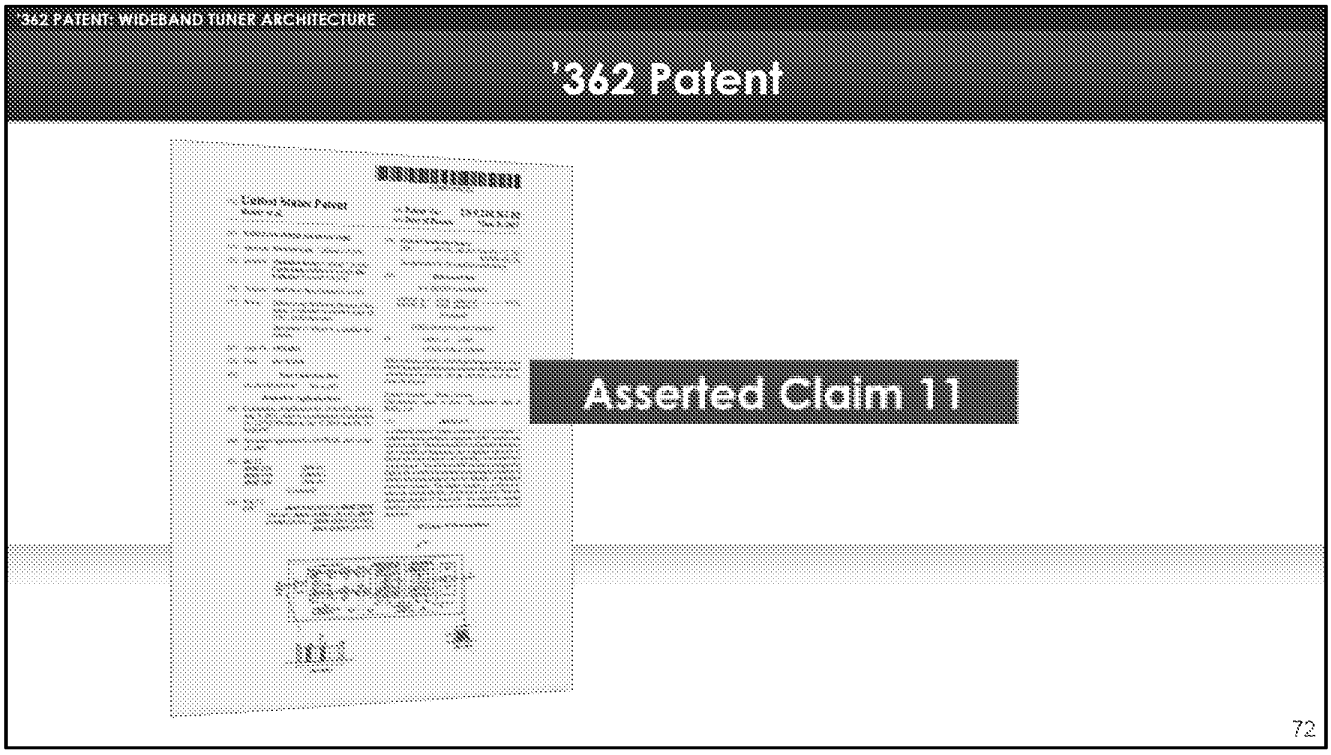


FIG. 2

'362 Patent, 5:54-58

71

Each of the filtered signals is then provided to an associated demodulator, which extracts the information in the desired channels.



Now we will briefly look at some select limitations of claim 11 of the 362 patent, which is the only asserted independent claim.

'362 Patent, Claim 11

11. A method comprising:

in a wideband receiver system:

down-converting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

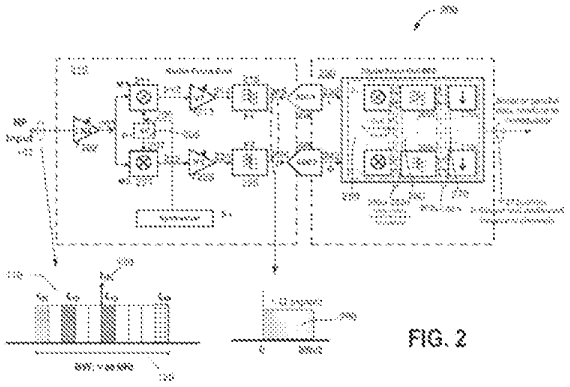


FIG. 2

73

Claim 11 is a method claim, whereby the steps are carried out in in a wideband receiver system.

'362 Patent, Claim 11

11. A method comprising:

in a wideband receiver system:

downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

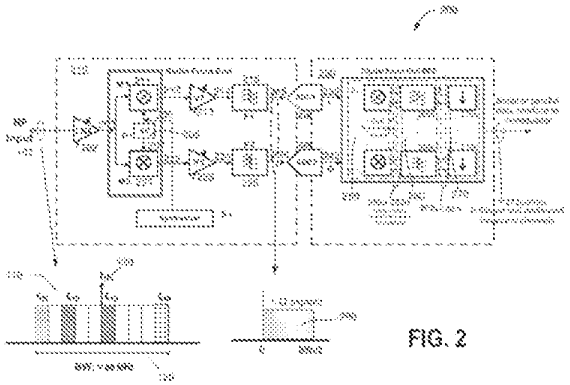


FIG. 2

74

The claim begins with the step of down converting by a mixer module This corresponds to the functions of mixer module 211.

'362 Patent, Claim 11

11. A method comprising:

in a wideband receiver system:

downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

digitizing, by a wideband analog-to-digital converter (ADC) module **of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;**

selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

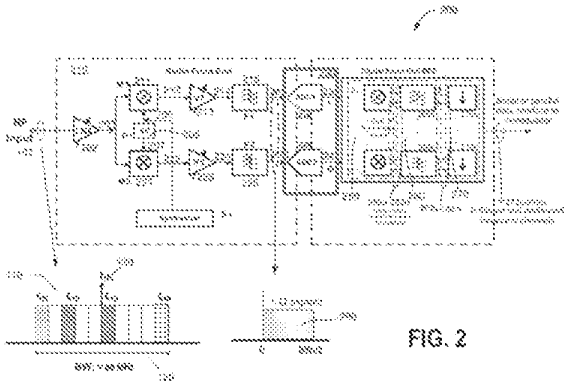


FIG. 2

75

Next, the claim requires digitizing by an analog-to-digital converter module.

We've annotated figure 2 to indicate the analog to digital converters in red.

'362 Patent, Claim 11

11. A method comprising:

in a wideband receiver system:

downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

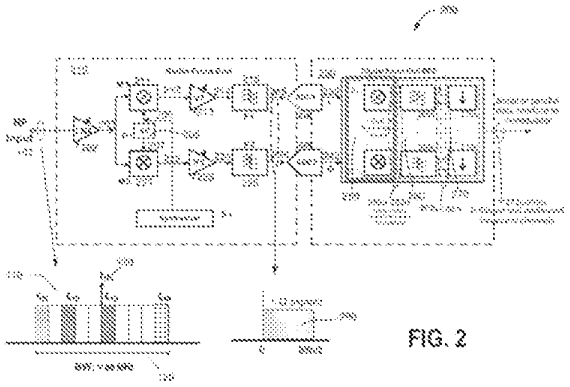


FIG. 2

76

After the digitization, the claim requires that digital circuitry select the desired television channels

'362 PATENT: WIDEBAND TUNER ARCHITECTURE

'362 Patent, Claim 11

11. A method comprising:

in a wideband receiver system:

downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

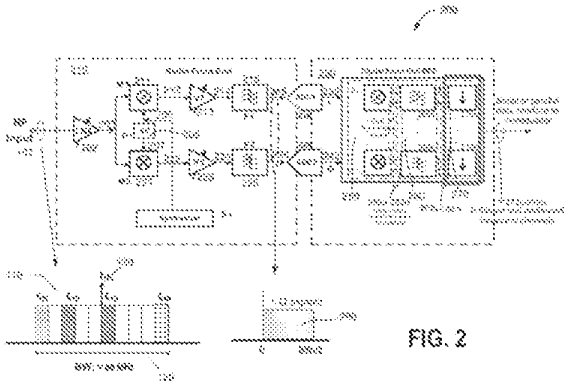
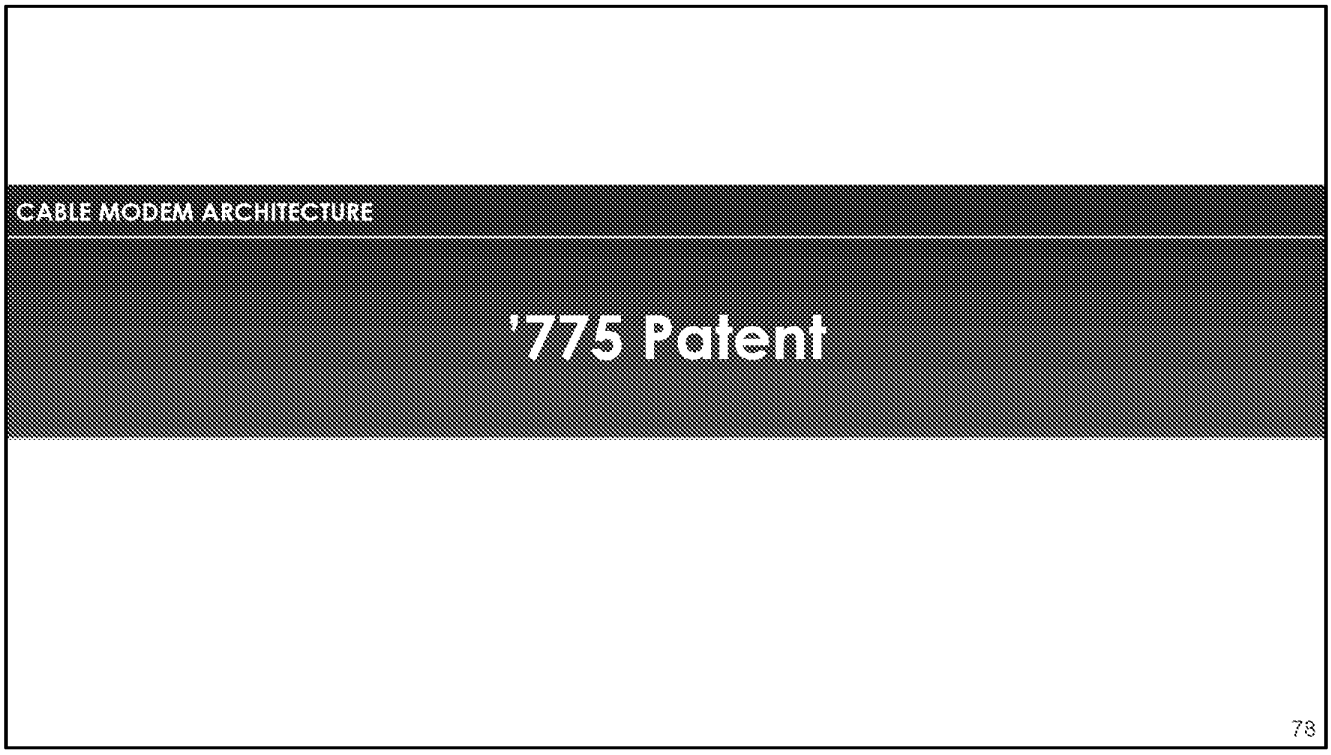


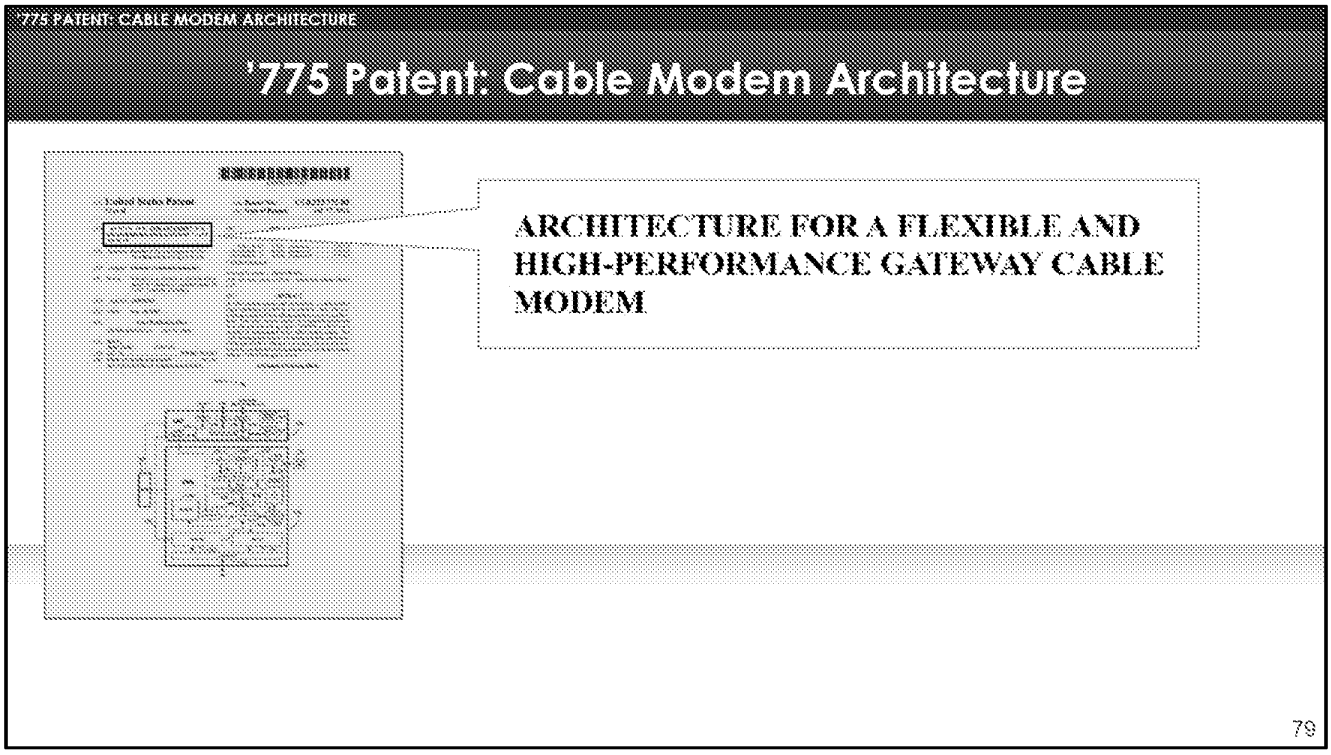
FIG. 2

77

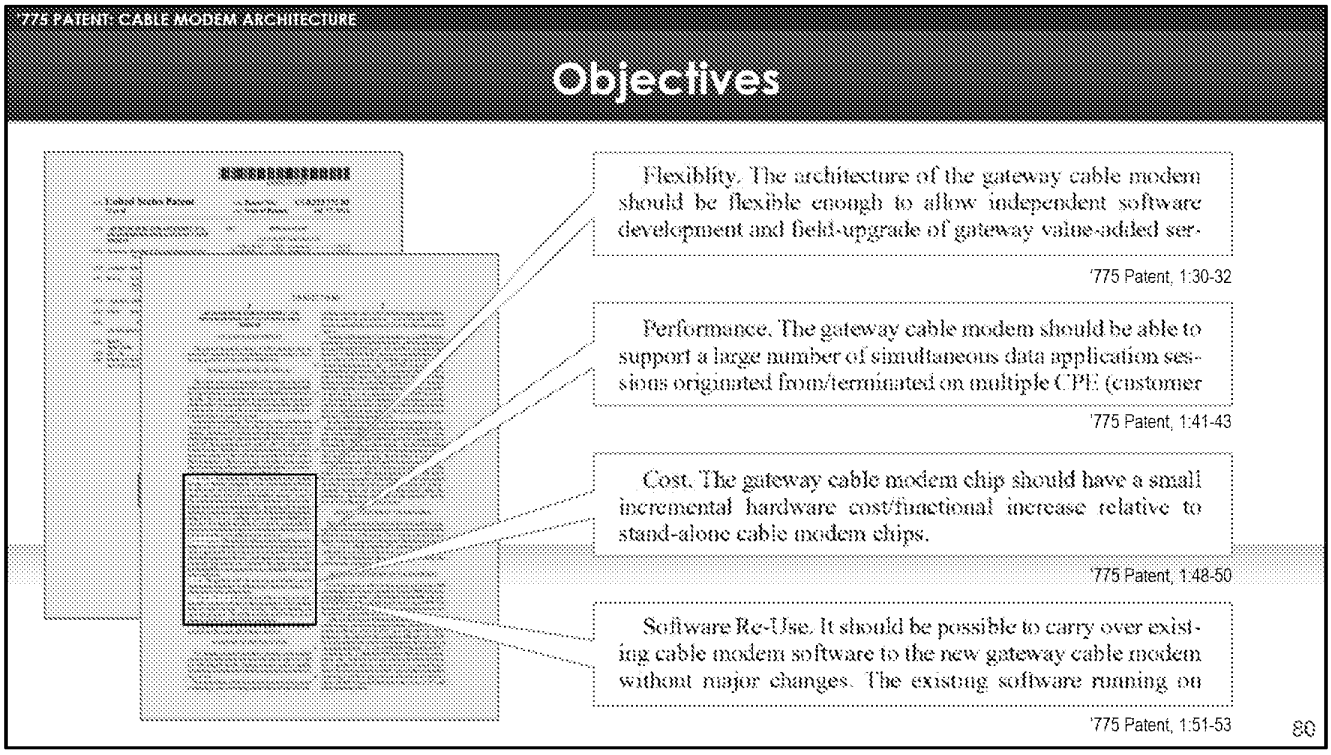
And output the selected channels to a demodulator.



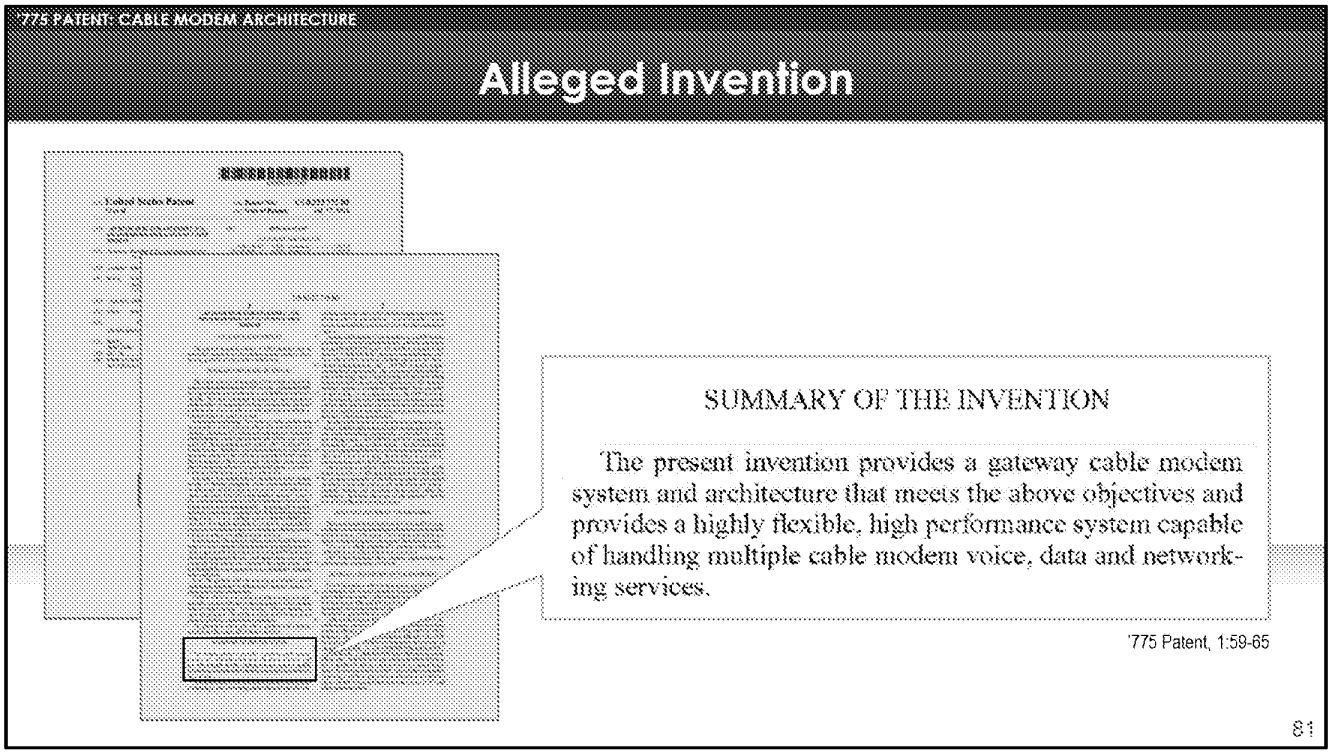
Now we will discuss the 775 patent.



As I mentioned earlier, the 775 patent is directed to an allegedly new architecture for a cable modem.



The specification identifies a number of objectives for a new cable modem, such as flexibility, performance, cost and software re-use.



The alleged invention is a cable modem architecture which meets all of these objectives

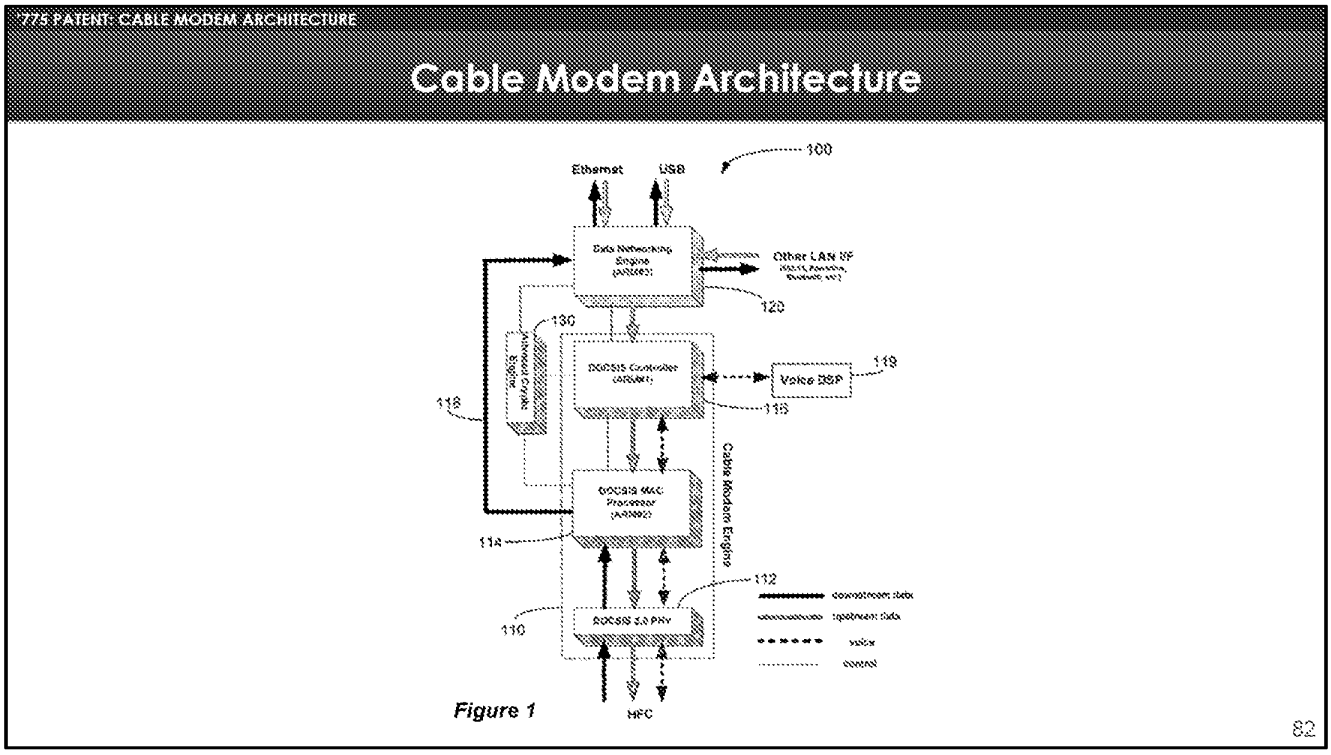


Figure 1 of the patent depicts the disclosed cable modem architecture. It is described as being the architecture of cable modem 100.

'775 PATENT: CABLE MODEM ARCHITECTURE

Cable Modem Architecture

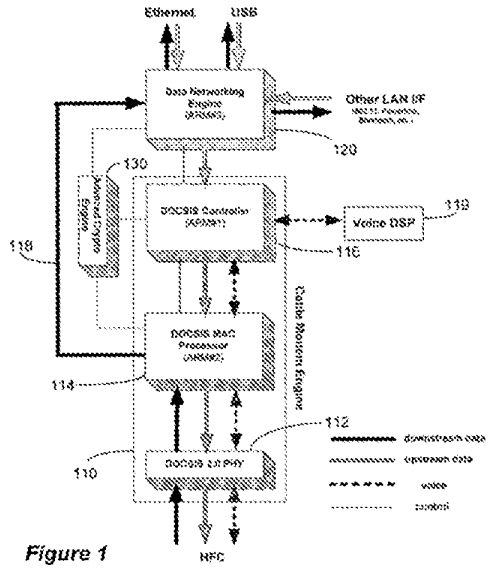


Figure 1

architecture. The architecture includes a cable modem engine having a DOCSIS PHY layer with a hardware transmitter and receiver, a DOCSIS MAC processor that implements real-time critical MAC functions for both upstream and downstream communications, and a DOCSIS controller implementing VoIP functionality. The architecture also includes a data networking engine implementing all data networking processing and home networking applications. The data networking engine is completely decoupled from the cable modem engine. In one implementation, the VoIP functional-

'775 Patent, 2:6-15

83

According to the specification, there are several distinct aspects to this cable modem architecture

'775 PATENT: CABLE MODEM ARCHITECTURE

Cable Modem Engine

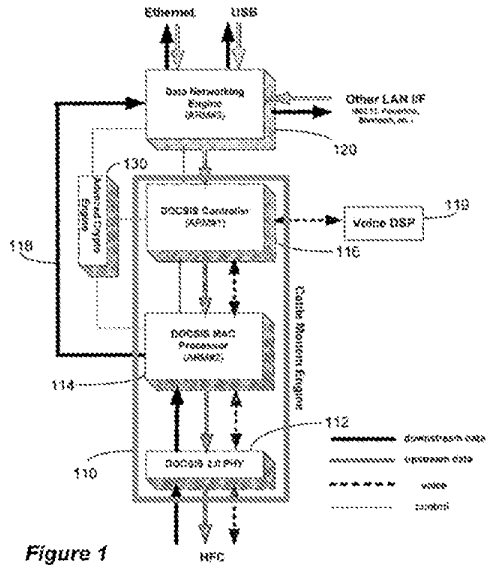


Figure 1

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'775 Patent, 2:6-15

84

The first is the inclusion of a so-called cable modem engine.

And that cable modem engine is in turn made up of three discrete physical components.

'775 PATENT: CABLE MODEM ARCHITECTURE

Cable Modem Engine Architecture

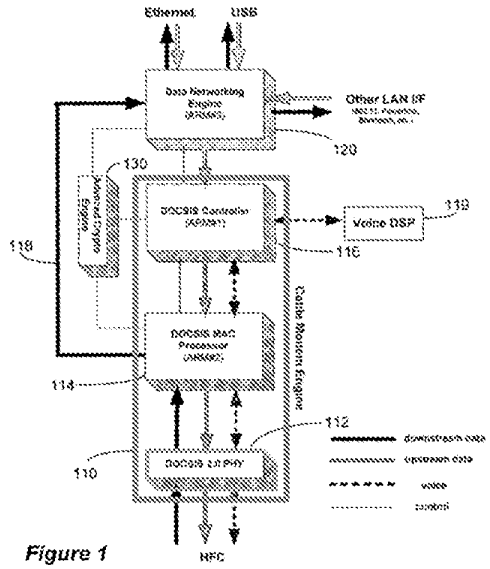


Figure 1

architecture. The architecture includes a cable modem engine having a DOCSIS PHY layer with a hardware transmitter and receiver, a DOCSIS MAC processor that implements real-time critical MAC functions for both upstream and downstream communications, and a DOCSIS controller implementing VoIP functionality. The architecture also includes a

'775 Patent, 2:6-11

85

The first is a so-called DOCSIS 2.0 P H Y labeled 112 in the figure.

'775 PATENT: CABLE MODEM ARCHITECTURE

Cable Modem Engine Architecture

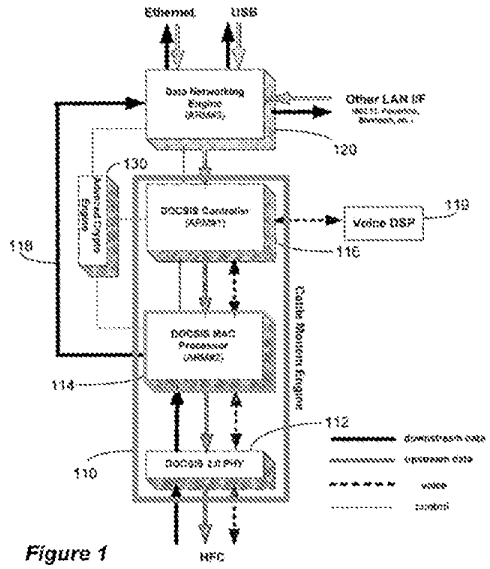


Figure 1

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'775 Patent, 2:6-11

86

The second is a so-called DOCSIS MAC processor labeled 114 in the figure.

'775 PATENT: CABLE MODEM ARCHITECTURE

Cable Modem Engine Architecture

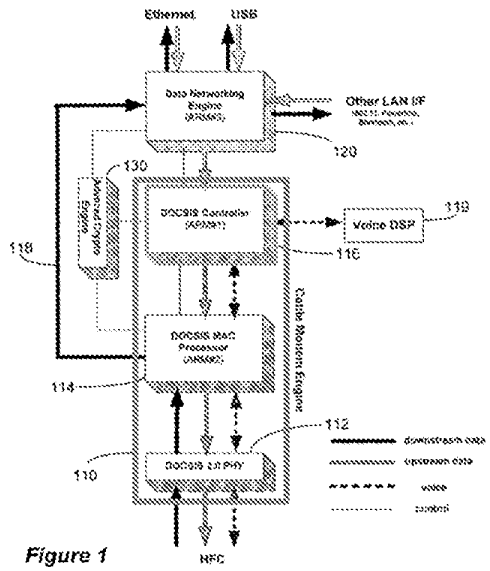


Figure 1

architecture. The architecture includes a cable modem engine having a DOCSIS PHY layer with a hardware transmitter and receiver, a DOCSIS MAC processor that implements real-time critical MAC functions for both upstream and downstream communications, and a DOCSIS controller implementing VoIP functionality. The architecture also includes a

'775 Patent, 2:6-11

87

And the third is a so-called DOCSIS Controller labeled 116 in the figure.

Now I'll discuss the disclosed functions of each of those three discrete physical components.

'775 PATENT: CABLE MODEM ARCHITECTURE

DOCSIS 2.0 PHY

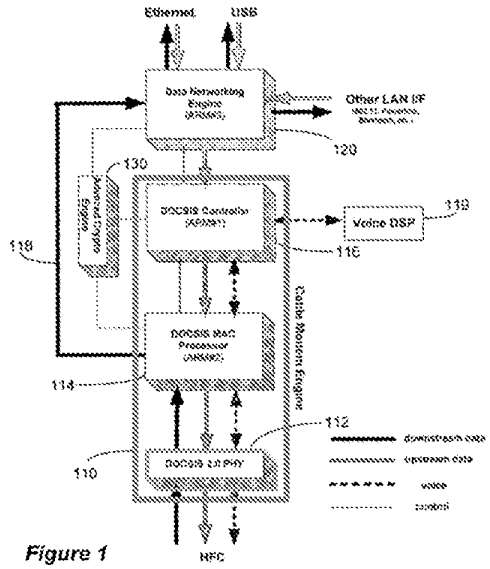


Figure 1

As seen in FIG. 1, DOCSIS PHY layer **112** receives downstream data, transmits upstream data and receives and transmits voice data from/to an external source. In one implementation, the external source is a HFC (hybrid fiber coax) cable employing both fiber optic and coaxial cable as an effective means for delivering combined data, video, voice, CATV and other communications.

'775 Patent, 2:61-67

88

The DOCSIS 2.0 P H Y receives downstream voice and other data from the cable network and transmits voice and other data upstream to the cable network.

'775 PATENT: CABLE MODEM ARCHITECTURE

DOCSIS MAC Processor

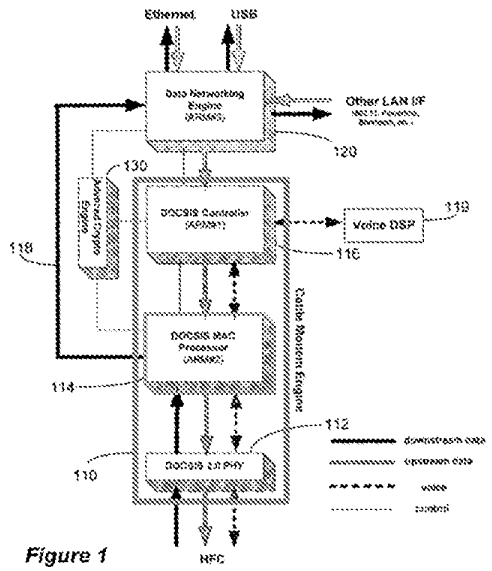


Figure 1

Processor **114** implements real-time critical MAC functions for both upstream (US) and downstream (DS) communications. These functions include US and DS synchronization, DS MAC address filtering, DS protocol filtering, US and DS PHS, concatenation, fragmentation, MAP processing, US transmission scheduling, as well as DOCSIS link-layer DES encryption and decryption. Processor 114 receives down-

'775 Patent, 3:1-7

89

The DOCSIS MAC processor performs some of the DOCSIS MAC functionality of the cable modem.

MAC is an acronym that stands for medium access control. MAC functions relate to how the cable modem accesses the cable television network.

'775 PATENT: CABLE MODEM ARCHITECTURE

DOCSIS Controller

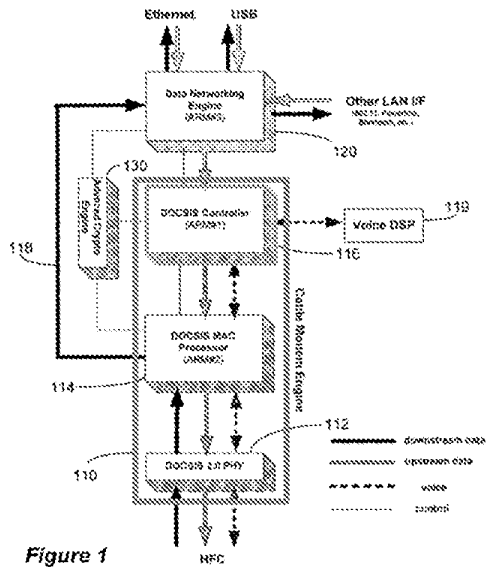


Figure 1

Controller **116** receives US PDU packets from data networking engine **120**. As previously described, DS PDU packets are forwarded by processor **114** to data networking engine **120** without involvement of controller **116**. In one implementation, controller **116** is an ARM940-based RISC processor. Controller **116** implements the following DOCSIS (blocks **200-212**) functions. MAC management message (MMM) processing (ranging, registration, UCD, UCC, DCC, DCI, UP-DIS, DSx and BPI+) (functional block **200** of FIG. **2**), IGMP, MAC address learning, classification, US protocol filtering (functional block **202** of FIG. **2**) and CM IP stack and software downloading. Functional block **204** carries out cable modem IP/UIP functions. functional block **206** carries out SNMP, DHCP, TFTP and TOD functionality and functional block **208** is responsible for cable modem provisioning. Controller **116** also includes a data network engine driver **210** in communication with data network engine **120** and cable MAC driver **212**.

In addition, in order to minimize the latency and jitter of voice packets, controller **116** also implements all PacketCable functionality. In FIG. **2**, PacketCable functionality is represented by functional blocks **220-228**. These PacketCable functions include provisioning (block **220**), security and signaling. Functional blocks **222** (voice DSP driver), **224** (streamlined IP/UDP/RTP with classification, PHS, IP/LLC filtering) and **226** (voice MAC driver) interface with external voice DSP **119**. Additionally MGCP and RTCP functions are provided by functional block **228**.

'775 Patent, 3:21-48

90

Finally, there is the DOCSIS controller. According to the specification, the DOCSIS controller performs a large number of functions, as indicated by the specification excerpts we include on this slide.

'775 PATENT: CABLE MODEM ARCHITECTURE

DOCSIS Controller

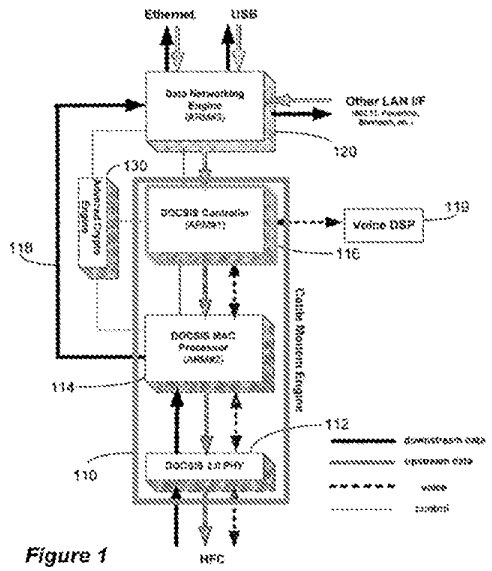


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'775 Patent, 3:21-48

91

Among the functions performed by the DOCSIS Controller are a number of DOCSIS MAC functions. These include MAC management message processing, MAC address learning, and voice MAC driver functions.

So although the cable modem engine includes a so-called DOCSIS MAC processor, the DOCSIS MAC processor does not perform all of the DOCSIS MAC functions of the cable modem. The DOCSIS controller performs a number of DOCSIS MAC functions as well.

'775 PATENT: CABLE MODEM ARCHITECTURE

Data Networking Engine

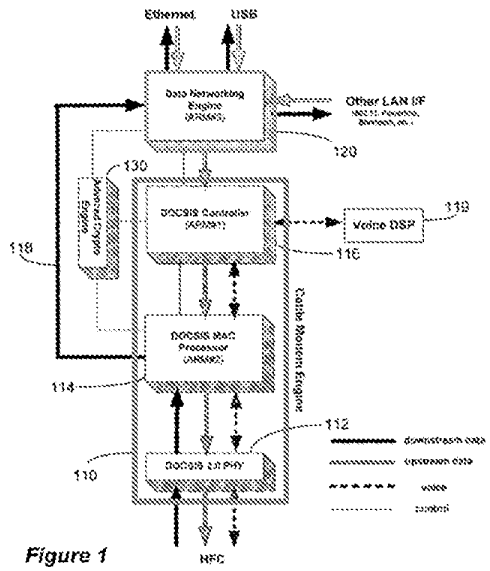


Figure 1

92

Now in addition to the cable modem engine, this cable modem architecture also includes a so-called data networking engine. We annotate that in green on this slide.

'775 PATENT: CABLE MODEM ARCHITECTURE

Data Networking Engine

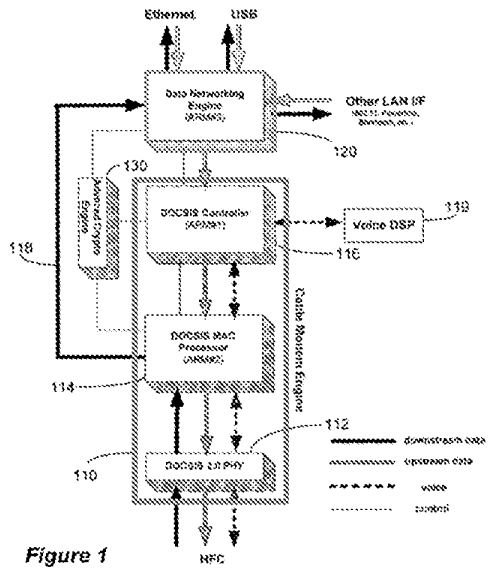


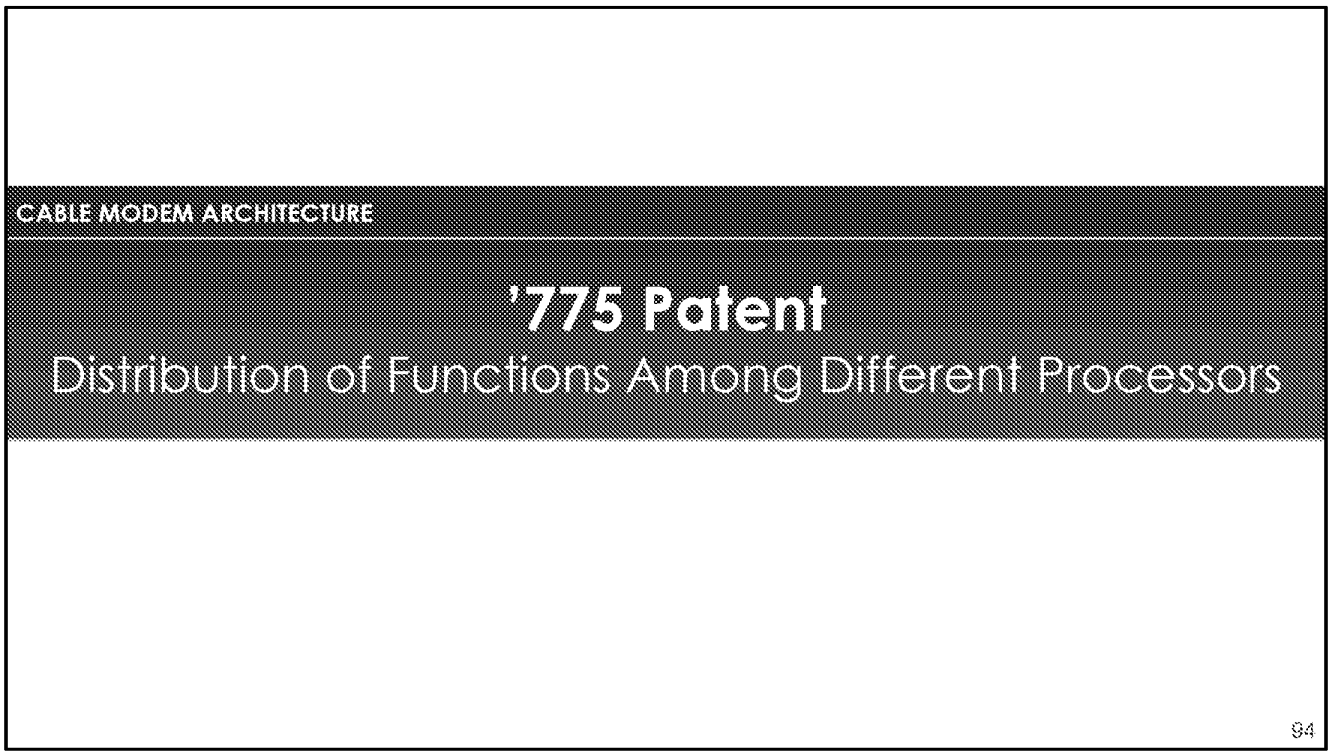
Figure 1

processing and home networking applications. The data networking engine is completely decoupled from the cable modem engine. In one implementation, the VoIP functional-

'775 Patent, 2:13-15

93

The data networking engine is said to be completely decoupled from the cable modem engine.



As I'll discuss now, an important aspect of the disclosed cable modem architecture is the distribution of functions among different processors within the cable modem.

'775 PATENT: CABLE MODEM ARCHITECTURE

Cable Modem Processors

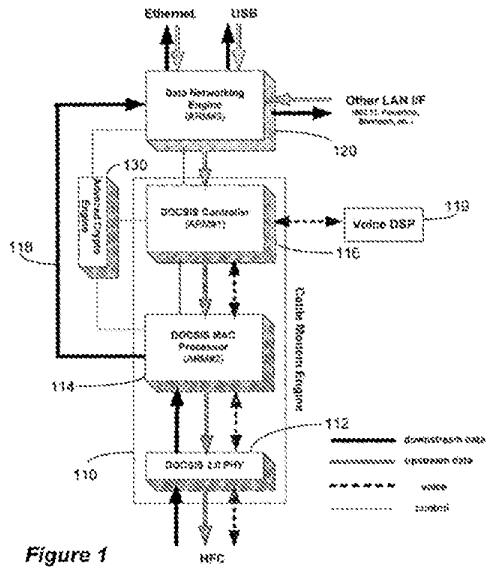


Figure 1

enhanced by the pipe-lining nature of system 100, the processing-intensive functions of the cable modem and data networking are rationally distributed among three different processors: DOCSIS MAC processor **114** (ARM #2); DOCSIS controller **116** (ARM #1); and data networking engine **120** (ARM #3), according to their orders in the packet flow. To

'775 Patent, 4:44-49

95

As the specification explains, the objectives of the invention are achieved by distributing the functions of the cable modem among three different processors. Each of these processors is an ARM processor, which is one type of processor known in the art.

'775 PATENT: CABLE MODEM ARCHITECTURE

Cable Modem Processors

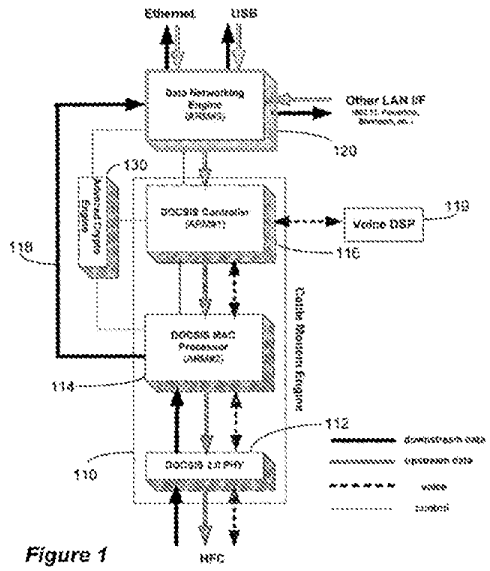


Figure 1

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'775 Patent, 4:44-49

96

The data networking engine is one of the 3 ARM processors.

In both figure 1 and in the specification, the data networking engine is identified as being ARM processor number 3.
The inventors designated this to be the third of the three ARM processors within cable modem 100.

'775 PATENT: CABLE MODEM ARCHITECTURE

Cable Modem Processors

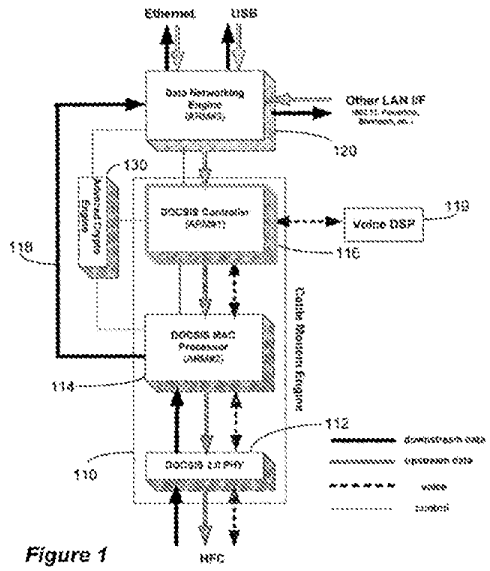


Figure 1

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'775 Patent, 4:44-49

97

The DOCSIS controller is another one of the three ARM processors within the cable modem. The inventors designated the DOCSIS controller as ARM processor number 1.

'775 PATENT: CABLE MODEM ARCHITECTURE

Cable Modem Processors

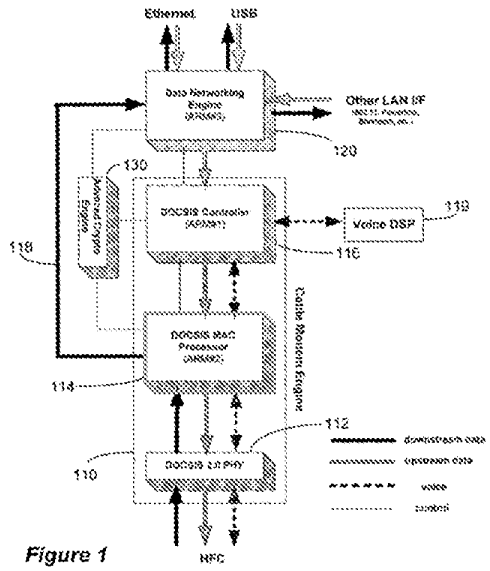


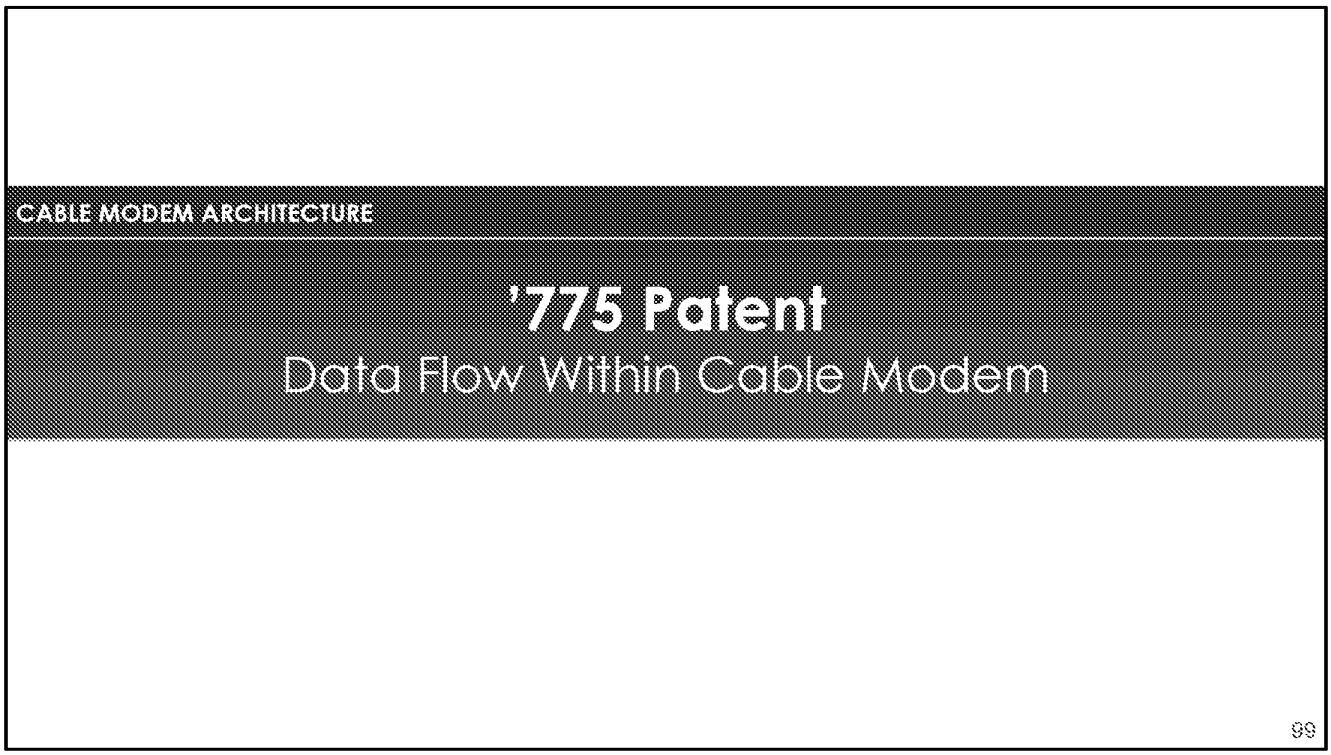
Figure 1

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'775 Patent, 4:44-49

98

Finally, the DOCSIS MAC processor is the last disclosed ARM processor within cable modem 100. The inventors designated the DOCSIS MAC processor as ARM processor number 2.



Another important aspect of the disclosed cable modem architecture is the way data flows through the cable modem. We will discuss that now.

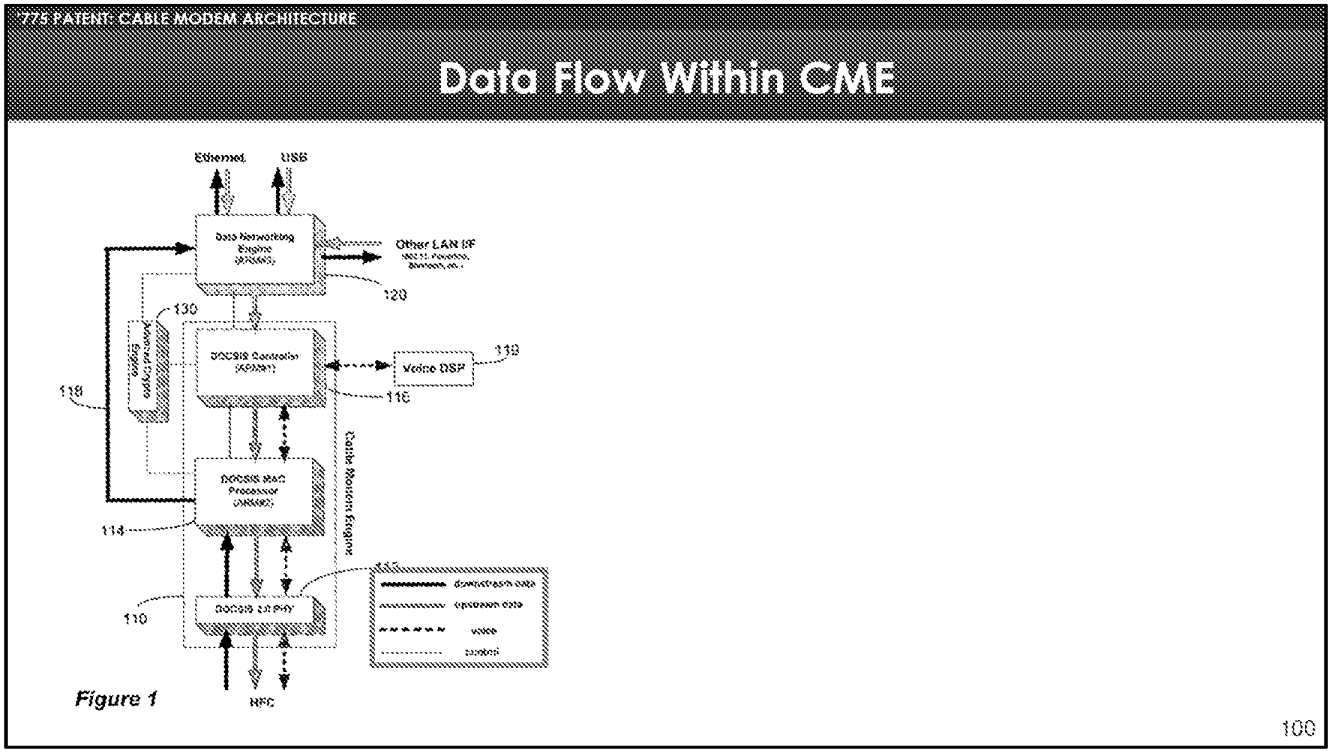
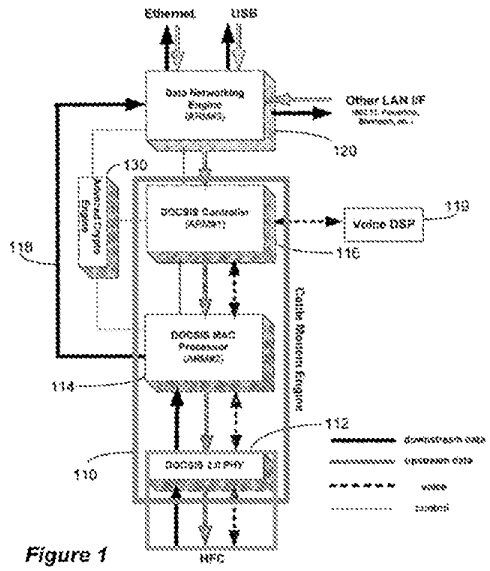


Figure 1 of the 775 patent includes a legend explaining how the different kinds of data that flow through cable modem 100 will be represented.

As indicated by the legend, voice is represented by a dashed line, upstream data by a thick grey line and downstream data by a thick black line.

'775 PATENT: CABLE MODEM ARCHITECTURE

Data Flow Within CME



As seen in FIG. 1, DOCSIS PHY layer 112 receives downstream data, transmits upstream data and receives and transmits voice data from/to an external source. In one implement-

'775 Patent, 2:61-63

101

As we see in figure 1 then, in the portion we annotated in green, all upstream and downstream voice and other data goes through the DOCSIS 2.0 PHY.

The specification spells this out as well.

'775 PATENT: CABLE MODEM ARCHITECTURE

Data Flow Within Cable Modem

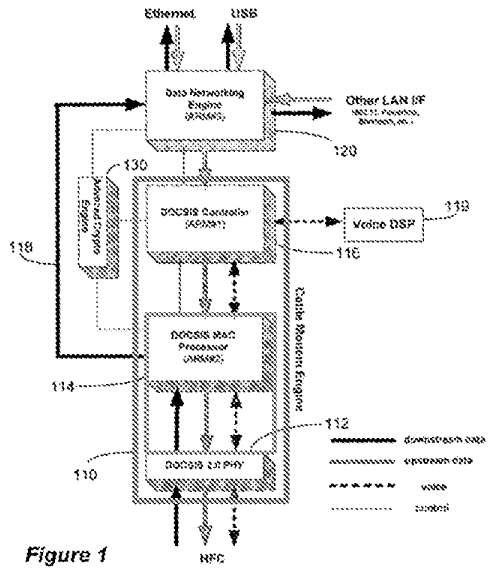


Figure 1

encryption and decryption. Processor **114** receives downstream data from, provides upstream data to and exchanges voice data in both directions with DOCSIS PHY **112**. It also

'775 Patent, 3:7-9

102

Similarly, all upstream and downstream voice and other data also goes through the DOCSIS MAC Processor.

'775 PATENT: CABLE MODEM ARCHITECTURE

Data Flow Within CME

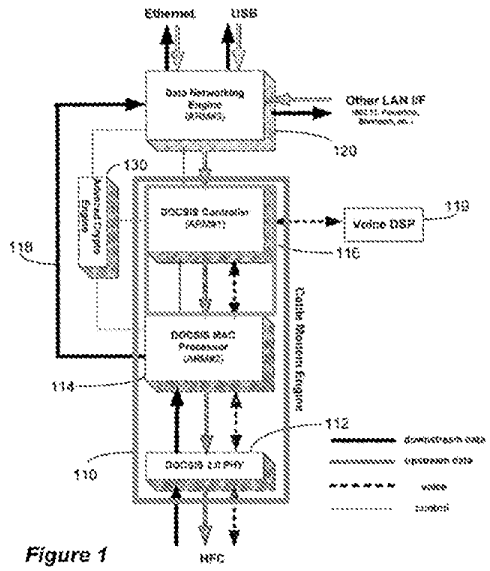


Figure 1

voice data in both directions with DOCSIS PHY 112. It also receives upstream data from, and exchanges voice data in both directions with, controller **116**. To increase downstream

'775 Patent, 3:9-11

103

Notice on this slide, however, that while all voice goes through the DOCSIS controller, only upstream data goes through the DOCSIS controller. Downstream data is not sent by the DOCSIS MAC Processor to the DOCSIS controller.

'775 PATENT: CABLE MODEM ARCHITECTURE

Data Flow Within CME

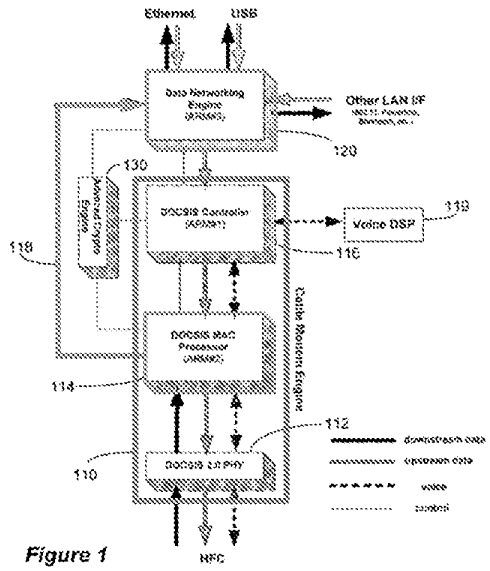


Figure 1

both directions with, controller 116. To increase downstream throughput, all processing of DS PDU (protocol data unit) packets is done within processor **114** without involving controller **116**. After being processed, DS PDU packets are forwarded by processor **116** directly to data networking engine **120** along path **118**, bypassing controller **116**. In one implo-

'775 Patent, 3:11-16

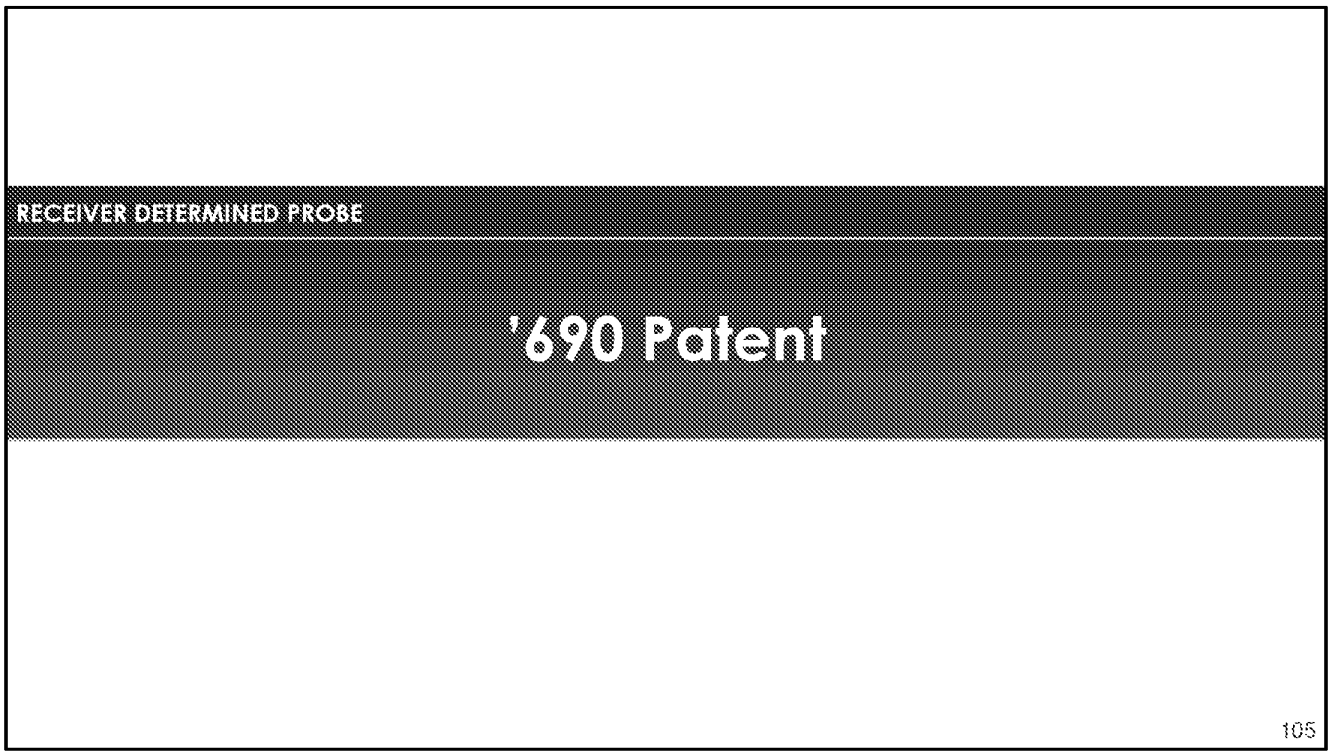
(ARM #3), according to their orders in the packet flow. To further boost downstream throughput, the downstream PDU packets are directly forwarded from the DOCSIS MAC processor **114** to the data networking engine **120** without going through DOCSIS controller **116**. This is made possible by exploiting the asymmetric nature of the DOCSIS US/DS **152** and **154**. In addition, the data path for voice packets is laid

'775 Patent, 4:49-55

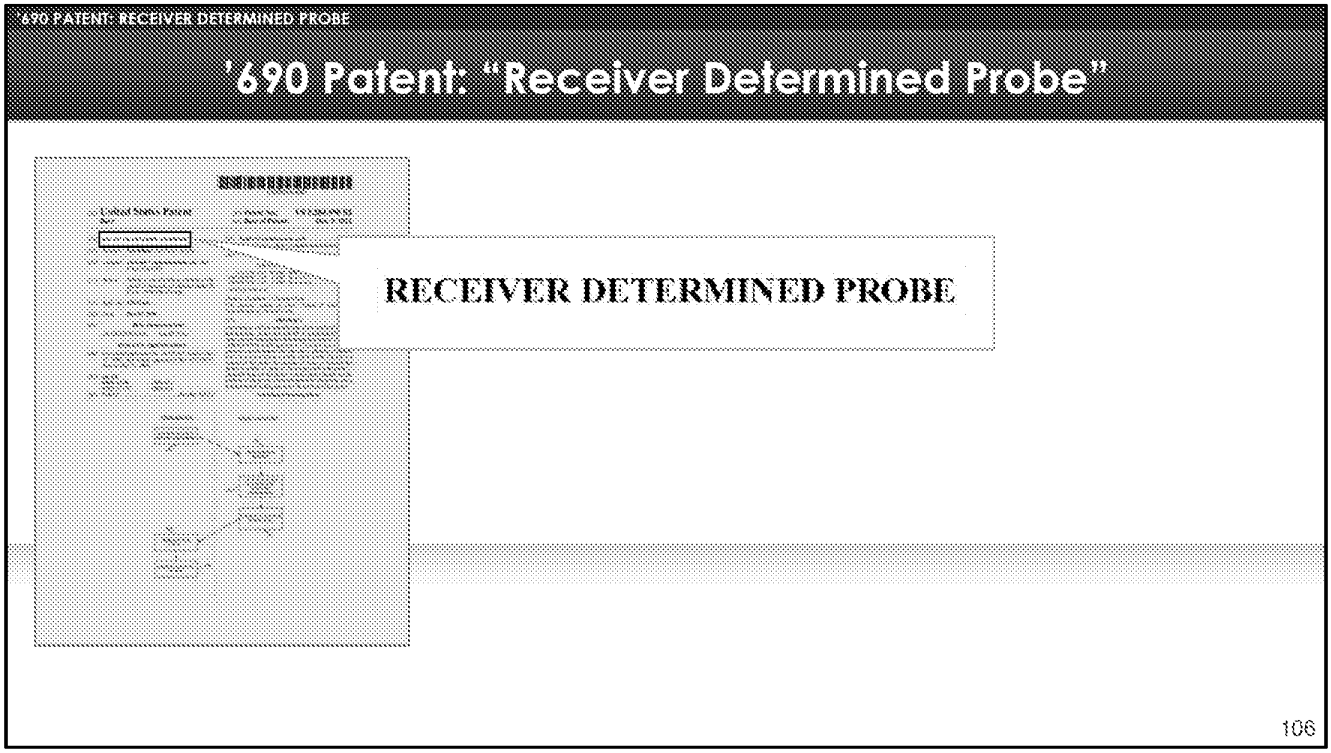
104

Instead, the DOCSIS MAC processor sends downstream data directly to the data networking engine, bypassing the DOCSIS controller completely.

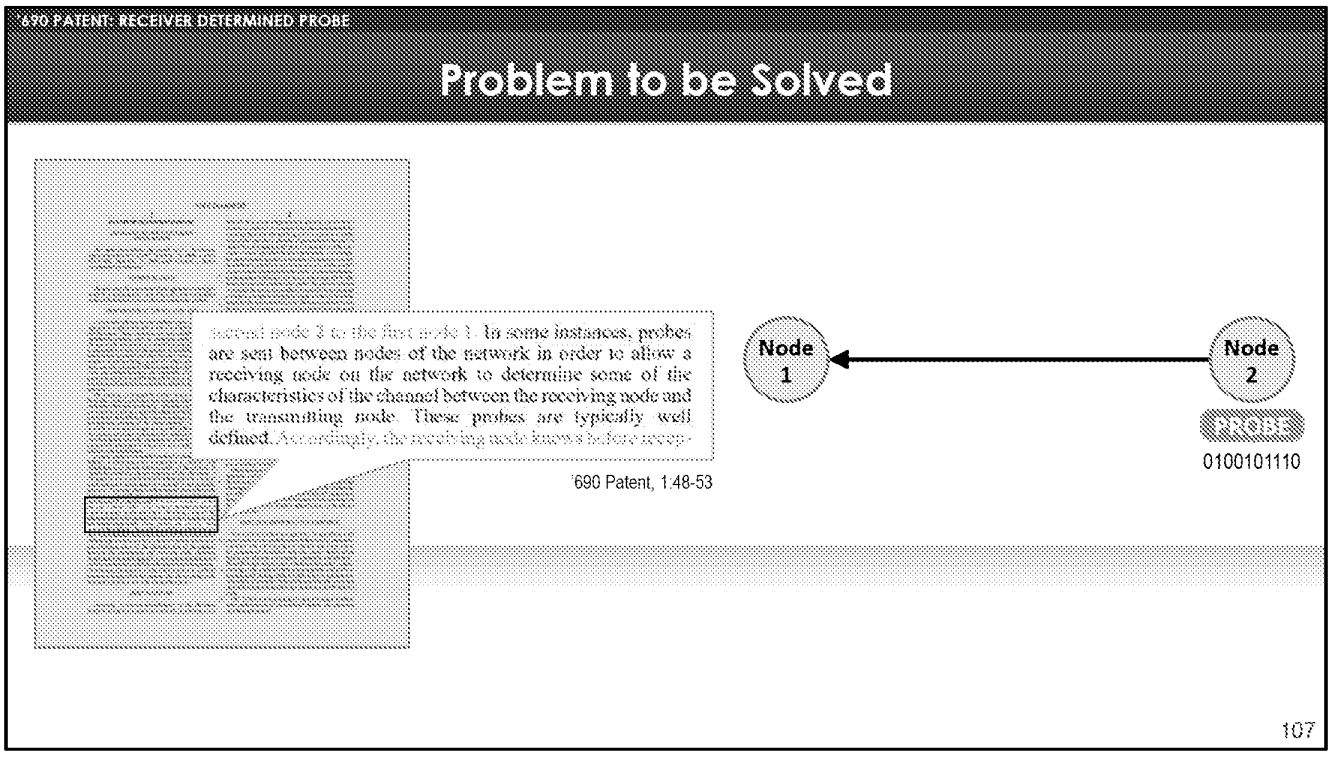
This ability to bypass the DOCSIS controller is described in the specification as being important to achieving the performance objectives of the cable modem architecture. That concludes our discussion of the 775 patent. We will not address the claims of the 775 patent because Charter contends those claims are indefinite, and that it is not possible to understand what those claims cover.



So now we'll turn now to the 690 patent.

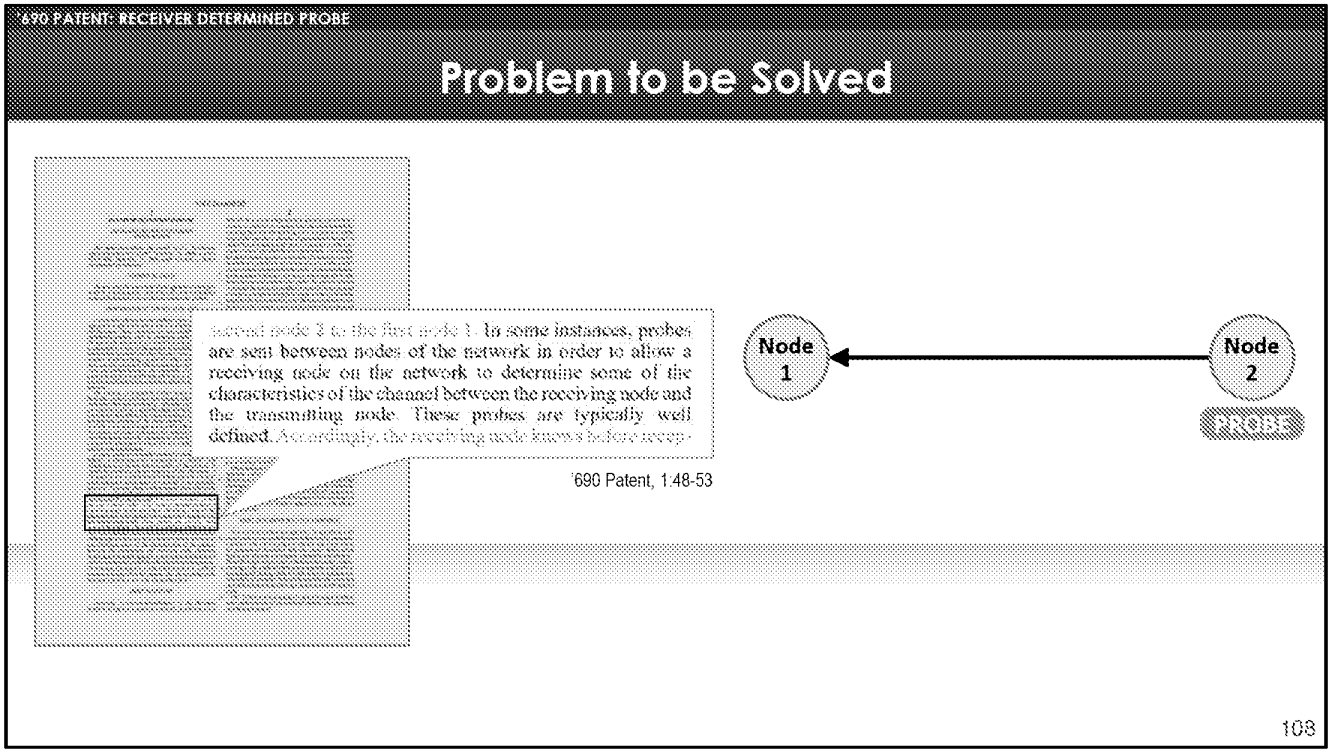


I mentioned earlier that the 690 patent is directed to a Receiver determined probe. Now I'll explain what that means.

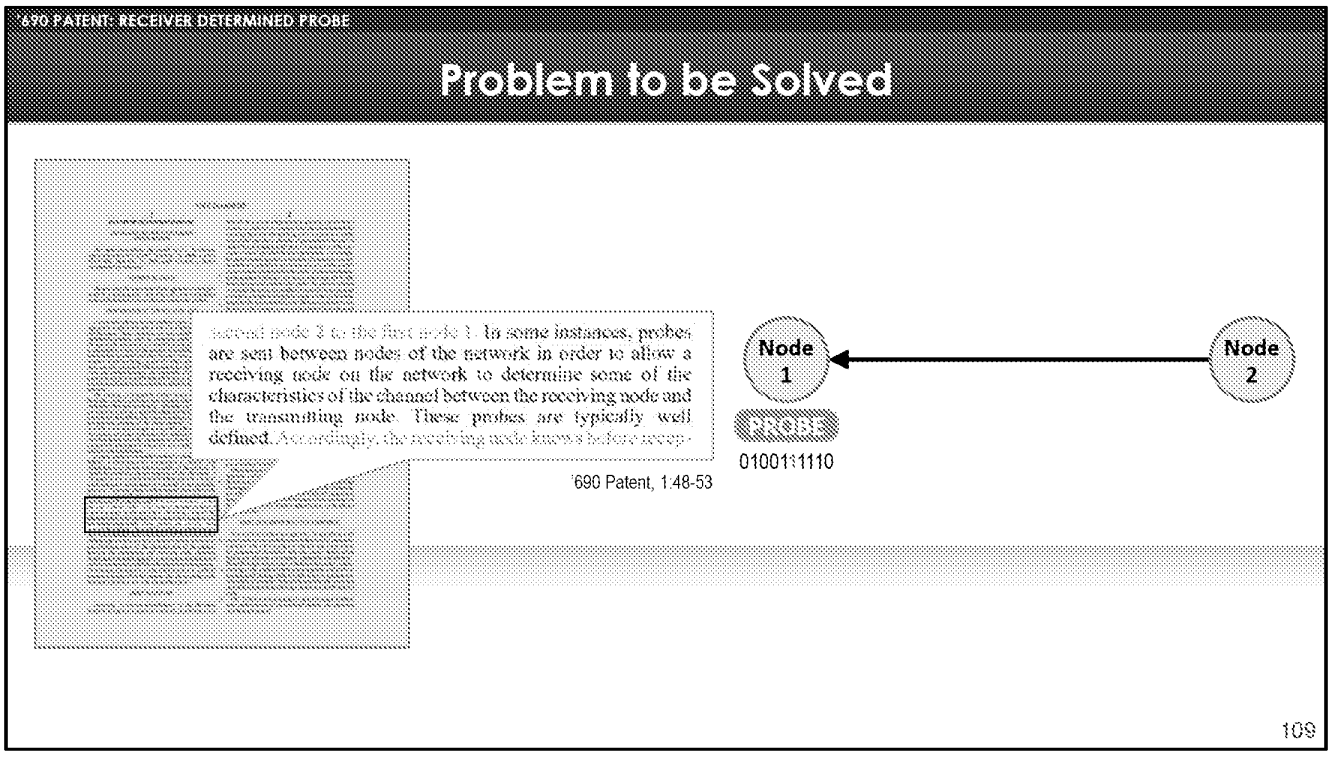


As the specification explains, it was known in the prior art for nodes on a network to send probes to one another. These probes included a known pattern which, at least according to the specification, were always defined in advance.

In the example we provide on this slide, the probe includes a predefined bit pattern of zeros and ones.

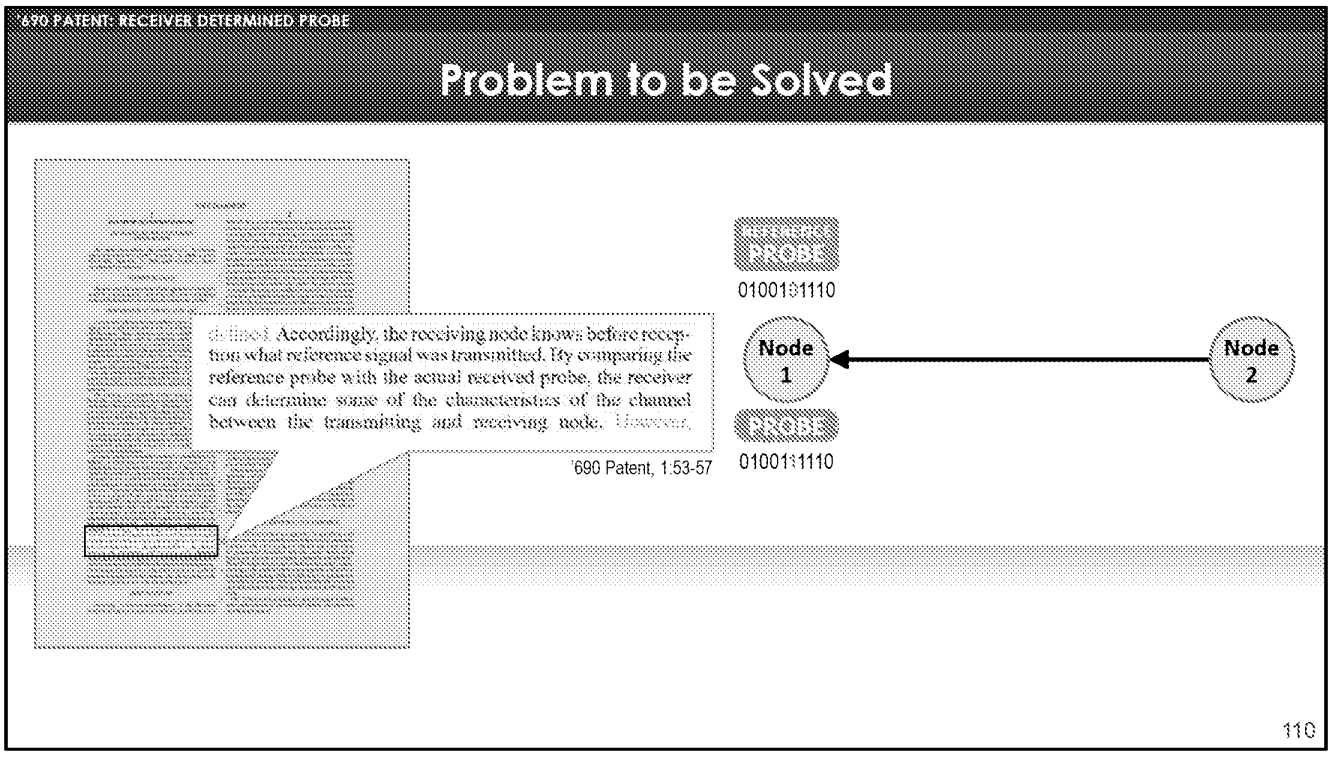


Here we show the probe being transmitted from node 2 to node 1.



Now during that transmission, problems with the communications channel can cause the probe to get corrupted.

In this example, the red probe bit highlighted in yellow was changed during transmission from a 0 to a 1.



Because the probes are defined in advance, however, the node that received the probe knows the pattern it was supposed to receive. It has a reference probe to compare to the probe it actually received.

As the specification explains, by examining the difference between the reference probe and the probe it actually received, the receiving node can determine characteristics of the channel over which the probe was transmitted.

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ENTROPIC COMMUNICATIONS, LLC, Plaintiff v. CHARTER COMMUNICATIONS, INC., Defendant.	Civil Action No. 2:22-cv-00125-JRG **JURY TRIAL DEMANDED**

CHARTER'S RESPONSIVE CLAIM CONSTRUCTION BRIEF

TABLE OF CONTENTS

I. INTRODUCTION 1

II. The '775 Patent 1

A. The Specification of the '775 Patent (Charter TT 78-104) 1

1. Distribution of Functions Among Three Processors (Charter TT 94-98) 2

2. Data Flow Within Cable Modem 100 (Charter TT 99-104) 3

3. Prosecution History of the '775 Patent 3

B. Construction of '775 Patent Claim Terms 4

III. The '008 and '826 Patents 11

A. The Specification of the '008 and '826 Patents (Charter TT 21-53) 11

B. Construction of '008 and '826 Patent Claim Terms 12

IV. The '690 Patent 16

A. The Specification of the '690 Patent (Charter TT 105-120) 16

B. Construction of '690 Patent Claim Terms 18

V. The '362 Patent 22

A. The Specification of the '362 Patent (Charter TT 54-77) 22

B. Construction of '362 Patent Claim Terms 24

VI. The '682 Patent 26

A. The Specification of the '682 Patent (Charter TT 121-146) 26

B. Construction of '682 Patent Claim Terms 27

TABLE OF AUTHORITIES

Page(s)

Cases

Altiris, Inc. v. Symantec Corp.,
318 F.3d 1363 (Fed. Cir. 2003).....24, 26

Becton, Dickinson & Co. v. Tyco Healthcare Grp., LP,
616 F.3d 1249 (Fed. Cir. 2010).....14, 15

Dow Chemical Co. v. Nova Chemicals Corp. (Canada),
803 F.3d 620 (Fed. Cir. 2015).....6, 7

GPNE Corp. v. Apple Inc.,
830 F.3d 1365 (Fed. Cir. 2016).....9

Hytera Commc'ns Co. Ltd. v. Motorola Solutions, Inc.,
841 F. App'x. 210 (Fed. Cir. 2021).....26

Kyocera Senco Indus. Tools Inc. v. Int'l Trade Comm'n,
22 F.4th 1369 (Fed. Cir. 2022).....15, 16

Lucent Technologies, Inc. v. Gateway, Inc.,
525 F.3d 1200 (Fed. Cir. 2008).....30

Nautilus, Inc v. Biosig Instruments, Inc.,
572 U.S. 898 (2014).....6, 7

Oak Tech., Inc v. Int'l Trade Comm'n,
248 F.3d 1316 (Fed. Cir. 2001).....25

Outside the Box Innovations, LLC v. Travel Caddy, Inc.,
695 F.3d 1285 (Fed. Cir. 2012).....14

Red Rock Analytics, LLC v. Samsung Electronics Co., Ltd.,
No. 2:17-CV-101-RWS-RSP, 2018 WL 1806859 (E.D. Tex. Apr. 16, 2018).....24

SimpleAir, Inc. v. Sony Ericsson Mobile Commc'ns AB,
820 F.3d 419 (Fed. Cir. 2016).....18, 19, 20

Teva Pharmaceuticals USA, Inc. v. Sandoz, Inc.,
789 F.3d 1335 (Fed. Cir. 2015).....7

TQ Delta, LLC v. CommScope Holding Co., Inc.,
No. 2:21-CV-310-JRG, 2022 WL 2071073 (E.D. Tex. June 8, 2022).....13

TABLE OF EXHIBITS

No.	Description
Exhibit 1	Charter's Technology Tutorial Slides and Script, submitted to the Court on May 9, 2023
Exhibit 2	Condensed Transcript of the Deposition of Dr. Richard A. Kramer (excerpts), dated May 4, 2023
Exhibit 3	Newton's Telecom Dictionary, 17th Ed. 2001 (excerpt), introduced as Exhibit 5 to the Deposition of Dr. Richard A. Kramer on May 4, 2023
Exhibit 4	Data-Over-Cable Service Interface Specifications DOCSIS® 3.1 – MAC and Upper Layer Protocols Interface Specification – CM-SP-MULPIv3.1-I03-140610, issued June 10, 2014 (excerpts), bearing bates number CHARTER_ENTROPIC00101872
Exhibit 5	Data-Over-Cable Service Interface Specifications DOCSIS 3.0 – MAC and Upper Layer Protocols Interface Specification – CM-SP-MULPIv3.0-I18-120329, issued March 29, 2012 (excerpts), bearing bates number CHARTER_ENTROPIC00101132

TABLE OF ABBREVIATIONS AND ACRONYMS

Charter	Charter Communications, Inc.
Entropic	Entropic Communications, LLC
EBr.	Entropic's Opening *Markman* Brief, Dkt. 97
CEx.	Exhibit to the Declaration of Albert J. Boardman in Support of Charter's Responsive Claim Construction Brief
EEx.	Exhibit to Entropic's Opening *Markman* Brief, Dkt. 97
Charter TT	Charter's Technology Tutorial Slides/Script, CEx. 1
'775 or '775 Patent	U.S. Patent No. 8,223,775, EEx. 1
'008 or '008 Patent	U.S. Patent No. 8,792,008, EEx. 2
'826 or '826 Patent	U.S. Patent No. 9,825,826, EEx. 3
'690 or '690 Patent	U.S. Patent No. 8,284,690, EEx. 4
'362 or '362 Patent	U.S. Patent No. 9,210,362, EEx. 5
'682 or '682 Patent	U.S. Patent No. 10,135,682, EEx. 6
Kramer	Rebuttal Expert Declaration of Dr. Richard A. Kramer Regarding Claim Construction, EEx. 7
Almeroth	Declaration of Dr. Kevin Almeroth Regarding Claim Construction and Accompanying Appendices A-I, EEx. 8
DOCSIS	Data-Over-Cable Service Interface Specifications

All emphasis in quotations herein is added, unless indicated otherwise.

I. INTRODUCTION

The specifications of the asserted patents disclose very specific structures and methods. In some cases, the claims hue closely to the disclosures, and those claims should be construed accordingly. In other cases, the claims deviate wildly from the disclosures in ways that render them unintelligible. Those claims are indefinite. In all cases, Charter's constructions are grounded in the intrinsic record and the plain meanings of claim terms which actually have plain meanings. Those constructions should be adopted. Certainly, Entropic's proposal that the Court construe nothing, and that the jurors be left to fend for themselves on all of these issues, should be rejected.

II. The '775 Patent

A. The Specification of the '775 Patent (Charter TT 78-104)

Entropic agrees that the alleged invention of the '775 Patent is an "architecture for cable modems." (EBr. at 1.) An "architecture" of a computerized device "refers to how the device's components are connected to, and operate with, each other." (Almeroth ¶32.) And so it is with the '775 Patent, where the disclosed cable modem architecture has specifically enumerated physical components which operate and interoperate in specifically enumerated ways.

Fig. 1 depicts the disclosed architecture as embodied in a cable modem "100." ('775 2:49-50, 4:10.) One aspect of the architecture is the inclusion of a so-called "cable modem engine" ("CME"). The phrase "cable modem engine" does not have a plain meaning. (Almeroth ¶34.) According to the specification, the CME "performs all cable modem functions" and "implements the entire DOCSIS cable modem functionality." ('775 Abstract, 2:55-56; Almeroth ¶36.)

The CME comprises three discrete physical components among which the CME functions are distributed. ('775 2:5-11, Fig 1; Almeroth ¶¶42-51):

> 1) **"DOCSIS 2.0 PHY":** This device sends and receives voice and data over the cable network. ('775 2:61-63.)

> 2) **"DOCSIS MAC processor":** The term "DOCSIS MAC processor" does not have a plain meaning. According to the specification, the DOCSIS MAC processor performs some (but not all) of the DOCSIS MAC functions of cable modem 100 ("CM 100"). ('775 3:1-7.)
>
> 3) **"DOCSIS controller."**. The term "DOCSIS controller" does not have a plain meaning either. According to the specification, the DOCSIS controller performs a host of functions itemized at '775 3:21-48. Among those functions are a number of DOCSIS MAC functions, including DOCSIS "MAC management message (MMM) processing" ('775 3:27-29), "MAC address learning" ('775 3:30), and "voice MAC driver" functions ('775 3:46).

Thus, although the CME includes a "DOCSIS MAC processor," that processor does not perform all the MAC functions. The DOCSIS controller also performs DOCSIS MAC functions.

In addition to the CME, the cable modem also includes a so-called data networking engine ("DNE"). The term "data networking engine" does not have a plain meaning, but according to the specification it "implement[s] all data networking processing and home networking applications." ('775 2:11-13; Almeroth ¶¶34, 37.) According to the specification, it is important that the DNE and CME be "completely partitioned." ('775 1:66-2:4, 2:13-15, 2:24-27, 3:53-58, 4:13-16; Almeroth ¶38.) However, the specification does not explain what "complete" partitioning means or in what way the two are completely partitioned. (Almeroth ¶39.)

1. Distribution of Functions Among Three Processors (Charter TT 94-98)

Cable modem 100 contains three different ARM processors (a specific type of processor known in the art (Almeroth ¶40)). The objectives of the invention are said to be achieved by having "the processing-intensive functions of the cable modem and data networking rationally distributed among three different processors: DOCSIS MAC processor **114** (ARM #2); DOCSIS controller **116** (ARM #1); and data networking engine **120** (ARM #3)." ('775 4:44-49.) Each of these three components is labeled with its associated ARM processor number in Fig 1.

2. Data Flow Within Cable Modem 100 (Charter TT 99-104)

Another important aspect of the architecture is the way data flows through the components of the cable modem. Downstream data and downstream voice are received into the cable modem at the DOCSIS 2.0 PHY of the CME. ('775 2:61-63.) The DOCSIS 2.0 PHY then sends the downstream data and voice to the DOCSIS MAC processor. ('775 3:7-9.) However, although the DOCSIS MAC Processor then sends the downstream voice to the DOCISIS controller ('775 3:9-11), it does not send downstream data to the DOCSIS controller. Instead, as represented by line 118 in Fig. 1, the DOCSIS MAC processor sends downstream data directly to the DNE, "bypassing" the DOCSIS controller completely. ('775 3:11-16 (hereinafter, the "DOCSIS Controller Bypass Feature.").) This feature is said to "further boost downstream throughput" above and beyond that afforded by the distribution of functions among three different processors alone. ('775 4:49-55.) This data flow is further explained at Almeroth ¶¶52-56.

3. Prosecution History of the '775 Patent

During prosecution, the patent examiner repeatedly rejected the claims – including the predecessor claim to '775 claim 18 – as being anticipated by US Patent Application Publication No. 2001/0039600 to Brooks et al. ("Brooks"). As relevant here, the examiner found that Brooks teaches a CME and DNE whereby the "cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine." (Almeroth App. G, at ENTROPIC_CHARTER_0000092, -0000096.)

Brooks disclosed two processors, one of which the examiner said comprised a DNE and the other of which the examiner said was part of a CME. (Almeroth ¶59; *id.*, App. G, at ENTROPIC_CHARTER_0000123.) To overcome the rejection, the applicants argued that the CME and DNE in Brooks were not "completely partitioned" because there was "connecting circuitry" between the two processors:

> because available connecting circuitry would be shared by both the one processor and the other processor, the asserted cable modem engine and home networking engine could not be completely partitioned as claimed.

(*Id.* at ENTROPIC_CHARTER_0000132.) The applicants further argued that the CME and DNE in Brooks cannot be completely partitioned:

> because the CMAC/CPHY block (114, 118, 224 and 228) communicates with both the processors 102 and 104 *by sharing the same data paths and sharing the same direct memory access controller.* (See peripheral bus 112 - bridge 110 - **system bus 108** in Fig. 1 and APB 214- DMA Controller/ASB-APB Bridge 212- **ASB 210** in Fig. 2, and paragraphs 0034 and 0035).

(*Id.*, at ENTROPIC_CHARTER_0000133.)

The Brooks "system bus 108" and "ASB 210," which the applicants pointed to as demonstrating that the Brooks CME and DNE are not "completely partitioned," is the data bus between the two processors. Entropic's expert Dr. Kramer agrees. (Kramer ¶114.)[1] In view of these arguments, the examiner withdrew his rejection of the claims over the Brooks reference. (Almeroth ¶63; *id.*, App. G, at ENTROPIC_CHARTER_0000143 – 0000153.)

The prosecution history is further explained at Almeroth ¶¶57-63.

B. Construction of '775 Patent Claim Terms

Claim Term	Entropic's Construction	Charter's Construction
"a data networking engine implemented in a first circuit that includes at least one processor…" (cl. 18)	Plain and ordinary meaning.	Indefinite.
"a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit…" (cl. 18)	Plain and ordinary meaning.	Indefinite.

[1] Dr. Kramer also says that the applicants did not rely on "system bus 108" and "ASB 210" in distinguishing Brooks. In view of the above excerpted passage from the prosecution history, he is clearly mistaken about that.

'775 claim 18 requires that an infringing device contain both a DNE and a CME. But that is not all. The claim further requires that the DNE be "implemented in a first circuit that includes at least one processor…" and that the CME be "implemented in a second circuit that includes at least one processor…" Moreover, the second circuit in which the CME is implemented must be "separate from" the first circuit in which the DNE is implemented. ('775 7:34-35, 8:5-7.)

The specification does not disclose any of this. There is no disclosure of a DNE or CME implemented in any circuit, much less two circuits which are "separate" from one another. Indeed, the word "circuit" does not even appear in the specification. The specification therefore provides no guidance whatsoever as to what these "circuit" limitations mean. (Almeroth ¶64.)

Of course, the word "circuit" does have a plain meaning. The dictionary definition of circuit (the only definition in the record) is as follows:

> 1. Any path that can carry electrical current. 2. A combination of electrical components interconnected to perform a particular task. At one level, a computer consists of a single circuit; at another, it consists of hundreds of interconnected circuits.

(*Id.* ¶65; *id.*, App. C, at 99.) Pursuant to definition # 1, processors such as the disclosed ARM processors would each comprise billions of circuits because every processor contains billions of electrical paths. (Almeroth ¶71.) Pursuant to this definition, the claimed "circuits" could not "include at least one processor" as required by claim 18: processors are made up of electrical paths, not vice-versa. Claim 18 would therefore be indefinite.

According to definition # 2, the boundaries of a circuit – and the number of circuits in a device – depends entirely on a person's perspective. Any combination of electrical components which perform a task can be considered a circuit. Thus, as the definition explains, "at one level" an entire computerized device constitutes one circuit for performing the tasks it was built to perform. At this "level," disclosed cable modem 100 is one circuit. Thus, hypothetically, if cable

modem 100 were an accused device, it would not infringe claim 18 because its DNE and CME would not be implemented in two separate circuits. (*Id.* ¶¶67-68.)

Entropic's own reading of the patent confirms that cable modem 100 is a single circuit. According to Entropic, cable modem 100 is a "System-on-Chip" or "SOC" (EBr. at 7-8.) According to the dictionary definition of SOC, an SOC is *one circuit*. (CEx. 3 at 636.) Entropic's expert Dr. Kramer agrees that an SOC can be considered one circuit. (CEx. 2 at 127:13-22.)

Entropic's response appears to be that it is Entropic's prerogative to employ whichever "level" of circuit suits its infringement read. If cable modem 100 was an accused device, it is supposedly Entropic's prerogative not to employ the "level" of circuit at which the entire device is one circuit because that would not result in infringement. Instead, Entropic contends, it is permitted to designate the single processor which constitutes the DNE as the first circuit. And it is further permitted to designate, collectively, the two processors of the CME and its other components as one, singular second circuit.[2] That is not the law.

As the Federal Circuit explained, prior to the Supreme Court's decision in *Nautilus, Inc v. Biosig Instruments, Inc.*, 572 U.S. 898 (2014), if multiple methods existed to determine the scope of a claim limitation "leading to different results without guidance in the patent or the prosecution history as to which method should be used," the claim could still be definite "if someone skilled in the art could arrive at a method and practice that method." Post-*Nautilus*, that is no longer sufficient, as it does not satisfy the *Nautilus* "reasonable certainty" test. *Dow Chemical Co. v. Nova Chemicals Corp. (Canada)*, 803 F.3d 620, 634 (Fed. Cir. 2015).

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[2] If Entropic had another claim that was the opposite of claim 18 and required that the DNE and CME be implemented in the *same* circuit, Entropic would simply employ the level of circuit whereby the entire cable modem 100 is one circuit. It would then allege that cable modem 100 infringes that opposite claim as well.

The disputed limitation in *Dow* was "a slope of strain hardening coefficient greater than or equal to 1.3" *Id.* at 631. The slope could be measured with four different methods, whereby "the method chosen for calculating the slope of strain hardening could affect whether or not a given product infringes the claims." *Id.* at 634. "Neither the patent claims nor the specification here discusses the four methods or provide[d] any guidance as to which method should be used..." *Id.*

Prior to *Nautilus*, the Federal Circuit had determined that the claim was not indefinite because "the mere fact that the slope may be measured in more than one way does not make the claims of the patent invalid." *Id.* Due to a procedural anomaly in the case, however, the Federal Circuit had the opportunity to decide that exact same issue in the exact same case post-*Nautilus*. And the decision came out differently. Because the intrinsic evidence did not reveal which slope measurement method to employ, the claim was indefinite. *Id.* at 635. The plaintiff did not have the prerogative to pick whichever slope measurement method resulted in a "coefficient greater than or equal to 1.3" when applied to the accused product.

Other post-*Nautilus* Federal Circuit authority is consistent. In *Teva Pharmaceuticals USA, Inc. v. Sandoz, Inc.*, 789 F.3d 1335 (Fed. Cir. 2015), for example, the claim limitation at issue required a substance to have "a molecular weight of about 5 to 9 kilodaltons." 789 F.3d at 1338. But there were three relevant measures for molecular weight, each of which typically resulted in a different value. *Id.* Because the intrinsic record did not teach which measurement to use, the claim was indefinite. Again, the patentee was not permitted to select whichever measurement method satisfied the "about 5 to 9 kilodaltons" limitation when applied to the accused product.

Entropic suggests that because the specification describes the DNE and CME as "engines" which perform their respective "functions," those skilled in the art would equate them with the two claimed circuits. (EBr. at 7.) The one simply does not follow from the other. Entropic ignores

the fact that the specification also describes the "cable modem 100" as performing functions. By Entropic's logic, this means the entire cable modem is one circuit. The specification also describes the DOCSIS MAC processor and DOCSIS controller as performing their respective "functions." Yet, with respect to those devices, Entropic contends that they are both in the same single circuit. The disclosure of two "engines" performing functions is irrelevant.

Finally, Entropic relies on cases which reject contentions that "circuit" is a means plus function limitation or that claimed circuits should be construed as performing specific functions. (EBr. at 7-8.) Those cases are irrelevant. None of them address an undisclosed claim limitation requiring that two engines in the same computerized device be implemented in "separate" circuits.

Claim Term	Entropic's Construction	Charter's Construction
"data bus" (cl. 18)	Plain and ordinary meaning.	Indefinite.
"wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine" (cl. 18)	Plain and ordinary meaning.	The cable modem engine and the data networking engine do not share any connecting circuitry, data paths, or memory devices.

Claim 18 requires (i) a "data bus" that connects the DNE and CME, "wherein" (ii) the DNE and CME are "completely partitioned." ('775 8:23-27.) The "wherein" clause recites the precise limitation the applicants told the Patent Office was missing from the *Brook*s reference because Brooks had a CME and DNE which shared connecting circuitry/data paths (*i.e.* the "data bus") and memory devices (see Section II.A.3 *supra*). Thus, the "data bus" limitation is irreconcilable with the "completely partitioned" limitation, and claim 18 is therefore indefinite. (Almeroth ¶79.)

Claim Term	Entropic's Construction	Charter's Construction
"DOCSIS functions" (cl. 19)	Plain and ordinary meaning.	This limitation does not change the scope of claim 18.

According to claim 19, all DOCSIS functions are localized in the CME. However, as explained in Section II.A above, the specification explains that the *sine qua non* of a CME is that it "performs all cable modem functions" including "the entire DOCSIS cable modem functionality." Accordingly, claim 19 is redundant and does not further limit the scope of claim 18. Otherwise, the term "cable modem engine" is indefinite. It is a phrase coined by the inventors. If it does not refer to the components of a cable modem that perform all the cable modem functions, then there is no way to know what it is. "Claim differentiation is 'not a hard and fast rule,' but rather a presumption that will be overcome when the specification or prosecution history dictates a contrary construction." *GPNE Corp. v. Apple Inc.*, 830 F.3d 1365, 1371 (Fed. Cir. 2016).

Claim Term	Entropic's Construction	Charter's Construction
"DOCSIS MAC processor" (cl. 18)	Plain and ordinary meaning.	"DOCSIS MAC processor" is the DOCSIS MAC processor as described in the patent specification (*see, e.g.*, '775 Patent at 3:1-20; 4:41-57; *id.* at FIGs. 1 & 2). Otherwise indefinite.
"DOCSIS controller" (cl. 18)	Plain and ordinary meaning.	"DOCSIS controller" is the DOCSIS controller as described in the patent specification (*see, e.g.*, '775 Patent at 3:21-48; 4:41-57; *id.* at FIGs. 1 & 2). Otherwise indefinite.

Neither the phrase "DOCSIS MAC processor" nor "DOCSIS controller" has a plain meaning – there are no dictionary definitions to look to for a construction. According to Entropic, however, dictionary definitions are unnecessary because a DOCSIS MAC processor simply performs DOCSIS MAC functions and a DOCSIS controller simply controls DOCSIS functions. (EBr. at 14.) While simplistic, it cannot possibly be correct. Such a construction would either (i)

contradict the specification (the only source to look to for a construction); or (ii) make it impossible to distinguish a DOCSIS MAC processor from a DOCSIS controller.

If, for example, the DOCSIS MAC processor were construed as the component of the cable modem which performs *all* DOCSIS MAC functions, that would contradict the specification. As explained in Section II.A above, the disclosed DOCSIS MAC processor does *not* perform all DOCSIS MAC functions of cable modem 100. The DOCSIS controller also performs a number of DOCSIS MAC functions, such as DOCSIS "MAC management message (MMM) processing" ('775 3:27-29), "MAC address learning" (*id.* 3:30), and "voice MAC driver" functions (*id.* 3:46).

On the other hand, if the DOCSIS MAC processor need only perform *some* DOCSIS MAC functions and the DOCSIS controller need only control *some* DOCSIS functions, then there is no way to distinguish between the two. The disclosed DOCSIS controller would also be a DOCSIS MAC processor because it performs DOCSIS MAC functions. At the same time, the disclosed DOCISIS MAC processor would also be a DOCSIS controller because it controls the DOCSIS MAC functions it performs. Such a construction would render claim 18 indefinite. The claim requires both a DOCSIS MAC processor and a separate DOCSIS controller, and there would be no way to distinguish between the two. (Almeroth ¶¶48, 51, 76.)

Moreover, claim 18 requires the DOCSIS Controller Bypass Feature whereby downstream data packets are sent by the DOCSIS MAC processor directly to the DNE "without the involvement of the DOCSIS controller." ('775 8:18-22.) If every DOCSIS MAC processor is a DOCSIS controller then it would be impossible for a DOCSIS MAC processor to do anything "without the involvement of the DOCSIS controller." Claim 18 would be indefinite for this additional reason. (Almeroth ¶77.)

The only construction of DOCSIS MAC processor and DOCSIS controller that both comports with the specification and provides a basis for distinguishing between the two is a construction whereby each refers to the corresponding device described in the specification.

III. The '008 and '826 Patents

A. The Specification of the '008 and '826 Patents (Charter TT 21-53)

The '008 and '826 Patents disclose a receiver at a customer premises for receiving, processing and monitoring an incoming signal. ('008 3:5-12.)[3] The received signal can contain solely television channels, solely DOCSIS data channels, or both. (*Id.* 3:12-15.) The architecture of the receiver is depicted in Fig. 1B. (*Id.* 3:5-7.)

The signal is received into an "RF Receive Front end" 158 which converts the signal from analog into digital form. (*Id.* 3:11-12.) After the signal is digitized it is provided to a channelizer device 152. The channelizer selects which portion of the digitized signal to output to a monitoring device 154 and which to output to a data processing device 156. (*Id.* 3:20-23, 4:28-44.) In claim 1, the channelizer provides the different outputs to the monitoring and data processing devices "concurrently." (*Id.* 7:30-32.) The monitoring device and data processing device are in a "parallel arrangement" and "concurrently process[]" the signals they receive. (*Id.* 4:7-10, 4:45-50.)

The function of the data processing device is to recover the data in the television channels it receives. (*Id.* 3:61-64) The function of the monitoring device is to "measure/determine characteristics [of the signal] such as, for example, signal power level vs. frequency…" (*Id.* 3:33-36.) The monitoring device can then send the "measured/determined characteristic" back to the cable headend. (*Id.* 3:55-57.) Alternatively, the monitoring device can analyze the measured

[3] The specifications of the '008 and '826 Patents are identical. All specification citations herein are to the '008 Patent.

characteristic and send that analysis back to the headend. The disclosed example of this analysis is determining whether the measured characteristic is "outside acceptable bounds." (*Id.* 3:48-57.)

B. Construction of '008 and '826 Patent Claim Terms

Claim Term	Entropic's Construction	Charter's Construction
"network management messages" ('826 cl. 1)	Plain and ordinary meaning.	Messages which report on the status of the network based on an analysis of the measured characteristic.

As explained in the preceding section, the specification discloses two types of messages which the monitoring device can send. The first contains the measured/determined characteristic itself. Claim 1 of the '008 Patent recites this message type ("report said *determined characteristic* to a source of said received signal"). ('008 7:23-24.)

The second message type contains the results of an analysis the monitoring device performs on the measured characteristic. Claim 1 of the '826 Patent is directed to this message type ("measur[ing] a characteristic" and then controlling transmission of network management messages "*wherein said measured characteristic is different than said network management messages*." ('826 7:48-55)). Thus, Entropic is correct that Charter is "attempting to construe [network management messages] to exclude ... 'conveying measured/determined characteristics.'" (EBr. at 15.) Charter is attempting this because the claim expressly excludes this.

Entropic goes on to say that the claim requirement that the network management messages be "based on" the measured characteristic counsels against any construction. (*Id.* at 15-16.) That statement masks the claim scope Entropic intends to argue to the jury. Entropic contends that the Charter set-top boxes return one thing to a headend – one measured characteristic. In its infringement contentions, however, it alleges that this one capability satisfies both the '008 Patent requirement that the measured characteristic itself be returned *and* the '826 Patent requirement that something different than the measured characteristic be returned. It justifies this seeming

contradiction by contending, for purposes of the '826 Patent, that a message containing the measured characteristic is "different than" and "based on" the measured characteristic alone. That improper construction cannot be presented to the jury.

In view of the specification, Charter contends that network management messages which are "different than" the measured characteristic refers to the only other disclosed option – messages which report on the status of the network based on an analysis of the measured characteristic of the signal (*e.g.,* signal "outside acceptable bounds"). If the Court disagrees, however, it should at least construe "network management messages" which are "different than the measured characteristic" of the received signal to mean that the claimed messages convey *characteristics of the received signal* which are different than the measured characteristic. A message is not "different than" the measured characteristic simply because the measured characteristic is packaged into a message.

Claim Term	Entropic's Construction	Charter's Construction
"operable to" ('008 cl. 1)	Plain and ordinary meaning.	Configured to.

The Court should construe a device "operable to" to perform a function to mean the device is "configured to" perform that function. Otherwise, the jury might misinterpret "operable to" to cover a device even if it cannot perform the function, so long as it is "capable of" doing so if it is properly modified. *TQ Delta, LLC v. CommScope Holding Co., Inc.*, No. 2:21-CV-310-JRG, 2022 WL 2071073, at *9-*10 (E.D. Tex. June 8, 2022).

Claim Term	Entropic's Construction	Charter's Construction
"digitize a received signal spanning an entire television spectrum comprising a plurality of television channels" ('008 cl. 1)	Plain and ordinary meaning.	The "received signal" contains only television channels.

As explained in Section III.A above, the specification discloses embodiments in which the received signal contains only television channels, only data channels, and both television and data channels. ('008 3:12-15.) '008 Patent claim 1, with its limitation that the received signal "span[]" an entire television spectrum, is directed to the television channel-only embodiment. This contrasts with claim 1 of the '826 Patent, which states that the received signal comprises "one or both of television and data channels." ('826 7:38-40.)

Entropic asserts that this claim term should be construed pursuant to its plain and ordinary meaning. Charter's construction *is* that plain and ordinary meaning. "Span" is a plain English word which means the full extent of something from end to end (*e.g.*, "wing span," "life span," "span of a bridge"). Thus, the full extent of the received signal in '008 Patent claim 1 is the television spectrum, not other parts of the spectrum containing data channels. The "comprising" preamble does not change this: "The usage 'comprising' means that additional components may be present in the device, but does not change the elements that are stated in the claim." *Outside the Box Innovations, LLC v. Travel Caddy, Inc.*, 695 F.3d 1285, 1305 (Fed. Cir. 2012).

Claim Term	Entropic's Construction	Charter's Construction
"signal monitor," "data processor," "channelizer" ('008 cl. 1)	Plain and ordinary meaning.	Three separate pieces of hardware, configured to perform the functions the claim ascribes to the signal monitor, data processor, and channelizer, respectively.

'008 claim 1 sets forth three distinct elements: a "signal monitor," a "data processor" and a "channelizer." Yet, Entropic contends that there need not be any "separateness" between the three, and that they can all refer to the same physical device. (EBr. at 17.) Entropic provides no support for its contention that this is the "plain and ordinary meaning" of these terms, or any facts to overcome the presumption that each of these must be a distinct physical component. "Where a

claim lists elements separately, 'the clear implication of the claim language' is that those elements are 'distinct component[s]' of the patented invention." *Becton, Dickinson & Co. v. Tyco Healthcare Grp., LP*, 616 F.3d 1249, 1254 (Fed. Cir. 2010)); *Kyocera Senco Indus. Tools Inc. v. Int'l Trade Comm'n*, 22 F.4th 1369, 1382 (Fed. Cir. 2022) (components listed separately in a claim gives rise to "a presumption that those components are distinct.").

Nor could Entropic possibly overcome this presumption, as neither the claims nor the specification make any sense unless each of the three is a separate device. For example, both the claims and the specification require the channelizer to provide "outputs" to the signal monitor and data processor. ('008 7:27-30, 3:20-23.) There would be no "outputs" from a channelizer to either the signal monitor or data processor if all three were the same device. Moreover, the claim requires that the channelizer provide "concurrent outputs" to two different places, while the specification teaches that the monitoring device and data processing device are in a "parallel arrangement" and "concurrently process[]" the signals they receive. (*Id.*, 7:27-32; 4:7-10; 4:45-50.) None of this would be possible unless there were three distinct devices.

Because it is not possible to explain the claims or the disclosure without assuming the "signal monitor," "data processor" and "channelizer" are separate physical components, Entropic does not even try. For purposes of explaining the alleged invention, Entropic assumes they are separate physical devices, even referring to the first two as the "monitoring device" and "data processing device." (EBr. at 3.) It is only later in its brief, outside the context of the claimed and disclosed operation of these components, that it contends all three can be one device.

Based on the following one sentence in the disclosure, Entropic alleges that the specification discloses an alternative embodiment whereby the channelizer, data processor and signal monitor are all one device: "[t]he various modules of the subassembly 174 may reside in …

one or more integrated circuits." (*Id.* at 17.) That is a misreading. What this sentence means is that each individual module can be one or more integrated circuits, not that all of the different modules can be one device. Entropic' s reading renders the sentence irreconcilable with the claim language and all of the other disclosure in the specification as identified above. Moreover, even if the specification did disclose this alternative embodiment (it does not), this still would not overcome the presumption that there are three separate devices. This would mean only that the alternative embodiment was not claimed. *Kyocera*, 22 F.4th at 1382 (internal citation omitted).

IV. The '690 Patent

A. The Specification of the '690 Patent (Charter TT 105-120)

As its title says, the '690 Patent is directed to a "receiver determined probe." Prior to the alleged invention, it was common for nodes on a network to receive probes from other nodes. ('690 1:48-53.) "Probe" has a well understood meaning in the art. As explained in the DOCSIS specification, a probe contains a pattern known to the receiver of the probe (called the "probe receiver" or "receiving node") before the probe is received. By comparing the probe that it received with the known pattern, the probe receiver can determine characteristics of the channel on which the probe was received. (CEx. 4 at CHARTER_ENTROPIC00101928.) This is exactly how the '690 Patent specification explains what probes are and how they are used:

> …probes are typically well defined. Accordingly, the receiving node knows before reception what reference signal [i.e. known pattern] was transmitted. By comparing the reference probe with the actual received probe, the receiver can determine some of the characteristics of the channel between the transmitting and receiving node.

('690 1:52-57.) The alleged problem with this technique was that the probes were predetermined. (*Id.* 1:57-62.) That is where the alleged invention comes in. The patent is directed to a "receiver determined probe," whereby the receiving node determines what the "form" of the probe will be.

The process begins with the receiving node sending a "probe request" to another node identifying parameters which define the "form" of the probe its wants to receive:

> The receiving node may generate a probe request that specifies a plurality of parameters to be used in such a "receiver determined" probe to generate a probe having the "form" specified by these parameters. Accordingly, the probe request specifies a plurality of parameters associated with the generation and transmission of a probe, including the content of a payload of the probe

(*Id.* 2:3-9) Although "form" is a plain English word, the inventors put it in quotes to signal that they would explain its meaning in the immediately subsequent sentence – the "form" of a probe relates to the "generation and transmission" of the probe. "[P]arameters associated with the generation and transmission of a probe" are parameters which "specif[y]" the form of the probe.

As the specification excerpt at 2:3-9 teaches, a "probe request" will always include at least "the content payload of the probe." However, there are a number of other "form" parameters that can be included in a probe request as well. These include the preamble type, the number of times to transmit the probe, and the transmit power of the probe. (*Id.* 2:9-16.) "Accordingly, the probe that is transmitted in response to the probe request will have a form dictated by the parameters specified in the probe request." (*Id.* 2:16-18.)

The remainder of the process is depicted in Fig. 4. In block 200 the probe receiver transmits the probe request to a "probe transmitter," which is the node that "will be transmitting the eventual probe(s) having a form that is dictated by the" parameters specified in the probe request. (*Id.* 6:17-22.) After the probe transmitter receives the probe request (block 201), it "uses the specified probe parameters to generate a probe having a form that complies with the specified parameters." (*Id.* FIG. 4 (block 202), 6:38-40.) In block 203, the probe transmitter transmits the probe to the probe receiver. In blocks 204 and 205, the probe receiver receives the probe and processes it to determine characteristics of the channel on which it was received.

B. Construction of '690 Patent Claim Terms

Claim Term	Entropic's Construction	Charter's Construction
"probe" (cls. 1,7, 9, 11)	Plain and ordinary meaning.	A "probe" is a packet transmitted to a network node which the node compares to a reference packet having a known form in order to determine characteristics of the channel on which the packet was transmitted.
"physical layer probe" (cl. 9)	Plain and ordinary meaning.	"Physical layer probe" means probe. Otherwise indefinite.

Entropic asserts that "probe" should be construed according to its plain and ordinary meaning, but it does not explain which of the many "plain meanings" of the word "probe" applies. Charter's construction, taken from the patent specification, *is* the plain meaning in the context of probes sent between nodes in a network. The DOCSIS specification confirms this.

Entropic takes issue with the term "reference packet" in the construction because that term is not in the specification. (EBr. at 18-19.) That is true—the specification instead refers to a "reference *probe*." ('690 1:55.) "Packet" is in the construction to avoid having the word "probe" in the construction of "probe" and because probes *are* packets. Both the patent and DOCSIS specifications relate to packet networks. (CEx. 4 at CHARTER_ENTROPIC00101891; '690 3:40-44.)

The DOCSIS specification also explains that a probe, by definition, is a physical layer signal: "A probe is a wideband physical-layer signal…" (CEx. 4 at CHARTER_ENTROPIC00101928.) The patent accordingly speaks only of generating physical layer ("PHY") packets. ('690 3:3-5, 3:40-64, 5:59) Thus, a "physical layer probe" is simply a probe. "It is true that 'interpretations that render some portion of the claim language superfluous are disfavored.' . . . The preference for giving meaning to all terms, however, is not an inflexible

rule that supersedes all other principles of claim construction." *SimpleAir, Inc. v. Sony Ericsson Mobile Commc'ns AB*, 820 F.3d 419, 429 (Fed. Cir. 2016).

Here, if "physical layer probe" does not mean "probe" then it is indefinite, as it would be impossible to know how it is different than a "probe" because probes *are* physical layer signals.

Claim Term	Entropic's Construction	Charter's Construction
"probe request" (cls. 1, 7, 8, 9, 11, 15, 16)	Plain and ordinary meaning.	A request sent by a first network node to a second network node which defines the form of a probe to be generated and transmitted by the second network node. The probe request specifies at least the content payload of the probe.

According to the specification, prior art probes were predefined. The alleged invention is the ability of a node to send a "probe request" to another node defining the form of the probe. As such, "probe request" could not possibly have had a plain and ordinary meaning in the context of the alleged invention. *The probe request is the invention*. And the specification explains exactly what this allegedly novel "probe request" is – it defines the form of the probe to be generated and transmitted by the node receiving the probe request, and includes at least the content payload of the probe. ('690, 2:3-9; *supra* at IV.A.) That is Charter's construction.

Entropic complains that Charter's construction is confusing because the sender of the probe request is designated the "first node" and the receiver of the probe request is designated the "second node" because, in the claims, those designations are reversed. (EBr. at 20.) If the Court finds this confusing, the construction is easily changed to reverse those designations.

Entropic places great reliance on its contention that Charter's construction renders some claim language redundant. For example, Entropic says the construction's requirement that the probe request define the form of the probe is redundant with claim limitations requiring that

parameters in the probe request dictate the form. (*Id.* at 19-20.) The two are not redundant – the "parameters" limitation specifies *the way* the probe request defines the form. Entropic further complains that the construction's requirement that the probe request specify the probe's content payload is already in claim 1 but not claim 9. That is true, and it is why Charter's construction is correct. The inventor's definition of his allegedly novel "probe request" must be in all the claims.

In any event, to whatever extent the inventor's definition of "probe request" makes that definition redundant with other claim language, the inventor's definition still governs: "[t]he preference for giving meaning to all terms [] is not an inflexible rule that supersedes all other principles of claim construction … [a]s we have explained, '[c]laims must always be read in light of the specification.'" *SimpleAir*, 820 F.3d at 429.

Finally, although Entropic complains that Charter's construction requires that the transmitter of the probe request be the node that receives the probe request (EBr. at 20), Charter's construction contains no such requirement.

Claim Term	Entropic's Construction	Charter's Construction
"generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters" (cl. 1)	Plain and ordinary meaning.	Indefinite.
"wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" (cl. 9)	Plain and ordinary meaning.	Indefinite.
"the first plurality of probe parameters comprising a form for the probe including a	Plain and ordinary meaning.	Indefinite.

modulation profile for the probe" (cl. 9)		

Unlike the disclosure of the '690 Patent, wherein only the parameters sent in the probe request are used to generate and transmit a probe, claims 1 and 9 of the patent require that the probe transmitter separately determine a "plurality of parameters associated with the generation of the probe." ('690 13:46-48, 13:51-52, 14:19-21, 14:26-28.) Both claims also require that the probe actually be generated "in accordance with" both the plurality of parameters in the probe request (the "first plurality of parameters") and the plurality of parameters determined by the probe transmitter (the "second plurality of parameters"). (*Id.* 13:53-54, 14:25-28; Almeroth ¶83.)

However, claim 1 requires that the form of the probe be "dictated by the first plurality of parameters." ('690, 13:55-56.) Similarly, claim 9 requires that the "first plurality of probe parameters compris[e] a form for the probe." (*Id.*, 14:21-23.) Neither requirement makes any mention of the second plurality of parameters. Thus, the claims cover the form of the probe being determined only by the parameters in the probe request. This renders the claims indefinite. (Almeroth ¶84.) If the parameters determined by the probe transmitter are used to generate the probe, those parameters necessarily contribute to defining the form of the probe. The inventor said that form-specifying parameters ***are*** parameters "associated with the generation and transmission of a probe." ('690 2:3-9.) And even putting the patentee's statement aside, it is impossible to imagine a parameter used to generate a probe that does not relate to its form.

Entropic' s response, it says, "is a simple one… [n]ot all probe parameters specify a form," and parameters relating to generation of a probe may not relate to its form. (EBr. at 21.) Yet, Entropic does not explain how this "simple" proposition can possibly be true or what definition of "form" it is applying when it makes that allegation. And it certainly does not identify a single disclosed parameter that relates to generation – but not form – of a probe.

Instead, Entropic points to Fig. 5 and contends that these parameters all relate to generation of a probe. (*Id.* at 22.) Yet the specification explicitly states that these very same parameters relate to the form of the probe ("the probe request specifies *a plurality of parameters* for the probe *that will dictate the form of the probe* to be transmitted. *These parameters are discussed in more detail below with respect to Fig. 5.*" ('690, 6:34-38 (emphasis added).)

Finally, Entropic says that a POSITA "would understand that the point of the probe request is for a node to generate a probe containing responsive information," that the parameters generated by the probe transmitter constitute that responsive information and are therefore included in the payload of the probe, and that the payload contents "do not necessarily relate to the form of the probe." (EBr. at 22.) Each and every one of these statements is demonstrably false: (i) the point of a probe request is *not* to receive a probe "containing responsive information." If the probe contains new information inserted by the probe transmitter, it cannot be used as a probe by the probe receiver to compare to a "reference probe"; (ii) for that reason, the specification says nothing about putting parameters into probe payloads; and (iii) even if the specification did disclose this, the specification is clear that payload content *does* relate to the form of the probe. ('690 2:3-9.)

V. The '362 Patent

A. The Specification of the '362 Patent (Charter TT 54-77)

The title of the '362 Patent is "Wideband Tuner Architecture." Prior art wideband tuners allegedly required expensive analog to digital converters ("ADCs") because of the wide bandwidth of the signal that had to be digitized. The purported invention is said to reduce the bandwidth of the signal to be digitized so that less expensive ADCs can be used. ('362 2:20-27.)

Fig. 2 depicts a wideband receiver which allegedly solves this problem. The ADCs in question are labeled 218 and 228 in the middle of the figure, and sit between a "radio front end" 210 on the left and a "digital front end" 230 on the right. (*Id.* 5:13, 4:18-19.) The incoming signal

is received into the radio front end on the left, and is described as the "RF Input" or "RF signal." (*Id.* 1:48-50, 4:27-28, Fig. 2.) As Entropic says, the RF signal is an analog signal. (EBr. at 23.)

In operation, the radio front end is said to somehow capture a "swath" of channels from the RF signal that includes the "desired" channels (channels the customer is interested in) and undesired channels. (*Id.* 1:27-31.) That swath has a bandwidth designated BW_1. (*Id.* 1:67-2:2, 4:19-22, Fig. 2.) BW_1 can be as wide as "800 MHz or higher," which would require the expensive analog to digital converters. (*Id.* 2:20-23.) That is the bandwidth that must be reduced.

The analog swath having bandwidth BW_1 is provided as input to mixers 211 and 221. (*Id.* 4:37-39.) Together, these mixers constitute a "complex mixer module for down-shifting the multiple RF channels and transforming them to an in-phase signal and a quadrature signal in the baseband or low intermediate frequency (IF) band." (*Id.* 2:45-49, 4:40-53.) "The system further includes a wideband analog-to-digital converter module that digitizes the in-phase and quadrature signals." (*Id.* 2:49-51.) These are the ADCs 218 and 228 in Fig. 2. The signal supplied to the ADCs is "one half of the RF signal bandwidth BW1 thanks to the complex down-mixer architecture" 211/221 (*Id.* 5:15-19, Fig. 2.) That is the reduction in bandwidth – achieved by mixers 211/221 – that allows the less expensive analog to digital converters to be used.

The output from the ADCs are "digital signals." (*Id.* 5:28-31.) These digital signals are supplied to a different "bank of N complex mixers 250," each of which "receives the digital signals… from ADCs 218 and 228 to extract a different one of the desired channels and frequency-shifts the extracted signals to the baseband frequency." (*Id.* 5:49-52.) Thus, the mixers 250 operate only on digital signals, and frequency shift *only the desired channels*.

B. Construction of '362 Patent Claim Terms

Claim Term	Entropic's Construction	Charter's Construction
"downconverting . . . a plurality of frequencies" (cl. 11)	Plain and ordinary meaning.	Downconverting a plurality of frequencies of an analog radio frequency (RF) signal.
order of the steps (cl. 11)	Plain and ordinary meaning.	Claimed steps must be performed in the order recited in the claim.

"Courts apply a two-part test to determine whether a particular order of steps is required: 'First, we look to the claim language to determine if, as a matter of logic or grammar, they must be performed in the order written,' and '[i]f not, we next look to the rest of the specification to determine whether it directly or implicitly requires such a narrow construction.'" *Red Rock Analytics, LLC v. Samsung Electronics Co., Ltd.*, No. 2:17-CV-101-RWS-RSP, 2018 WL 1806859, at *4 (E.D. Tex. Apr. 16, 2018) (*citing Altiris, Inc. v. Symantec Corp.*, 318 F.3d 1363, 1369–70 (Fed. Cir. 2003)). Because both parts of the two-part *Altiris* test are satisfied here, the steps of the claim 11 must be performed in the order recited. And in particular, the step of "downconverting ... a plurality of frequencies" must occur on the analog signal before the subsequent "digitizing" step.

First, the language of claim 11 itself dictates that the steps be performed in the order written. For example, the claim refers to frequencies which exist before analog-to-digital conversion as simply "frequencies." In contrast, the claim refers to frequencies after digitization as "*digitized* … frequencies." Thus, the first step of "downconverting" is said to be performed on a "plurality of frequencies." ('362 12:39-42.) Similarly, the subsequent step of analog to digital conversion is said to be performed on the "plurality of frequencies." (*Id.* 12:43-45.) As the name itself demands, the function of "*analog* to digital conversion" is performed on an *analog* input to the ADC. After the analog to digital conversion is completed, however, the claim then refers to the frequencies as the "*digitized* plurality of frequencies." (*Id.* 12:50.) "Downconverting" must

therefore operate on the analog signal, before the subsequently identified step of digitization. *Oak Tech., Inc v. Int'l Trade Comm'n*, 248 F.3d 1316, 1325 (Fed. Cir. 2001) (claim requiring that "assembled data" be "processed by the 'error correction circuitry,'" after which the data is referred to as "corrected assembled data," held to "explicitly describe[] a sequential process.")

The below chart summaries why all claim steps must be performed in the order recited. We insert a lettered designation to each claim limitation in blue for ease of reference:

'362 Patent Claim 11	**Reasons Why Claimed Order Is Required**
11. A method comprising: in a wideband receiver system:	
(a) downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;	As discussed above, this "downconverting" is performed on a "plurality of frequencies," not a "digitized plurality of frequencies." This step must therefore be performed before the subsequent step of "digitizing."
(b) digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;	"Digitizing" is also performed on said "plurality of frequencies" (obviously, an "*analog* to digital converter" performs its function on an *analog* signal). In contrast, the subsequent step (c) is performed on said "*digitized* plurality of frequencies." Thus, step (b) must be performed before step (c).
(c) selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and	"Selecting" is performed on said "*digitized* plurality of frequencies." This step (c) must therefore be performed after the "digitizing" in step (b). Moreover, subsequent step (d) requires outputting "said selected" channels. This step (c) is the step that does the "selecting." This step must therefore be performed before step (d).
(d) outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.	Step (d) requires outputting "said selected" channels. This step must therefore be performed after the "selecting" step (c).

Second, even if the structure of the claim did not mandate the order of the steps (it does), the specification "directly or implicitly requires" that the claims be performed in order. The "complex mixer module" 211/221 in Fig. 2 – which downconverts the *analog* signal – is the

component which performs the allegedly inventive halving of the bandwidth BW_1. *That* is the "mixer module" referred to in the claimed downconverting step. The specification's emphasis on the importance of the *analog* mixer module "directly or implicitly requires" that construction.

Finally, claim 11 is written to track the order in which the steps are performed in the specification. As the Federal Circuit has stated with respect to part two of the *Altiris* test: "though we have repeatedly held that 'it is ... not enough that the only embodiments, or all of the embodiments, contain a particular limitation to limit a claim term beyond its ordinary meaning,' . . . here, the only embodiments are consistent with the plain meaning of the claim in the order that is written, and we thus decline to construe the claim as allowing deviation from that order." *Hytera Commc'ns Co. Ltd. v. Motorola Solutions, Inc.*, 841 F. App'x. 210, 219 (Fed. Cir. 2021).

Relying on Fig. 4, Entropic contends that the specification discloses an alternative embodiment where the claimed "downcoverting" occurs after the analog-to-digital conversion. (EBr. at 25-26.) This is not so. The Radio Front End and Digital Front End in Fig. 4 are said to perform the same functions described above with respect to Fig. 2. ('362 7:29-32.) Digital mixers 432 in Fig. 4 correspond to digital mixers 250 in Fig 2. Although the digital mixers also do downconversion, they downconvert *only the desired channels*. (*Id.* 5:49-52.) In contrast, claim 11 expressly requires downconversion of both desired and undesired channels. (*Id.* 12:39-42.) The only disclosed component which does that is the analog mixer module 211/221.

VI. The '682 Patent

A. The Specification of the '682 Patent (Charter TT 121-146)

As Entropic says, the '682 Patent relates to assigning cable modems to service groups. (EBr. at 5.) Once these assignments are made, the CMTS communicates with all cable modems in the same service group using the same communications parameters. ('682 5:40-46.)

The CMTS determines how to communicate with the cable modems in each service group by using a "composite worst-case SNR profile" for that service group. (*Id.* 4:9-20.) This means that for every subcarrier, the composite worst-case SNR profile reflects the worst case SNR for that subcarrier among the CMs in that particular service group. (*Id.* 5:40-46.) By accommodating the "worst case" CM at every subcarrier, the CMTS can assure that all of the CMs in a service group can receive communications at all of the subcarriers. (*Id.* 5:46-6:2.) Dr. Almeroth provides further details of the specification's disclosure. (Almeroth ¶¶85-92.)

B. Construction of '682 Patent Claim Terms

Claim Term	Entropic's Construction	Charter's Construction
"a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" (cl. 1)	Plain and ordinary meaning.	Indefinite.

Claim 1 of the '682 Patent does not call for use of a "composite worst-case SNR profile" in order to determine how to communicate with the CMs in a service group. Instead, it requires the CMTS to generate a so-called "composite SNR-related metric" for each service group "based at least in part on a worst-case SNR profile" of a service group.[4] There is nothing about this limitation that finds any support in the specification. The specification does not disclose a "composite SNR-related metric," it does not disclose a "worst-case SNR profile" that is not a "composite" profile, and it does not disclose basing the former on the latter. Because these two terms do not have a plain meaning, a POSITA would necessarily look to the specification for their meanings. But there, the only thing they would find to support a construction of either term is the disclosed "composite worst-case SNR profile" for a service group. (*Id.* ¶¶94-95.) So the claim

[4] The claim actually says "said one of said service groups," a term with no antecedent basis. We separately address the indefiniteness of the "said one…" limitations below.

is indefinite. There is no way to know how the "composite SNR-related metric" can be "based *at least in part on*" the "worst-case SNR profile" if the two refer to the same thing. (*Id.* ¶96.)

Entropic alleges that the two terms do not mean the same thing. Yet, while Entropic insists that the specification discloses examples of a "worst-case SNR profile," every cited example it provides is to a "*composite* worst-case SNR profile." (EBr. at 27.) Thus, although Entropic's position is unclear, it seems to agree that "worst-case SNR profile" and "composite worst-case SNR profile" are synonymous.

The disagreement seems to be with the term "composite SNR-related metric." Although Entropic agrees that a "composite SNR-related metric" is the composite SNR profile for the service group (EBr. at 5), Entropic believes that it need not "inherently involve *worst case* SNR." (Kramer ¶168.) The only reason the specification discloses a "composite *worst-case* SNR profile," Dr. Kramer says, is "that is part of the disclosed invention." (*Id.* ¶169.) In isolation, however, Dr. Kramer contends that a "composite SNR-related metric" could refer instead to a composite "***best-case*** SNR" profile. (*Id.*) Even if true, that is irrelevant. Claim terms are to be construed in the context of the specification, not in isolation. Moreover, Entropic does not explain how one would even generate a "composite **best-case** SNR profile" based at least on part on a "**worst-case** SNR profile." Certainly the specification does not disclose any of this.

In view of the specification, "composite SNR-related metric" *cannot* mean a "composite **best-case** SNR profile." It can only refer to the "worst-case." And the claim is therefore indefinite, as there is no difference between "composite SNR-related metric" and "worst-case SNR profile."

Claim Term	Entropic's Construction	Charter's Construction
"service group[s]" (cl. 1)	Plain and ordinary meaning.	A "service group" is the complete set of downstream and upstream channels within a single CMTS that a single cable modem could

		potentially receive or transmit on.

Claim 1 of the '682 Patent requires assigning cable modems to service groups. ('682 8:7-9.) In the specification, the cable modems are part of a "cable/DOCSIS network." (*Id.* 2:56-60.) The DOCSIS specification itself provides the plain meaning definition of a "cable modem service group" in the cable television industry (a definition Charter identified in the P.R. 4-3 statement but which Entropic entirely ignores in its brief):

> **Cable Modem Service Group** In the HFC plant topology, the complete set of downstream and upstream channels within a single CMTS that a single Cable Modem could potentially receive or transmit on. In most HFC deployments, a CM-SG corresponds to a single Fiber Node. Usually, a CM-SG serves multiple CMs.

(CEx. 5, at CHARTER_ENTROPIC00101160.) Although it does not offer or provide any support for any alternative "plain meaning" of "service group," Entropic criticizes this published, well-accepted cable industry definition on the grounds that it is allegedly (i) describing only a group of channels, not a group of cable modems; and (ii) inconsistent with the claims and specification. (EBr. at 28-29.) Entropic is wrong on both counts.

First, the definition is for a "*cable modem*" service group, not a "channel" service group. The definition means that all of the cable modems which can potentially receive or transmit on the same upstream and downstream channels are part of the same service group. Entropic's misunderstanding of the plain meaning is not a basis to reject it.

Second, the definition is not inconsistent with the claims or specification. Although Entropic says the definition is limited to one cable modem, the definition itself says otherwise. ("Usually, a CM-SG serves multiple CMs.") Entropic's contention that the plain meaning excludes disclosed embodiments is also false. According to Entropic, the alleged invention can facilitate communication with upstream channels, downstream channels or both. (EBr. at 29.) Although that is factually untrue, it is irrelevant here. The fact that cable modems in the same

service group can potentially transmit on the same upstream or downstream channels has nothing to do with which of those channels the alleged invention facilitates better communications on.

Claim Term	Entropic's Construction	Charter's Construction
"[communicating with / corresponding to] said one of said plurality of service groups" (cl. 1)	Plain and ordinary meaning.	Indefinite.

'682 Claim 1 requires "assigning … among a plurality of service groups" ('682 8:7-8) and "generating, by said CMTS *for each one* of said plurality of service groups…" (*Id.* 8:10-11.) Thereafter, there are a number of steps for "communicating with" or "corresponding to" "said one of said plurality of service groups…" (*Id.* 8:13-14, 8:16-17, 8:21-22.) There is no antecedent basis for "said one of said plurality of service groups," and there is no way to know which one service group among the "plurality of service groups" the "communicating" and "corresponding" steps should be performed on. The claim is therefore indefinite.

Dr. Kramer contends that communicating with "said one of said plurality of service groups" should be read to mean communicating with "as many service groups in the plurality of service groups as preferred." (Kramer ¶177.) In other words, he rewrites "said one of said plurality of service groups" to instead say "at least one of said plurality of service groups." He gives no explanation for why he chose to rewrite the limitation that way, instead of rewriting it to say "said *each* one of said plurality of service groups," which would require the steps to be performed on *all* service groups. In any event, that is irrelevant, as Courts are not entitled to rewrite claims, either to sustain their validity or otherwise. *Lucent Technologies, Inc. v. Gateway, Inc.*, 525 F.3d 1200, 1215 (Fed. Cir. 2008).

Respectfully submitted,

Dated: May 23, 2023

/s/ Elizabeth Long

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Email: elizabeth.long@arnoldporter.com

Attorneys for Defendant Charter Communications, Inc.

CERTIFICATE OF SERVICE

The undersigned certified that on May 23, 2023, all counsel of record who are deemed to have consented to electronic service are being served with a copy of this document through the Court's CM/ECF system pursuant to Local Rule 5(a)(3).

/s/ Elizabeth Long
Elizabeth Long

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ENTROPIC COMMUNICATIONS, LLC, Plaintiff v. CHARTER COMMUNICATIONS, INC., Defendant.	Civil Action No. 2:22-cv-00125-JRG **JURY TRIAL DEMANDED**

DECLARATION OF ALBERT J. BOARDMAN IN SUPPORT OF CHARTER'S RESPONSIVE CLAIM CONSTRUCTION BRIEF

I, Albert J. Boardman, hereby declare as follows:

1. I am an attorney at the law firm of Arnold & Porter Kaye Scholer LLP, counsel of record for Charter Communications, Inc.

2. Attached as **Exhibit 1** is a true and correct copy of Charter's Technology Tutorial Slides and Script, submitted to the Court on May 9, 2023.

3. Attached as **Exhibit 2** are true and correct copies of excerpts from the condensed transcript of the Deposition of Dr. Richard A. Kramer, dated May 4, 2023.

4. Attached as **Exhibit 3** is a true and correct copy of an excerpt of Newton's Telecom Dictionary, 17th Ed. 2001, introduced as Exhibit 5 to the Deposition of Dr. Richard A. Kramer on May 4, 2023.

5. Attached as **Exhibit 4** are true and correct copies of excerpts of Data-Over-Cable Service Interface Specifications DOCSIS® 3.1 – MAC and Upper Layer Protocols Interface

Specification – CM-SP-MULPIv3.1-I03-140610, issued June 10, 2014, bearing bates number CHARTER_ENTROPIC00101872.

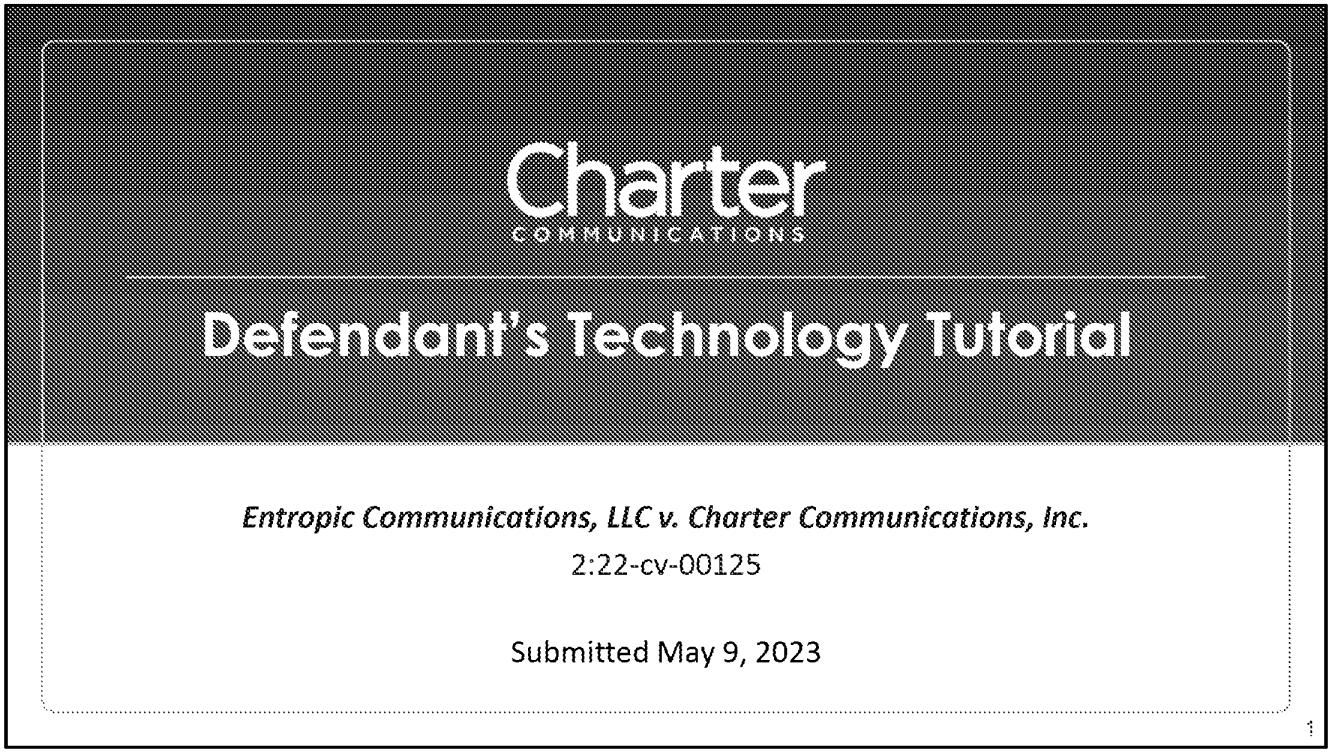
6. Attached as **Exhibit 5** are true and correct copies of excerpts of Data-Over-Cable Service Interface Specifications DOCSIS 3.0 – MAC and Upper Layer Protocols Interface Specification – CM-SP-MULPIv3.0-I18-120329, issued March 29, 2012, bearing bates number CHARTER_ENTROPIC00101132.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on May 23, 2023.

/s/ Albert J. Boardman
Albert J. Boardman

EXHIBIT 1



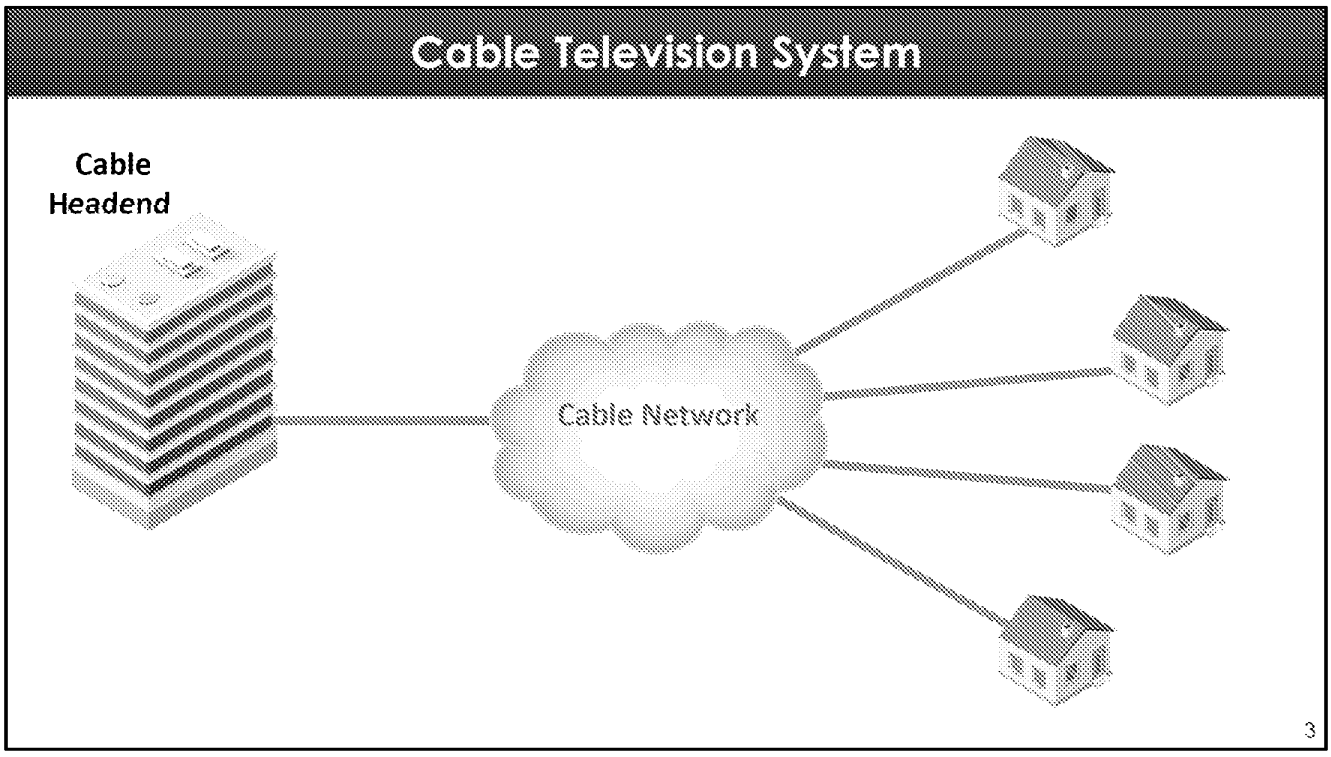
Good day Your Honor. This is Defendant Charter Communications' technology tutorial in the patent infringement action brought by Entropic Communications, case number 2:22-cv-00125.

Cable Television Systems

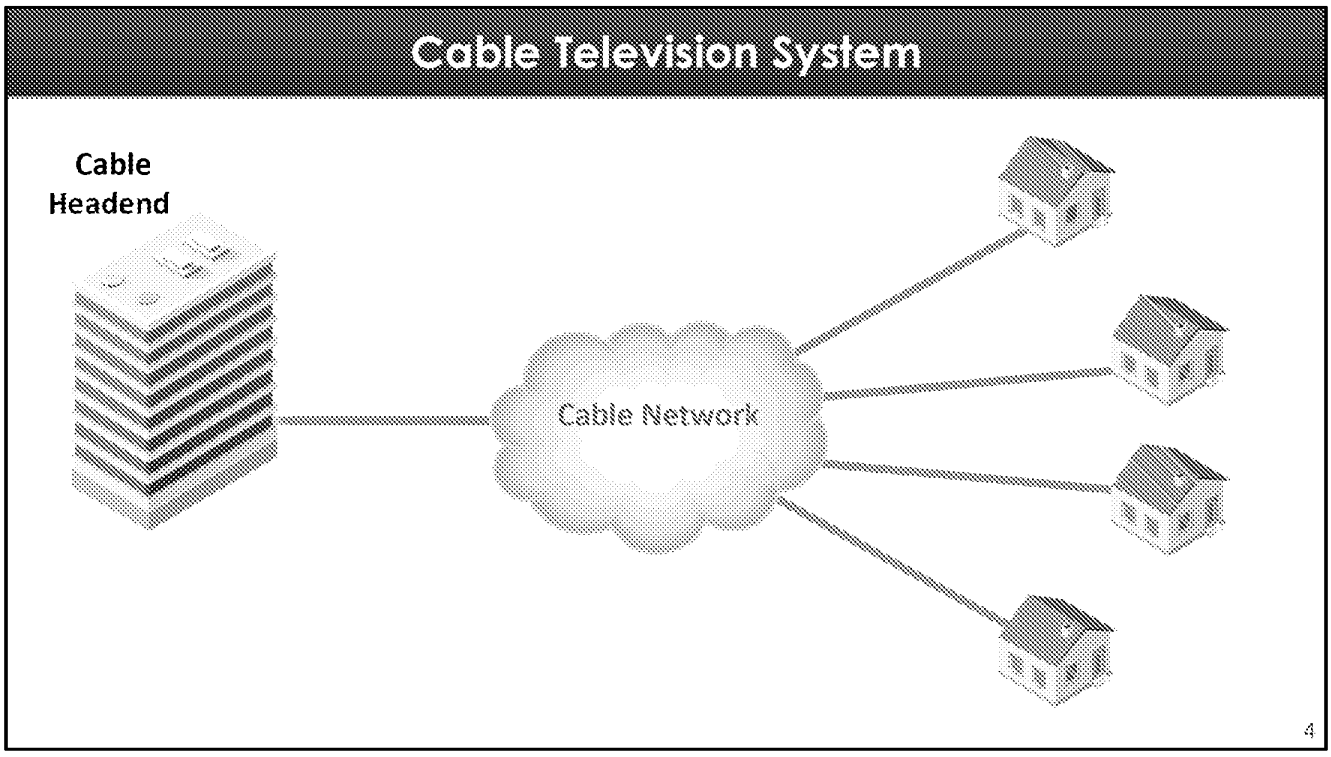
2

The patents at issue in this case are alleged to relate to cable television systems.

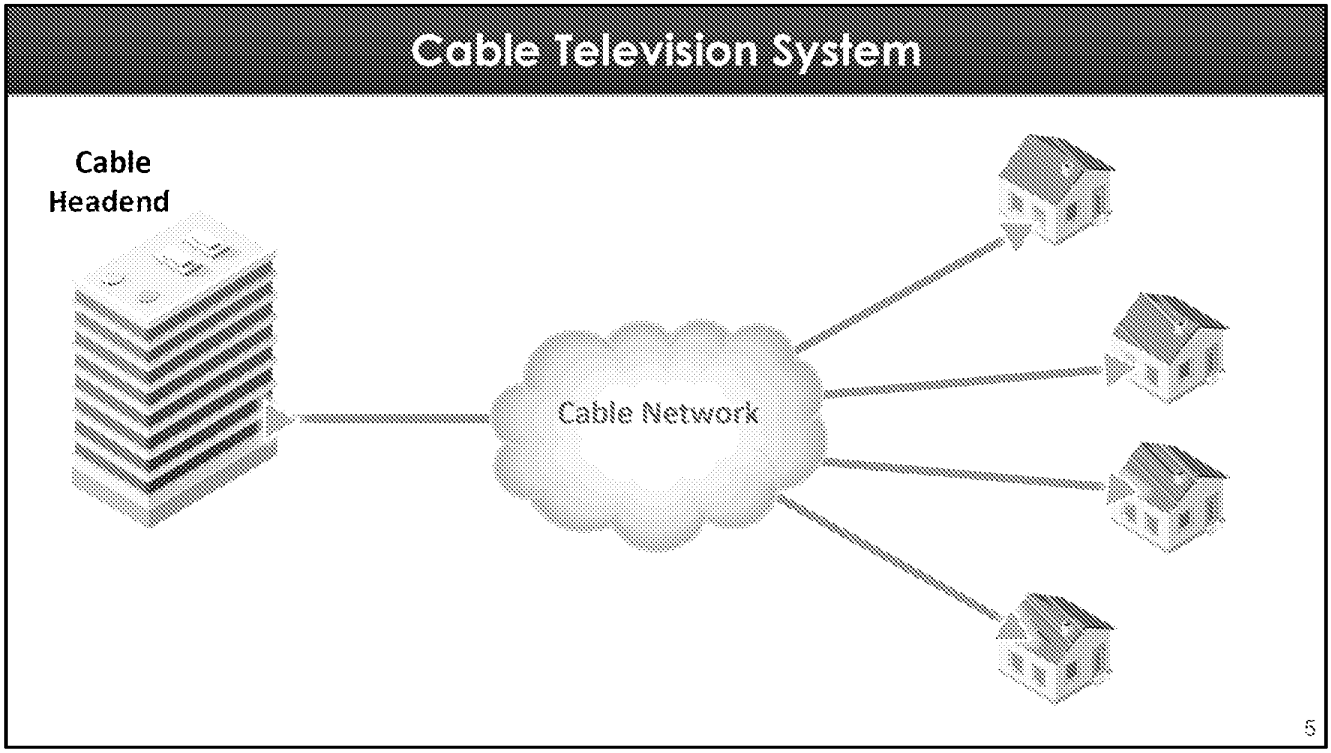
So we'll begin this tutorial with a brief overview of cable TV systems, after which we'll look at the patents.



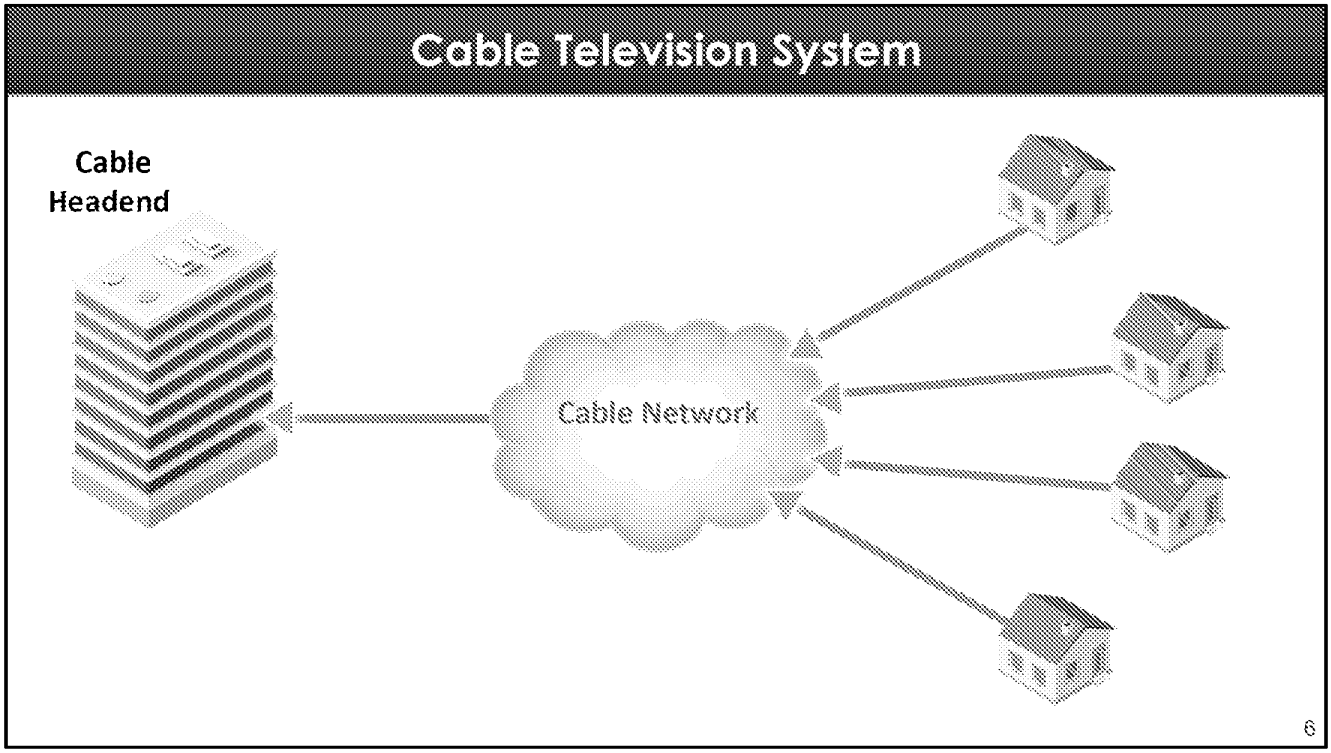
This figure is a simplified depiction of a cable television system.



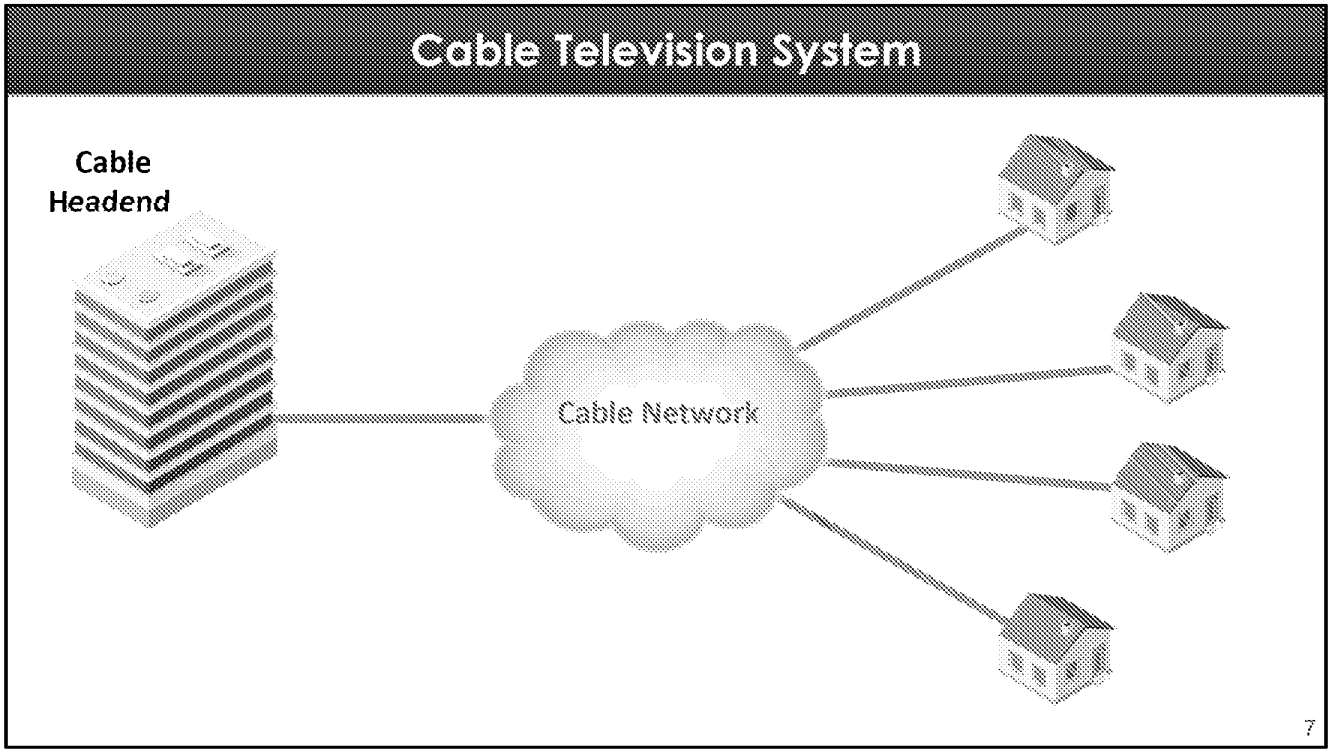
On the left we depict a Cable Headend.



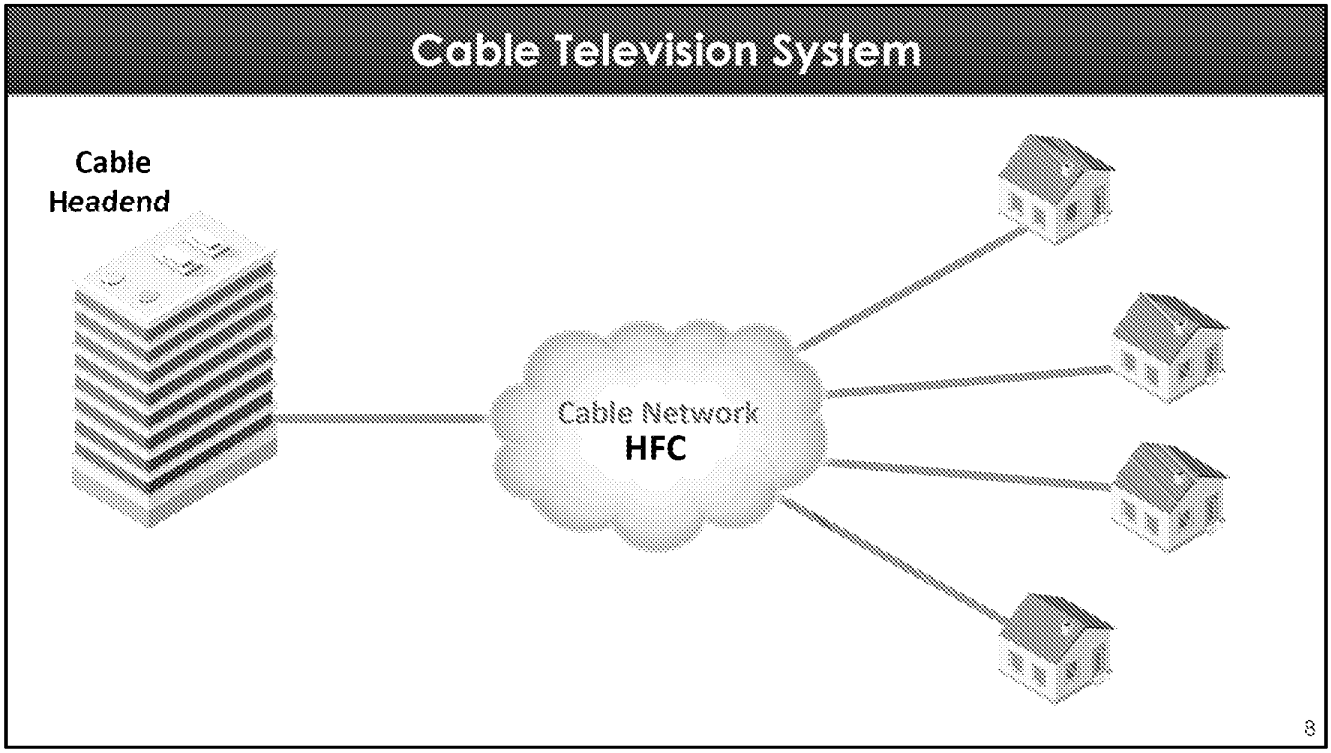
The headend contains equipment that sends television signals and data to customer homes.



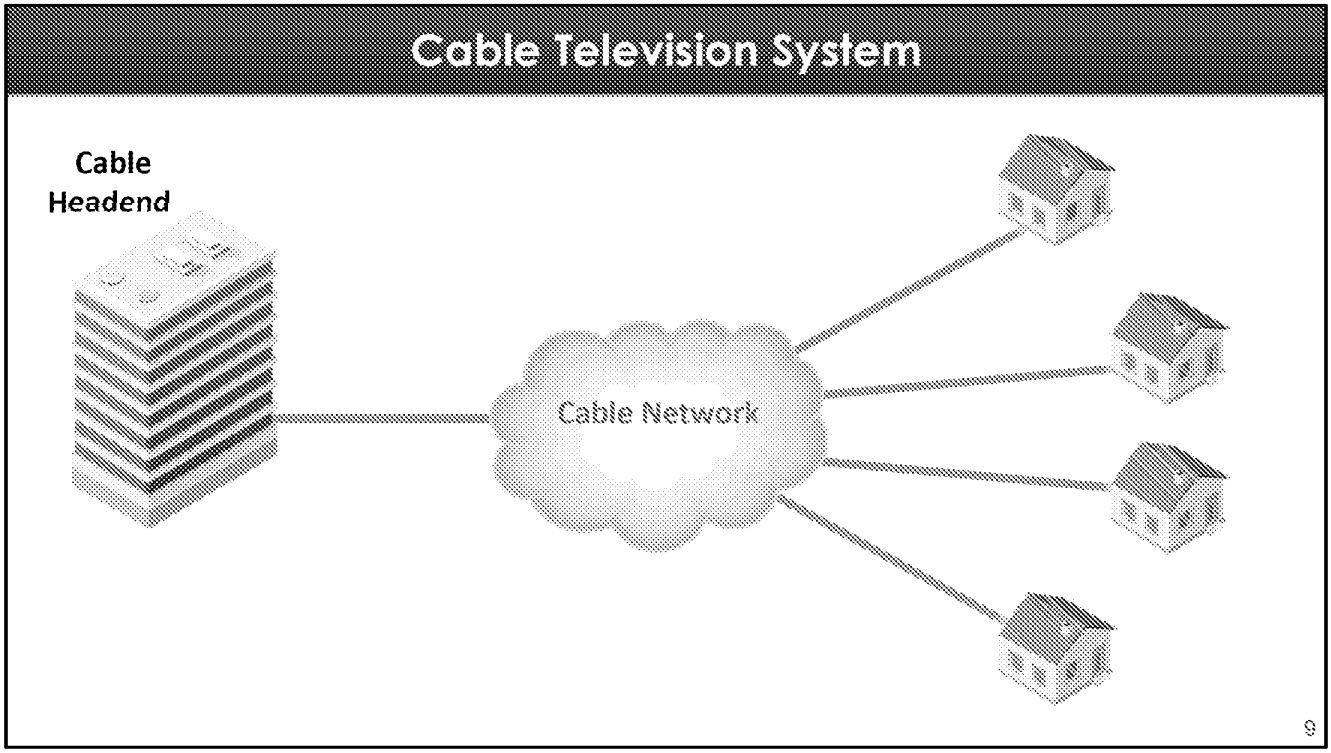
The headend also receives data from customer homes. For example, when customers order video on demand movies those requests can be sent to a cable headend.



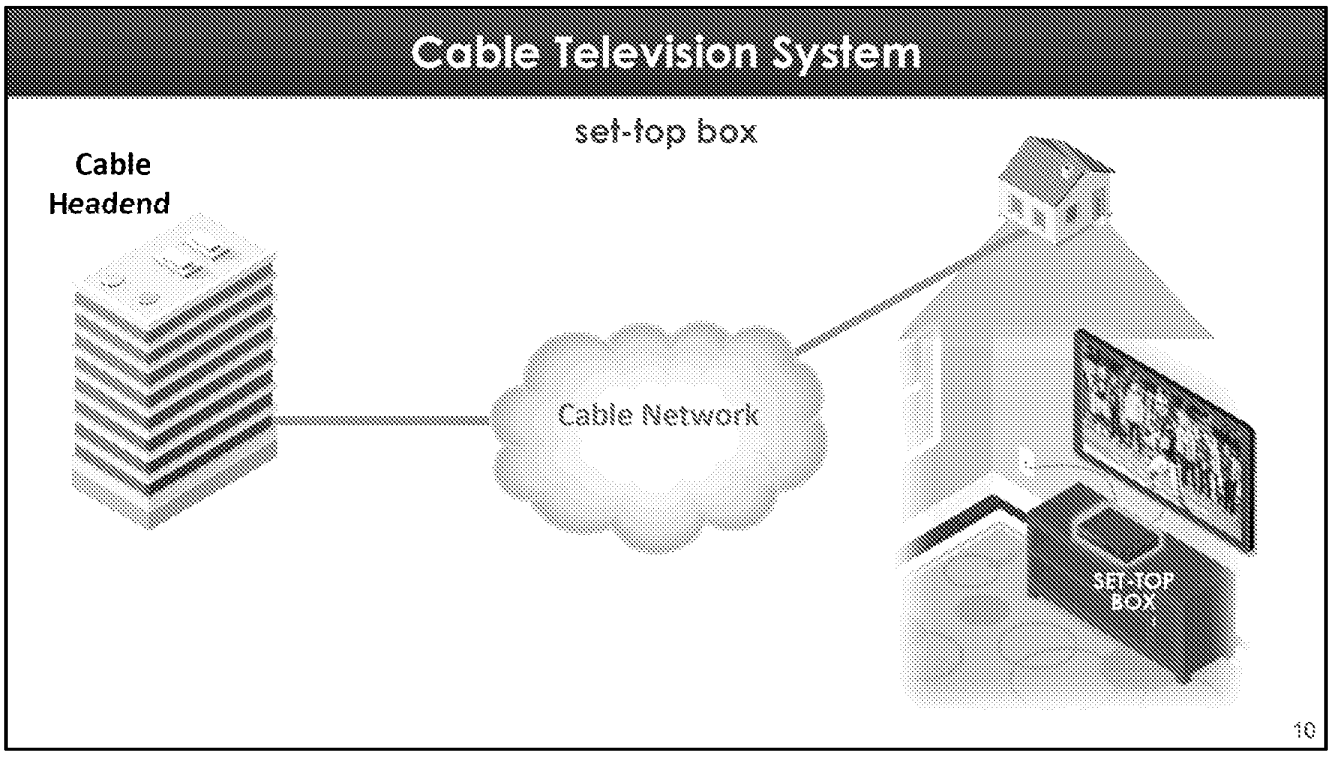
In the middle of the figure is the cable network, which connects the headend to customer homes.



The cable network can consist of both fiber optic cables and coaxial cables. Consequently, these networks are sometimes referred to as hybrid fiber-coax networks, or HFC networks for short.

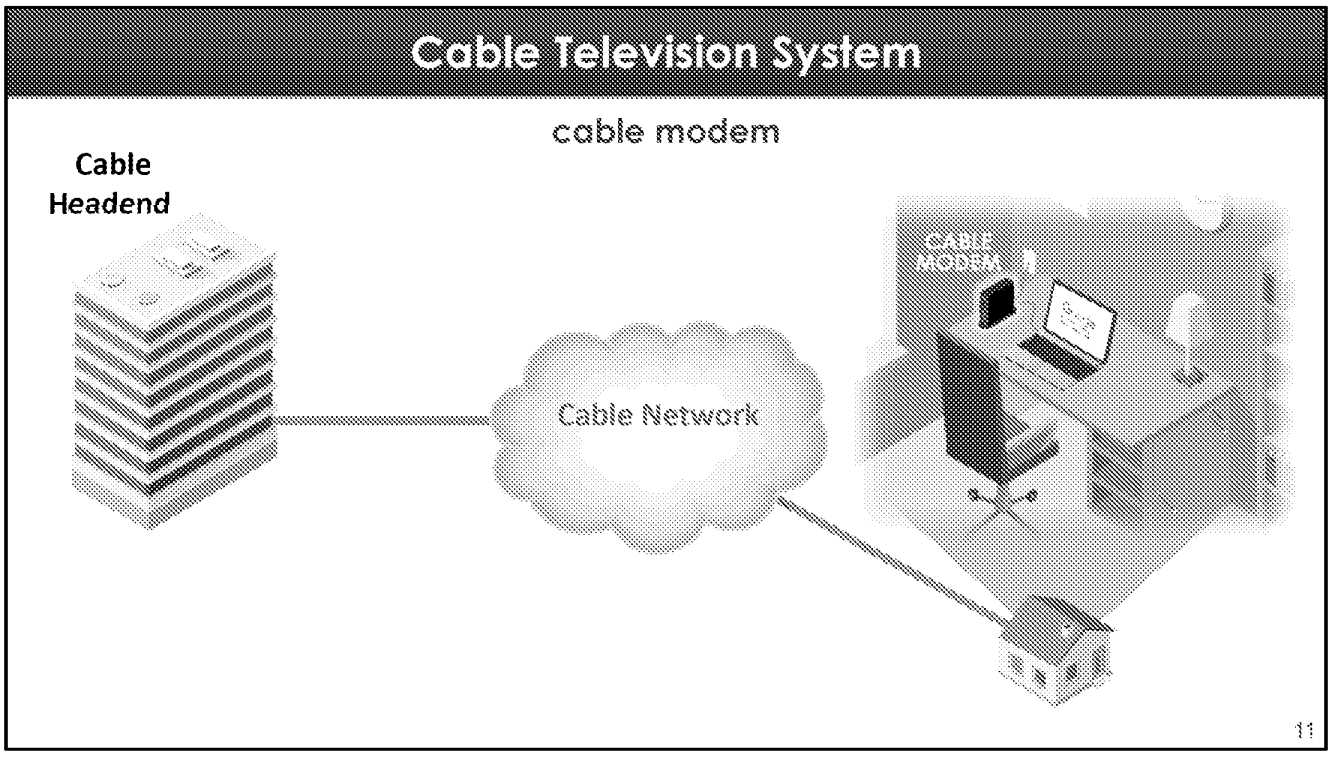


And finally, on the right side of the figure we show the customer homes.



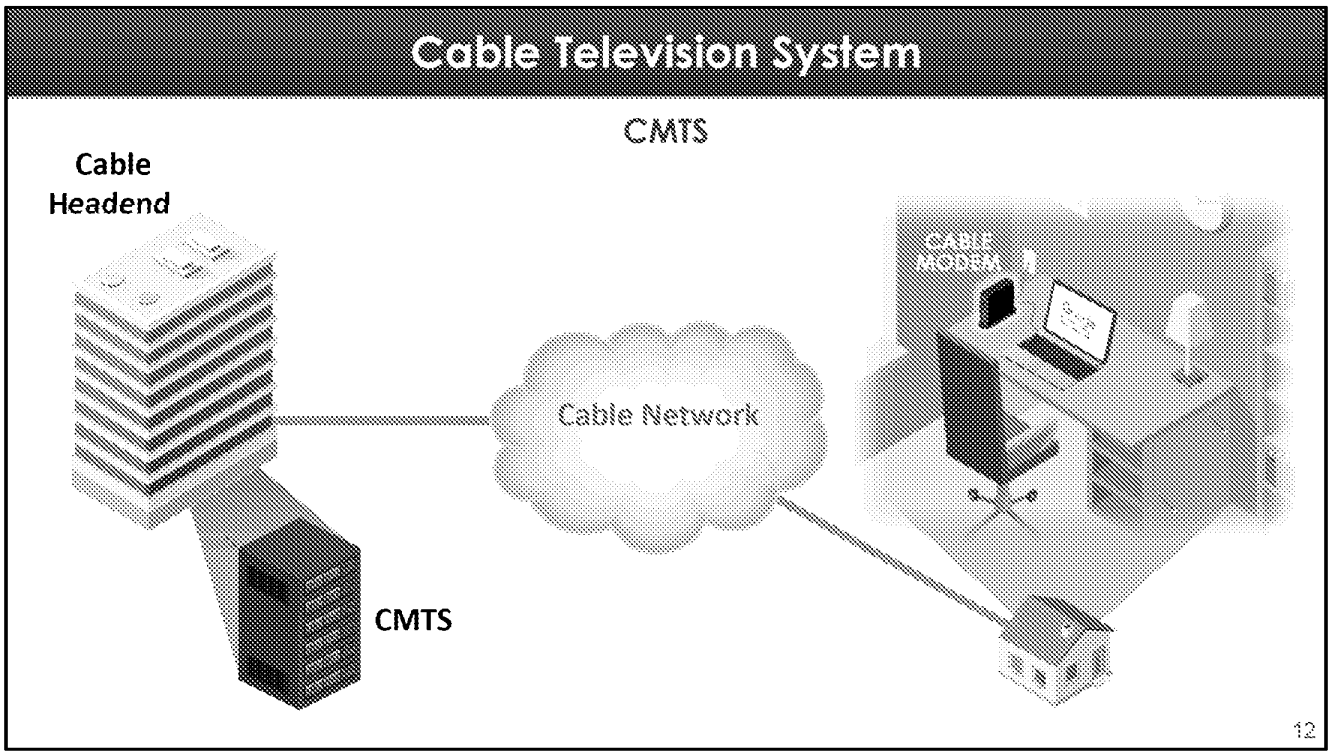
As Your Honor may know, cable companies provide different types of services to their customers. Obviously, one service cable television companies provide is television service. As shown on this slide, one way cable companies offer television service is through set-top boxes in customer homes.

A set top box receives television signals from the headend and displays them on the customer television. Here, we show the customer watching a football game.

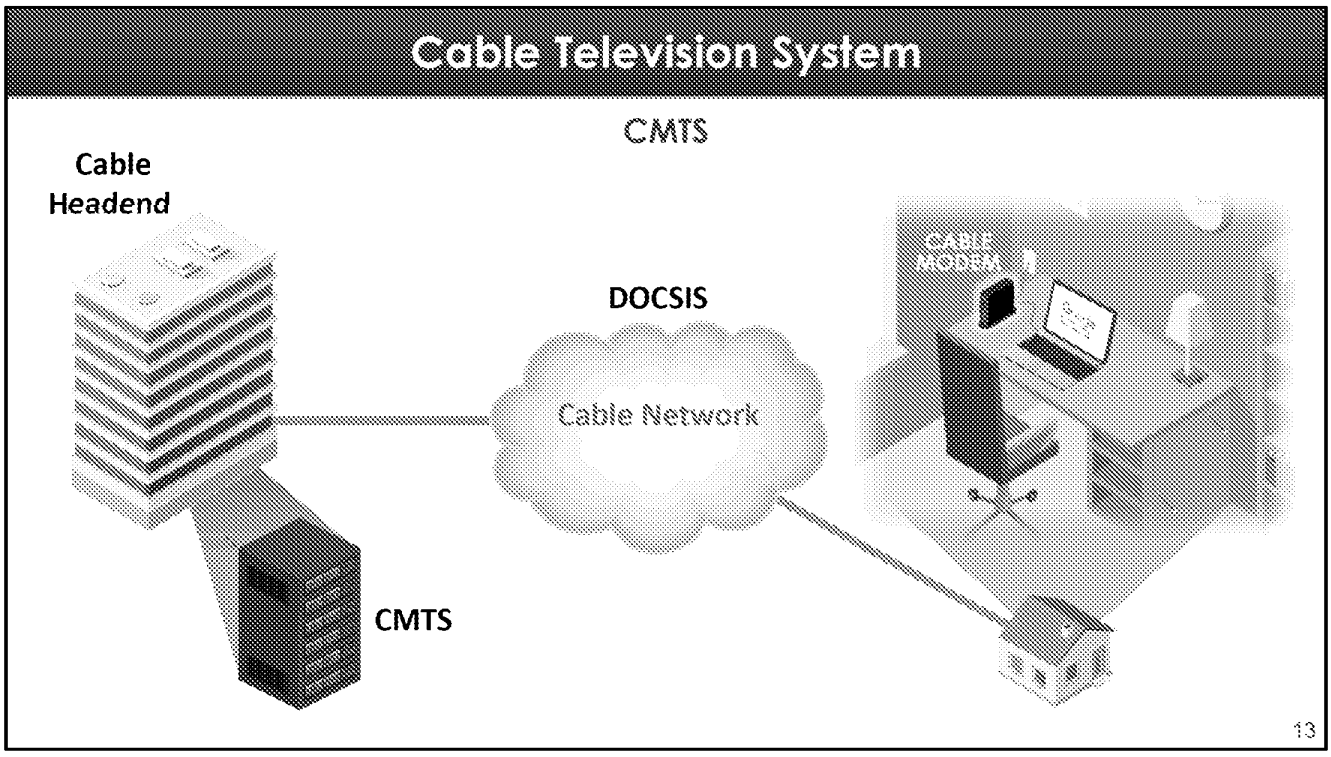


Cable companies today also provide data services to their customers, such as access to the Internet.

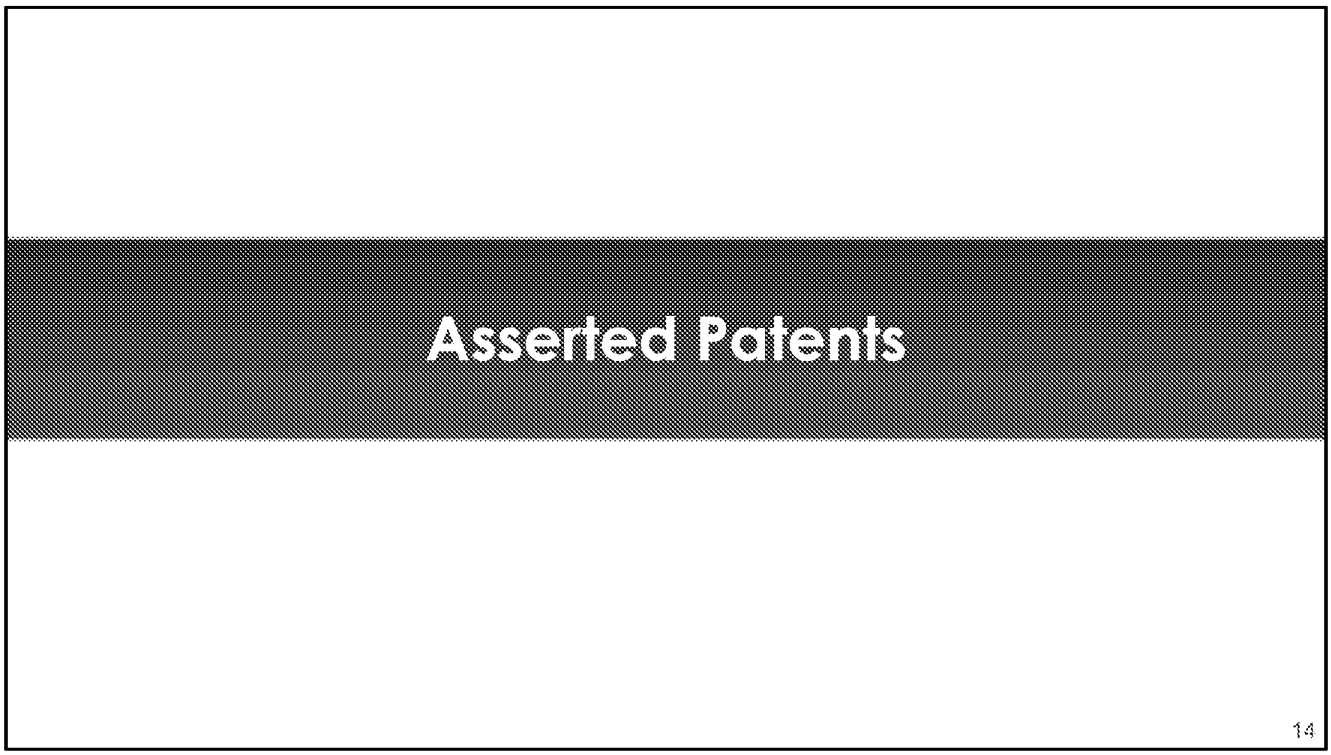
As shown here, one way that cable companies provide Internet access to customers is through cable modems in customer homes.



Those cable modems communicate with a device at the cable headend called a cable modem termination system, or CMTS.



That communication between the cable modems and the CMTS occurs pursuant to a cable industry communications standard called DOCSIS, which stands for Data Over Cable Service Interface Specification.



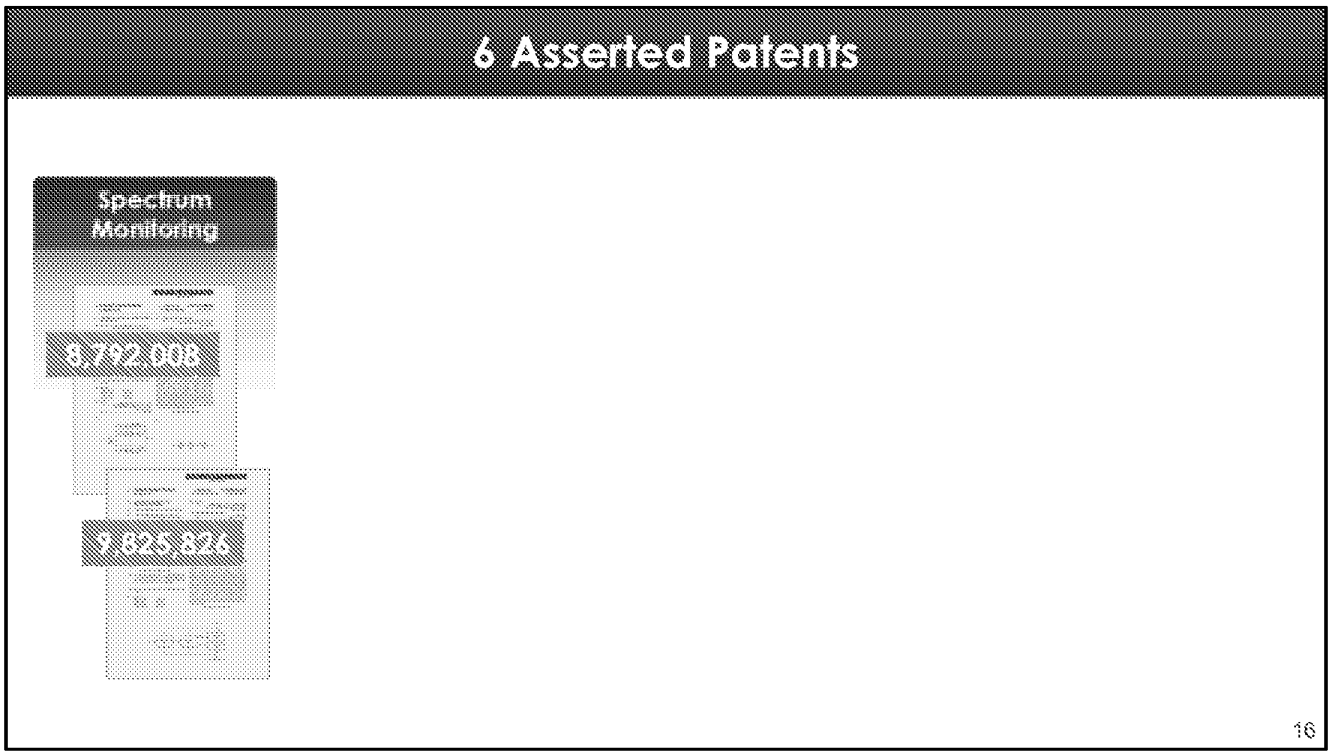
That concludes our overview of cable television systems.

We'll now turn to a discussion of the asserted patents.

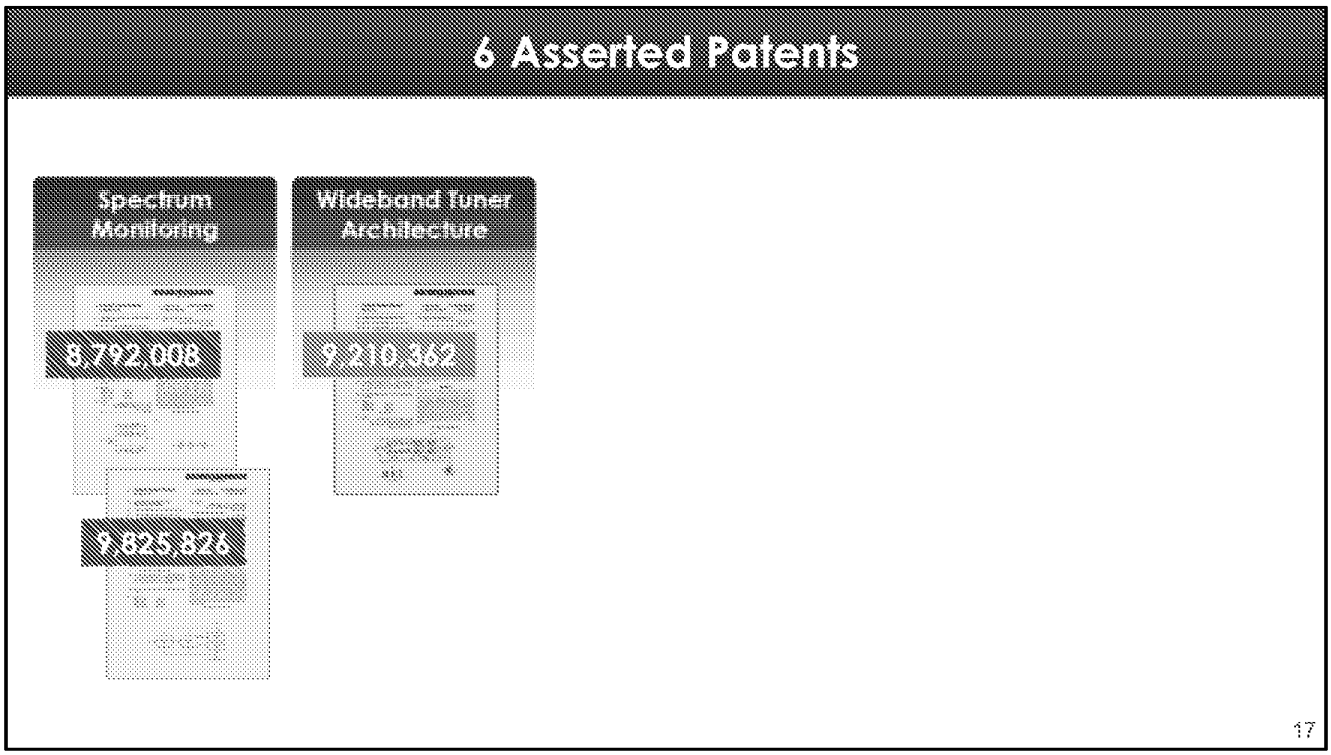
6 Asserted Patents

15

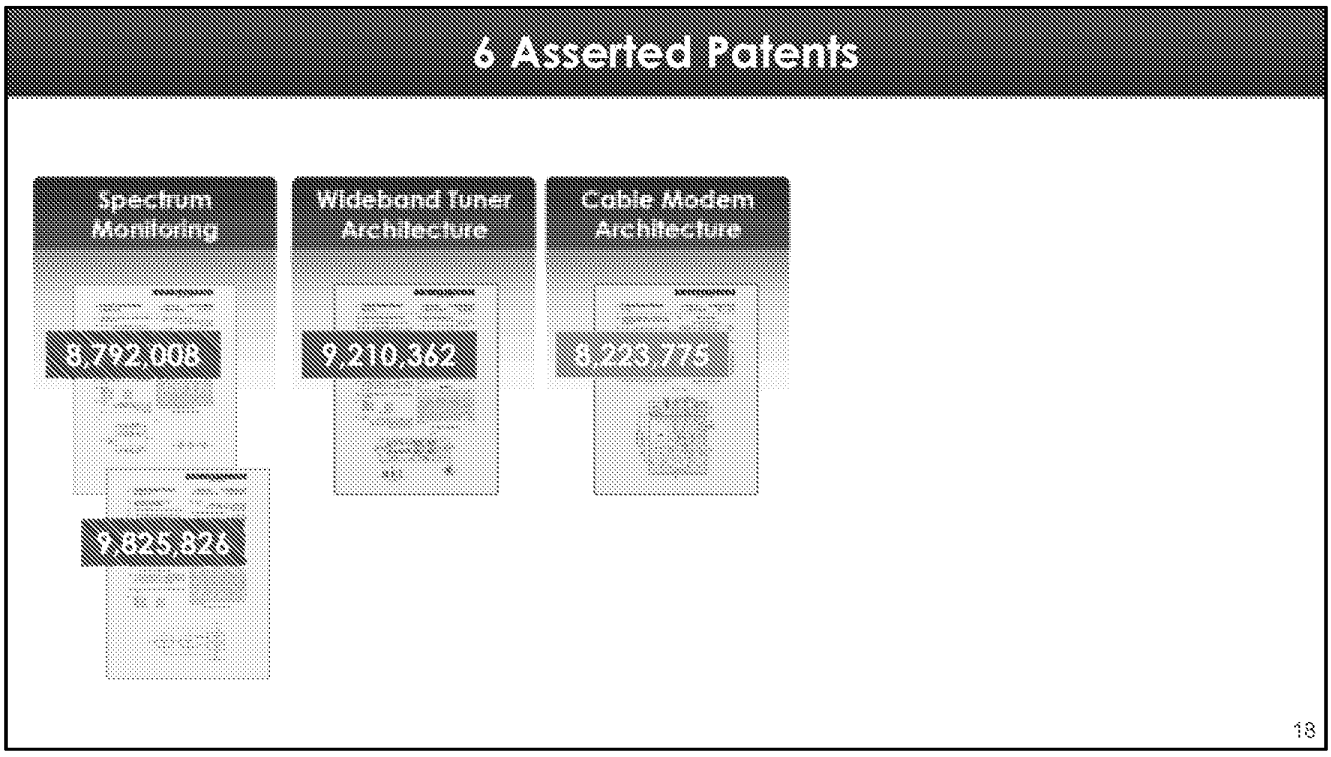
There are 6 asserted patents in this case. Three of them are asserted against set-top boxes, and the other three against cable modems or CMTSs.



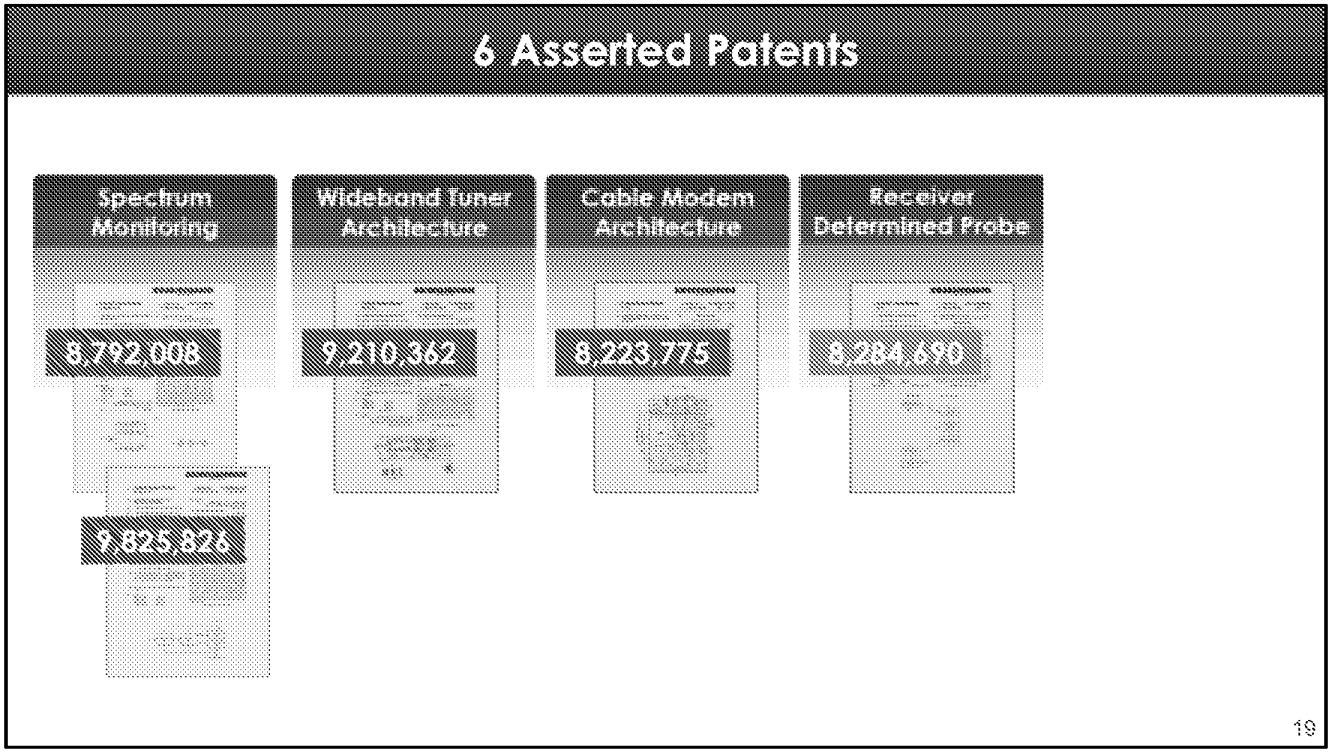
The 008 and 826 patents are in the same patent family and share a common specification. These patents relate to spectrum monitoring of television signals, and are asserted against set-top boxes.



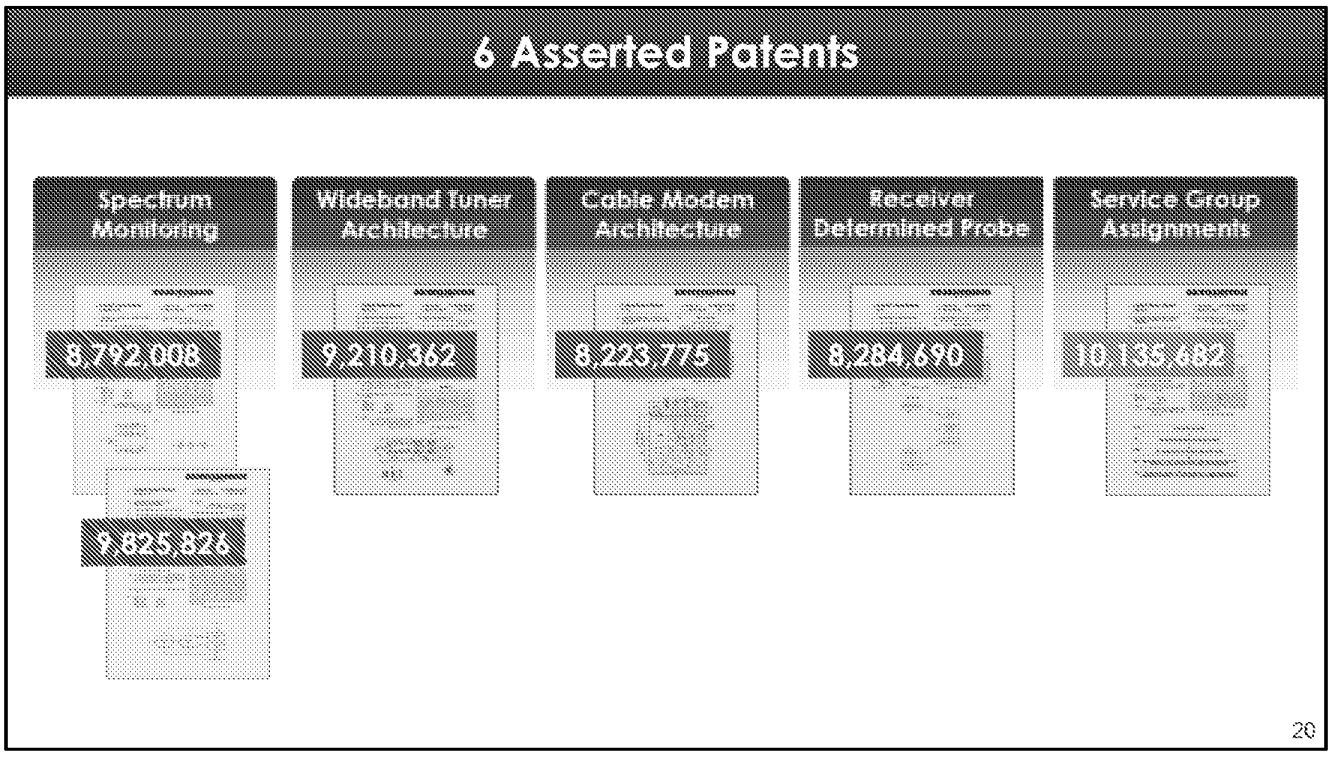
Next, the 362 patent discloses an allegedly novel architecture for a wideband tuner. This patent is also being asserted against set-top boxes.



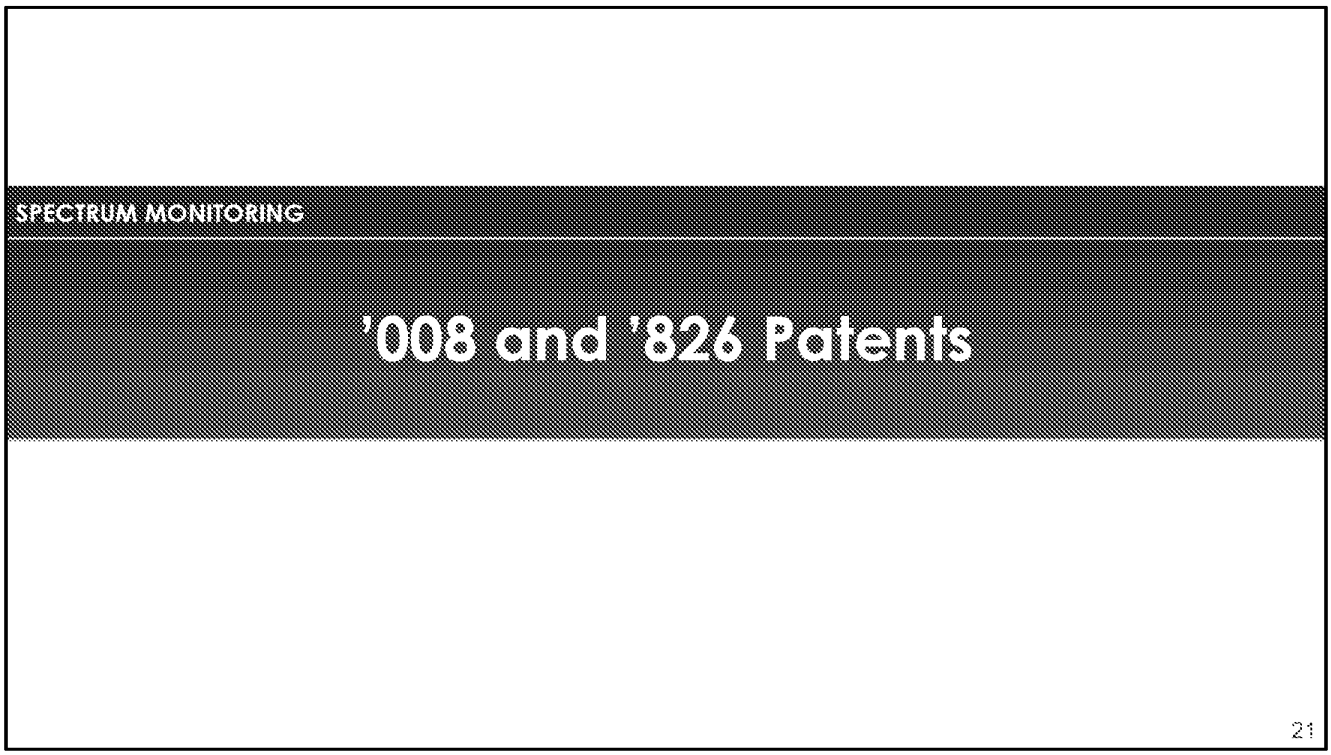
The fourth patent is the 775 patent, which is directed to an allegedly novel cable modem architecture. This patent is being asserted against cable modems.



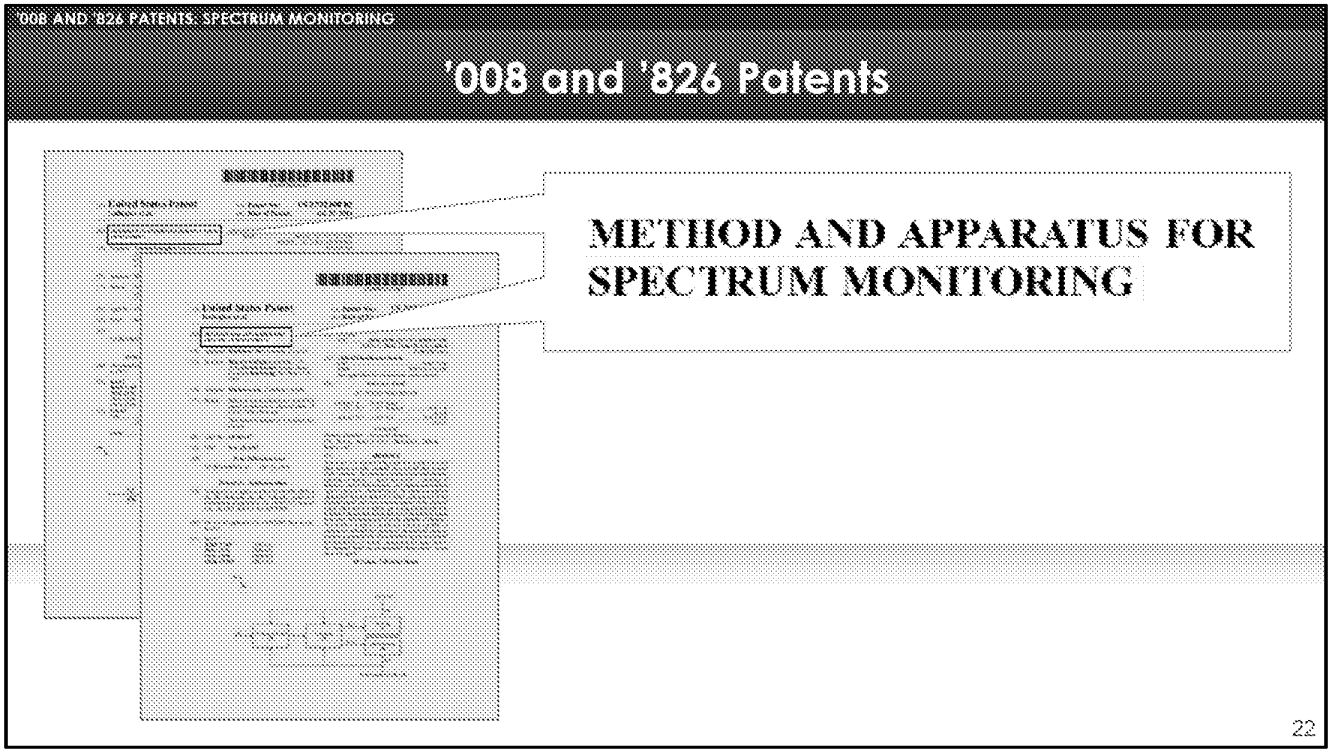
Next, the 690 patent is directed to a receiver determined probe. I'll explain what this means when I review the 690 patent. This patent is being asserted against cable modems and CMTSs.



And finally, the 682 patent is directed to an allegedly novel way to assign cable modems to service groups. This patent is being asserted against CMTSs.

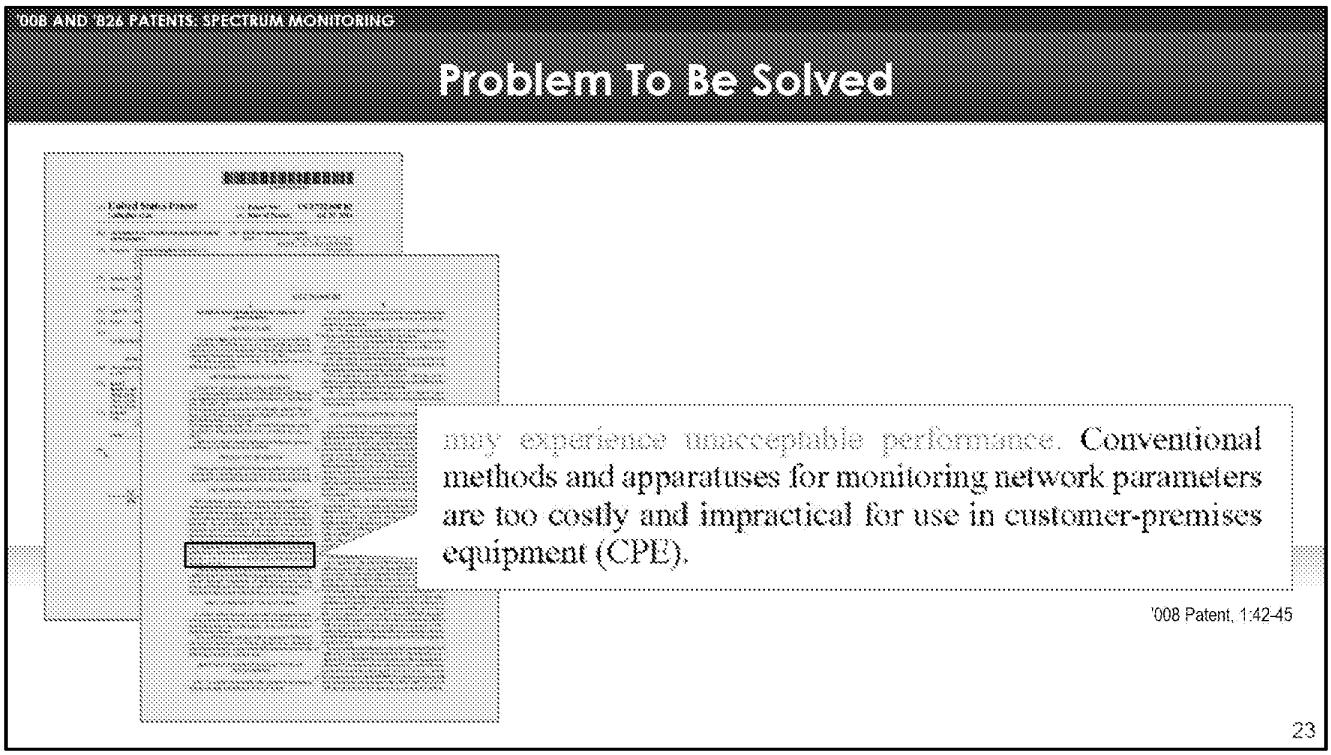


I'll begin my discussion of the patents with the 008 and 826 patents.



As their titles indicate, these patents relate to spectrum monitoring. The 008 patent relates to an allegedly novel architecture for a device that monitors cable television signals, and the 826 patent relates to the method by which that architecture operates.

As I mentioned earlier, the 008 and 826 patents are related and share a common specification.



According to the patents, while spectrum monitoring of cable television signals was known, existing ways of doing it were too costly and impractical.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Exemplary Cable System

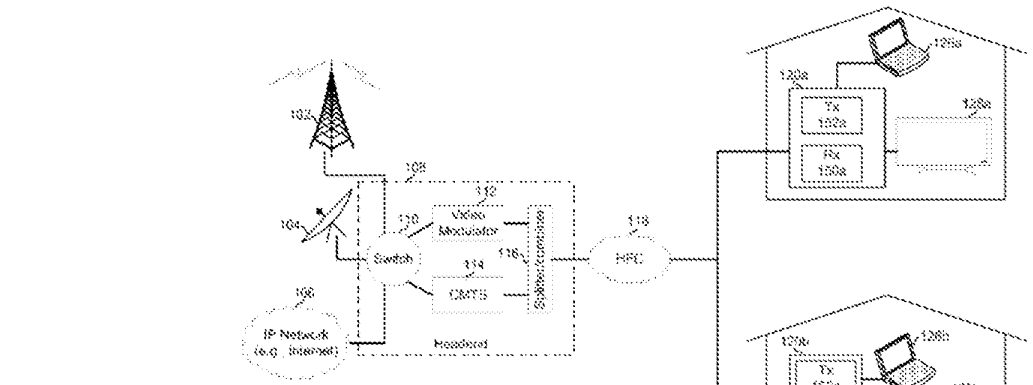


FIG. 1A depicts an example cable system in accordance with an example embodiment of the invention.

'008 Patent, 1:66-67

FIG. 1A

24

Figure 1A of the patent depicts an exemplary cable system in which the alleged invention would be used.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Exemplary Cable System

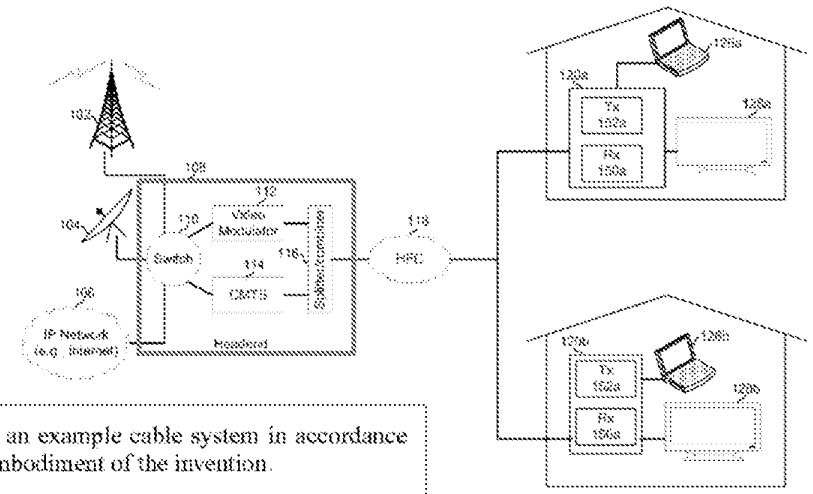


FIG. 1A depicts an example cable system in accordance with an example embodiment of the invention.

'008 Patent, 1:66-67

FIG. 1A

25

On the left, annotated in red, is the cable headend.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Exemplary Cable System

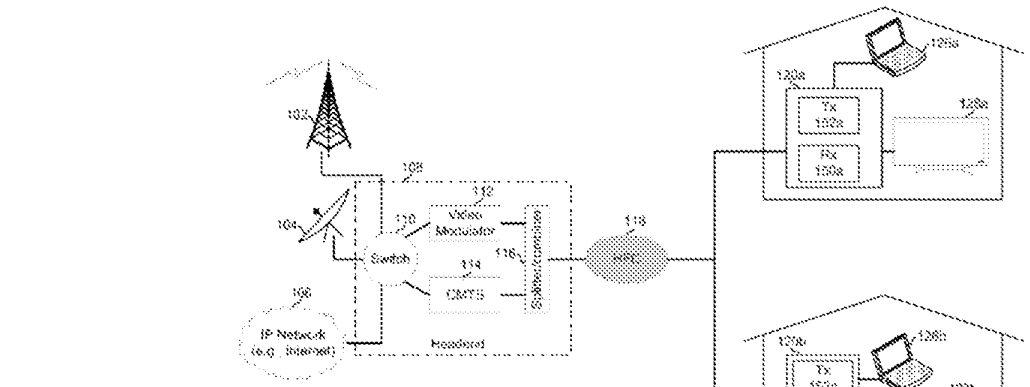


FIG. 1A depicts an example cable system in accordance with an example embodiment of the invention.

'008 Patent, 1:66-67

FIG. 1A

26

In the middle is the hybrid fiber/coax cable network annotated in blue.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Exemplary Cable System

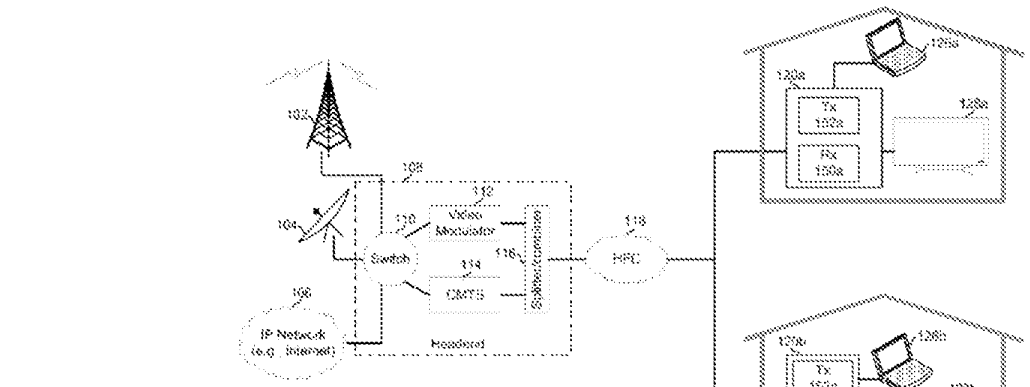


FIG. 1A depicts an example cable system in accordance with an example embodiment of the invention.

'008 Patent, 1:66-67

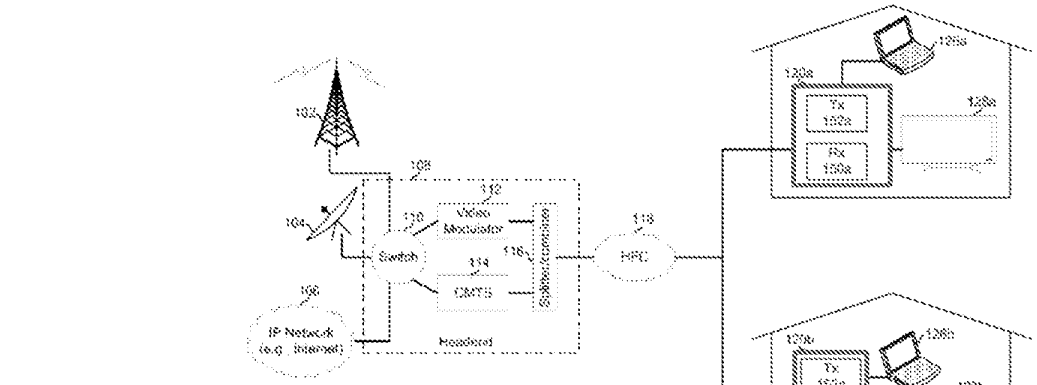
FIG. 1A

27

And on the right, annotated in green, are the customer homes.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Gateway



(HFC) network **118**, a gateways **120***a* and **120***b*, end systems

'008 Patent, 2:39

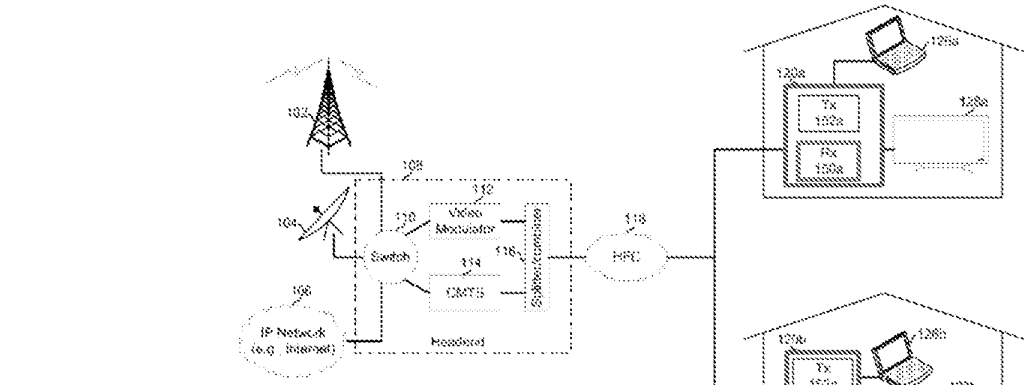
FIG. 1A

28

Within each of the customer homes is a gateway device, which we've outlined in blue. As you can see, within each gateway device is a transmit module T X and a receiver R X.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Receiver



Each of the gateways **120***a* and **120***b* may comprise a receive module **150** operable to process the received FDM signal as described below.

'008 Patent, 2:57-59

FIG. 1A

29

The alleged invention relates to the receiver, which we've indicated in red. The receiver is the component of the gateway that receives and processes the signals from the headend.

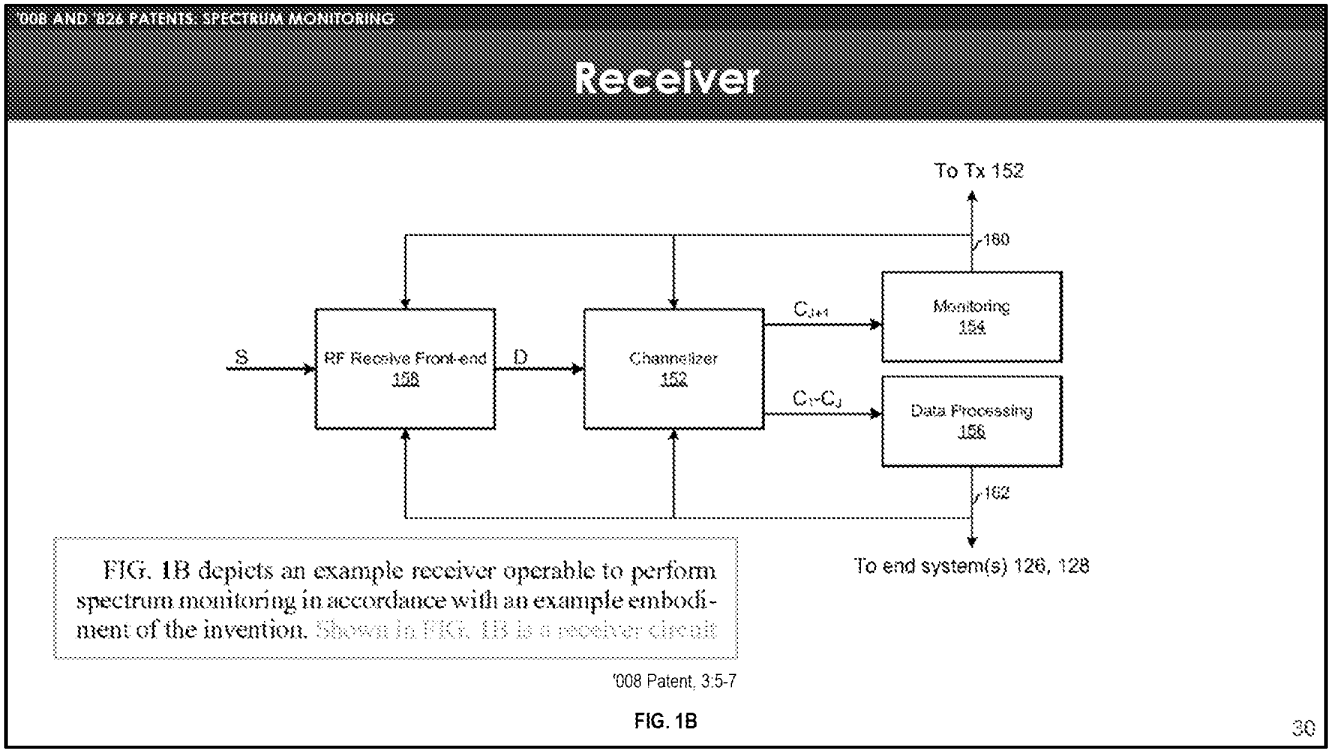
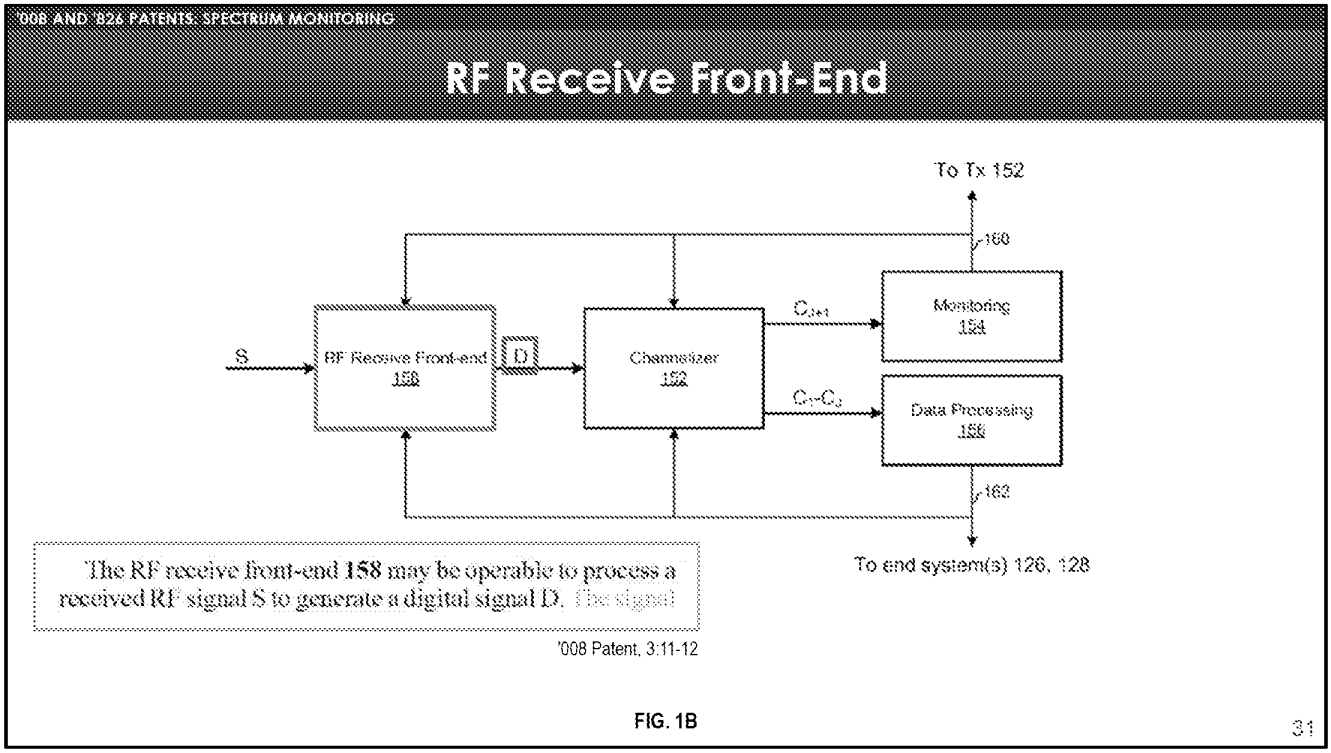
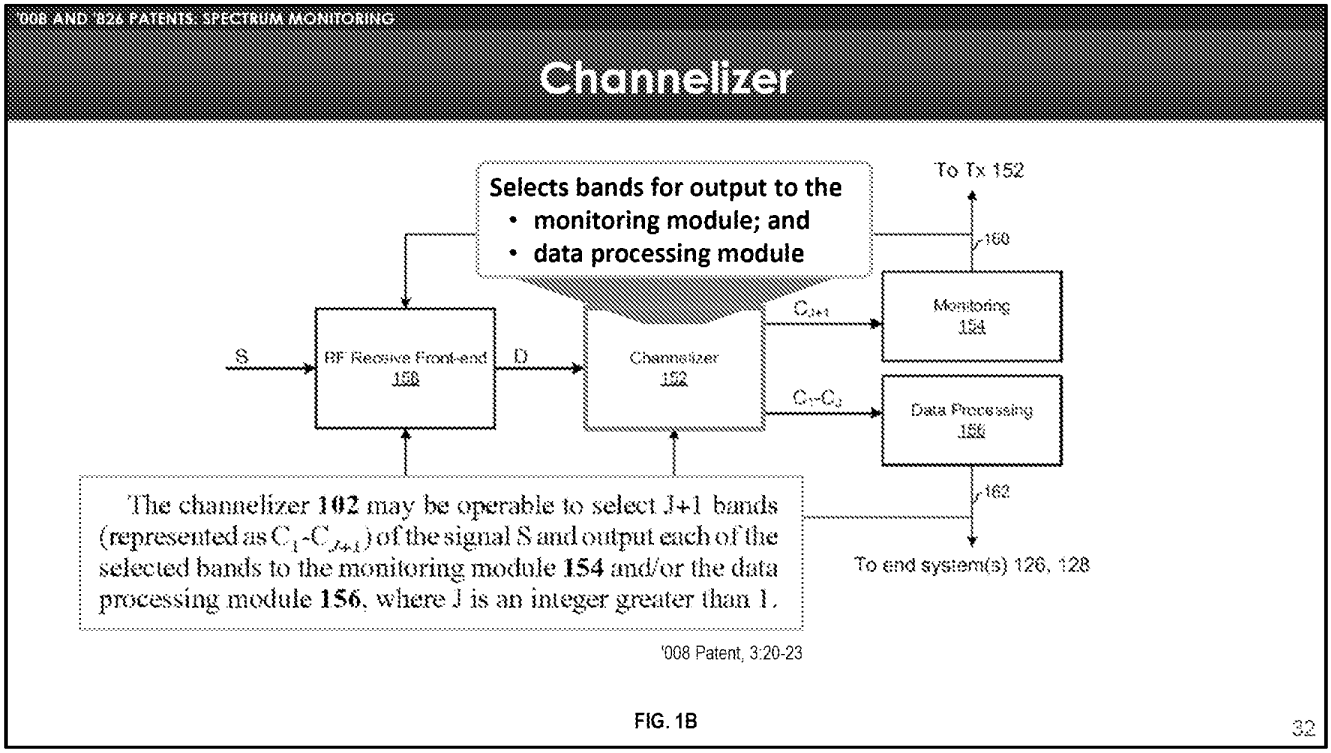


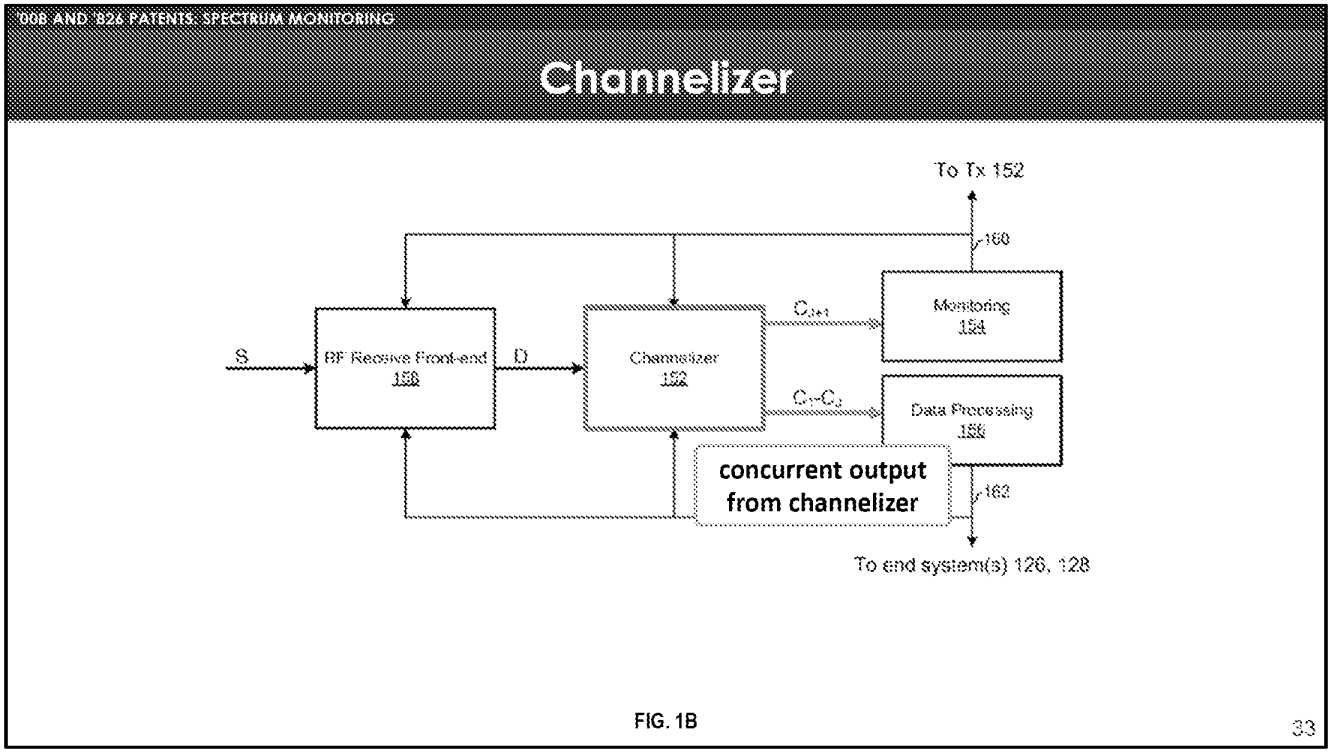
FIG. 1B depicts the allegedly novel architecture for the receiver.



The receiver includes a so-called RF Receive Front end, which we've annotated in red. This converts the incoming signal from analog to digital form. We've annotated the digital output in blue.



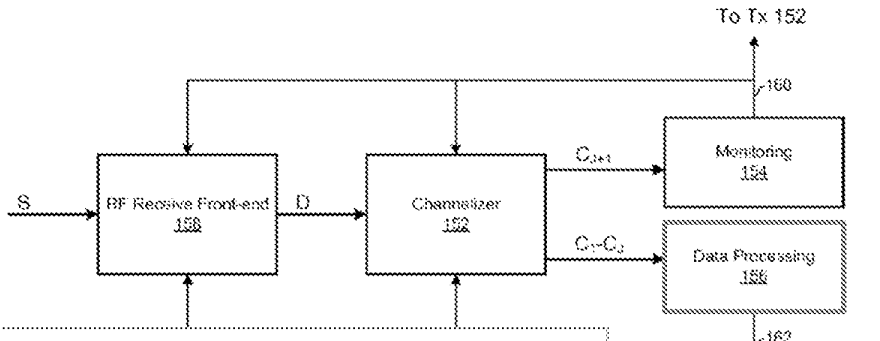
After the signal is digitized it is provided to a channelizer. The function of the channelizer is to select which of the received frequency bands to provide to the monitoring module 154 and which to provide to the data processing module 156.



According to the claims, after the selection is made, the channelizer provides concurrent output to the monitoring module and the data processing module.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Data Processing Module



The data processing module **156** may be operable to process the bands C_1-C_J conveyed to it by the channelizer **102** to recover data present in one or more television channels present in those bands of the signal S. The data processing

'008 Patent, 3:61-64

FIG. 1B

34

The function of the data processing module is to recover data in the TV channels it receives from the channelizer. The customer can then watch those channels on their TV.

'008 AND '826 PATENTS: SPECTRUM MONITORING

Monitoring Module

The monitoring module **154** may be operable to analyze the band $C_{x,1}$ that it receives from the channelizer **102** to measure/determine characteristics such as, for example, signal power level vs. frequency, delay vs. frequency, phase shift vs. frequency, type and/or amount of modulation, code rate, interference levels, signal to noise ratio, a transfer function of the channel of over which the signal was received, an impulse response of the channel over which the signal was received, and/or any other characteristic that may help assess characteristics of the channel over which the signal was received, assess characteristics of the transmitter that sent the signal and/or any otherwise be pertinent to performance of the communication system. The monitoring module may also be

'008 Patent, 3:33-45

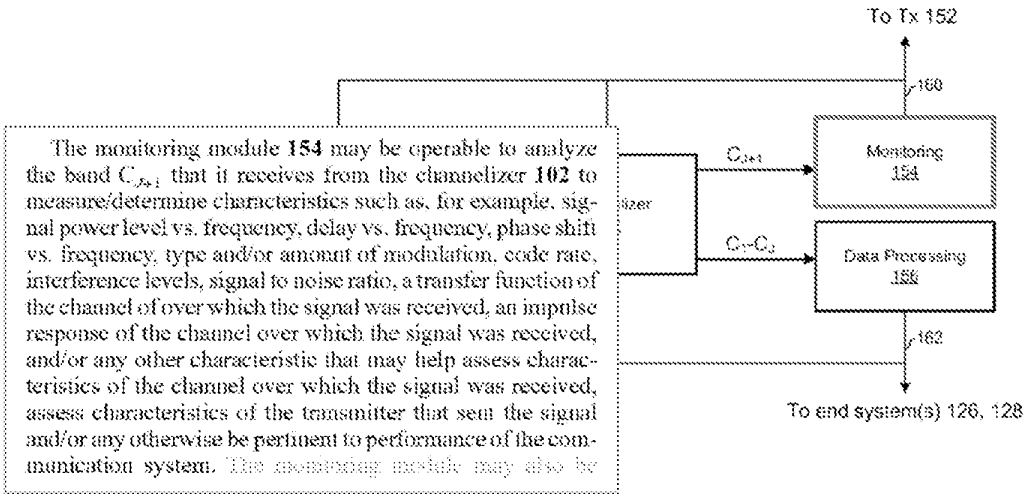


FIG. 1B

35

The job of the monitoring module is to measure or determine characteristics of the frequency band it receives from the channelizer.

16. Richard A. Kramer, "An analysis for the paper: Interactive Streaming of Stored Multiview Video Using Redundant Frame Structures". Oregon State University, December 22, 2015.

17. Richard A. Kramer, "An analysis for the paper: Video Streaming with Network Coding", Oregon State University, November 2, 2015.

18. Richard A. Kramer, Presentation/Lecture: "Hedera – An Analysis of Dynamic Flow Scheduling for Data Center Networks", Oregon State University, October 25, 2015.

19. Richard A. Kramer, "An Analysis of Cloud Based Data Centers Costs", Oregon State University, August 27, 2015.

EXHIBIT B

8293037

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

September 09, 2022

THIS IS TO CERTIFY THAT ANNEXED IS A TRUE COPY FROM THE RECORDS OF THIS OFFICE OF THE FILE WRAPPER AND CONTENTS OF:

APPLICATION NUMBER: *10/675,566*
FILING DATE: *September 30, 2003*
PATENT NUMBER: *8223775*
ISSUE DATE: *July 17, 2012*

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Performing the Functions and Duties of the
Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

14042 U.S. PTO
09/30/03

Patent
109822-95

Mail Stop: Patent Application
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

22141 U.S. PTO
10/675566
09/30/03

NEW APPLICATION TRANSMITTAL

UTILITY

Sir:

Transmitted herewith for filing is a **utility** patent application entitled:

ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

Inventors: Gordon G. Li and Yoav Hebron

I. PAPERS ENCLOSED HEREWITH FOR FILING UNDER 37 C.F.R. § 1.53(b):

11 Page(s) of Written Description

4 Page(s) of Claims

1 Page(s) of Abstract

2 Sheets of Drawings ☒ Formal ☐ Informal

II. ADDITIONAL PAPERS ENCLOSED IN CONNECTION WITH THIS FILING:

☐ Declaration

☐ Power of Attorney: ☐ Separate or ☐ Combined with Declaration

☐ Assignment to Conexant Systems, Inc., and Recordation Cover Sheet

☐ Information Disclosure Statement, PTO Form 1449 ☐ Copies of Cited References

☒ Return Postcard

CERTIFICATE OF MAILING
(37 C.F.R. §1.10)

I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as 'Express Mail Post Office To Addressee' in an envelope addressed to Mail Stop: Patent Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

EL986038243US
Express Mail Label No.

Troy M. Schmelzer
Name of Person Mailing Paper

September 30, 2003
Date of Deposit

Signature of Person Mailing Paper

109822.000095/426940.01

III. FEE CALCULATION

☐ Applicant claims small entity status under 37 CFR 1.27.

BASIC FILING FEE:							750.00
Total Claims	15	-	20	= 0	x	$18.00	$0.00
Independent Claims	3	-	3	= 0	x	$84.00	$0.00
Multiple Dependent Claims	$280.00	(if applicable)				☐	$0.00
TOTAL OF ABOVE CALCULATIONS							$750.00
Reduction by ½ for Filing by Small Entity.						☐	$0.00
Petition to Make Special							$0.00
TOTAL FEES DUE HEREWITH							$750.00

IV. PRIORITY - 35 USC § 119(e)

☐ Priority of provisional application Serial No. _____, filed on _____, is claimed under 35 USC § 119(e).

V. METHOD OF PAYMENT OF FEES

☐ Attached is a check in the amount of $_____.

☐ Charge Procopio, Cory, Hargreaves & Savitch's Deposit Account No. **50-2075** in the amount of $_____.

☒ Not attached. No filing fee is submitted. [This and the surcharge required by 37 CFR § 1.16(e) can be paid subsequently.]

VI. AUTHORIZATION TO CHARGE ADDITIONAL FEES

The Commissioner is hereby authorized to credit Procopio, Cory, Hargreaves & Savitch's Deposit Account No. **50-2075** for any over payment of fees and to charge the following additional fees by this paper and during the entire pendency of this application to Deposit Account No. **50-2075**:

☐ 37 CFR § 1.16 (Filing fees and excess claims fees)

☐ 37 CFR § 1.17 (Application processing fees)

☐ 37 CFR § 1.21 (Assignment recordation fees)

Please send all correspondence to Troy M. Schmelzer at Customer Number 27189:



PROCOPIO, CORY, HARGREAVES
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530 B Street, Suite 2100
San Diego, CA 92101-4469
(619) 238-1900

Please direct all inquiries to Troy M. Schmelzer, at the above Customer Number.

Respectfully submitted,
PROCOPIO, CORY HARGREAVES
& SAVITCH LLP

Dated: September 30, 2003

By: _____
Troy M. Schmelzer
Reg. No. 36,667

U.S. Express Mail No.: EL986038243US
Filing Date: September 30, 2003

PATENT
PCHS Matter No. 109822-95
02CXT0070D

UNITED STATES PATENT APPLICATION
FOR

ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

INVENTORS:

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YOAV HEBRON

PREPARED BY:
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PATENT
PCHS Matter No. 109822-95
02CXT0070D

ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

Field of the Invention

[01] The present invention relates to cable modems and, in particular, relates to a calbe modem system having a functionally partitioned and flexible architecture.

Background of the Invention

[02] The future gateway cable modem (CM) will provide a wide range of data networking and VoIP services, as exemplified by the requirements for initiatives such as CableHome and PacketCable. The major challenge in designing such a gateway cable modem is integration of these services with the basic cable modem functionality in an efficient and cost-effective. Several objectives need to be met:

[03] **Functional Partitioning.** The gateway cable modem will incorporate a variety of functions beyond the traditional cable modem, including IP routing, network address translation (NAT)/firewall, virtual private network (VPN), web server and VoIP. These functions need to utilize DOCSIS (Data Over Cable Service Interface Specification)services (link-layer transport and QoS) for wide area network (WAN) access. Partitioning these functions along with other cable modem functions among different computational agents is an essential issue in designing a gateway cable modem.

[04] **Flexiblity.** The architecture of the gateway cable modem should be flexible enough to allow independent software development and field-upgrade of gateway value-added services and basic DOCSIS cable modem services. From a development standpoint, the architecture should facilitate different software-partnering models, including all in-house, software components licensing, and OEM vendor-differentiating design. From a multiple system operator (MSO) perspective, it is highly desirable to be able to independently provision, maintain and upgrade revenue-producing gateway services and basic broadband access services.

[05] **Performance.** The gateway cable modem should be able to support a large number of simultaneous data application sessions originated from/terminated on multiple CPE (customer provided equipment) devices. VoIP applications must not be adversely impacted by an concurrent data applications, and the data path for voice packets must be optimized to minimize delay and jitter.

[06] **Cost.** The gateway cable modem chip should have a small incremental hardware cost/functional increase relative to stand-alone cable modem chips.

[07] **Software Re-Use.** It should be possible to carry over existing cable modem software to the new gateway cable modem without major changes. The existing software running on network processors should be easily portable to run on the gateway platform without major adaptation.

[08] The present invention provides a gateway cable modem architecture that meets all of these objectives.

Summary of the Invention

[09] The present invention provides a gateway cable modem system and architecture that meets the above objectives and provides a highly flexible, high performance system capable of handling multiple cable modem voice, data and networking services.

[10] One embodiment of the invention is a cable modem system comprising a data networking engine that performs data networking functions and a cable modem engine that performs all other cable modem functions, wherein the cable modem engine is completely partitioned from the data networking engine.

[11] Another embodiment of the invention is a cable modem architecture. The architecture includes a cable modem engine having a a DOCSIS PHY layer with a hardware transmitter and receiver, a DOCSIS MAC processor that implements real-time critical MAC functions for both upstream and downstream communications, and a DOCSIS controller implementing VoIP functionality. The architecture also includes a data networking engine implementing all data networking processing and home networking applications. The data networking engine is completely decoupled from the cable modem engine. In one implementation, the VoIP functionality provided by the cable modem is in accordance with the PacketCable specification and the data networking functionality provided by the data networking engine is in accordance with the CableHome specification.

[12] Another embodiment of the invention is a method for providing a flexible and partitioned cable modem gateway. Data and home networking functionality is provided by a data networking engine, and DOCSIS and VoIP functionality is provided by a cable

modem engine. The data networking engine is partitioned from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

[13] Other systems, methods, features and advantages of the invention will be or will become apparent to one with skill in the art upon examination of the following figures and detailed description. It is intended that all such additional systems, methods, features and advantages be included within this description, be within the scope of the invention, and be protected by the accompanying claims.

Brief Description of the Drawings

[14] The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. In the figures, like reference numerals designate corresponding parts throughout the different views.

[15] FIG. 1 is a block diagram of a gateway cable modem architecture according to the present invention.

[16] FIG. 2 is a functional block diagram implementing the cable modem architecture of FIG. 1.

Detailed Description of the Invention

[17] FIG. 1 illustrates a cable modem system architecture 100 according to the present invention. System 100 comprises three major subsystems: cable modem engine 110; data networking engine 120; and advanced crypto engine 130. The functional sub-components of these three-subsystems are illustrated in greater detail in FIG. 2.

[18] Cable modem engine 110 implements the entire DOCSIS cable modem functionality and is further divided into three functional blocks: DOCSIS PHY layer 112; DOCSIS MAC processor 114 and DOCSIS controller 116. DOCSIS PHY layer 112 comprises a hardware transmitter and receiver. In one implementation, it is for a DOCSIS 2.0-compliant PHY. As seen in FIG. 1, DOCSIS PHY layer 112 receives downstream data, transmits upstream data and receives and transmits voice data from/to an external source. In one implementation, the external source is a HFC (hybrid fiber coax) cable employing both fiber optic and coaxial cable as an effective means for delivering combined data, video, voice, CATV and other communications.

[19] Processor 114 implements real-time critical MAC functions for both upstream (US) and downstream (DS) communications. These functions include US and DS synchronization, DS MAC address filtering, DS protocol filtering, US and DS PHS, concatenation, fragmentation, MAP processing, US transmission scheduling, as well as DOCSIS link-layer DES encryption and decryption. Processor 114 receives downstream data from, provides upstream data to and exchanges voice data in both directions with DOCSIS PHY 112. It also receives upstream data from, and exchanges voice data in both directions with, controller 116. To increase downstream throughput, all processing

of DS PDU (protocol data unit) packets is done within processor 114 without involving controller 116. After being processed, DS PDU packets are forwarded by processor 116 directly to data networking engine 120 along path 118, bypassing controller 116. In one implementation, processor 114 is an ARM9TDMI-based RISC processor. In FIG. 2, processor 114 is represented by MAC DS block 152 and MAC US block 154.

[20] Controller 116 receives US PDU packets from data networking engine 120. As previously described, DS PDU packets are forwarded by processor 114 to data networking engine 120 without involvement of controller 116. In one implementation, controller 116 is an ARM940-based RISC processor. Controller 116 implements the following DOCSIS (blocks 200-212) functions: MAC management message (MMM) processing (ranging, registration, UCD, UCC, DCC, DCI, UP-DIS, DSx and BPI+) (functional block 200 of FIG. 2), IGMP, MAC address learning, classification, US protocol filtering (functional block 202 of FIG. 2) and CM IP stack and software downloading. Functional block 204 carries out cable modem IP/UDP functions, functional block 206 carries out SNMP, DHCP, TFTP and TOD functionality and functional block 208 is responsible for cable modem provisioning. Controller 116 also includes a data network engine driver 210 in communication with data network engine 120 and cable MAC driver 212.

[21] In addition, in order to minimize the latency and jitter of voice packets, controller 116 also implements all PacketCable functionality. In FIG. 2, PacketCable functionality is represented by functional blocks 220-228. These PacketCable functions include provisioning (block 220), security and signaling. Functional blocks 222 (voice DSP

driver), 224 (streamlined IP/UDP/RTP with classification; PHS, IP/LLC filtering) and 226 (voice MAC driver) interface with external voice DSP 119. Additionally MGCP and RTCP functions are provided by functional block 228.

[22] Data networking engine 120 is responsible for all data networking processing including advanced multi-port bridging/routing with NAT/firewall and VPN (block 250) and home networking applications (CableHome, Web Server, etc.) (block 252). In one implementation, the entire embedded portal services (PS) functionality of the CableHome specification is contained within data networking engine 120, with the CableHome functionality being completely decoupled from the PacketCable and and DOCSIS functionality provided by cable modem engine 110. As a result of the virtual de-coupling from cable modem engine 110, data networking engine 120 can be independently software-upgraded without impacting the functionality of cable modem engine 110 (and vice versa).

[23] As seen in FIG. 1, data networking engine is capable of additional CPE functionality such as Ethernet, USB and other LAN I/F communications (802.11, Bluetooth, Powerline, etc.), with appropriate CPE drivers 254, 256, 258 being provided to support such communications. Additionally, cable modem engine driver 260 communicates with cable modem engine 110 and functional block 262 provides SNMP, DHCP, TFTP and TOD functionality.

[24] Advanced crypto engine 130 provides hardware support for crypto functions. These include common crypto functions required by the baseline DOCSIS link-layer

security, PacketCable voice security and data-networking security (e.g. VPN). These functions include DES/3DES, AES and HMAC-MD5/SH-1.

[25] The architecture of gateway cable modem 100 addresses the objectives set forth in the "Background" section above as follows:

[26] **Functional Partitioning.** Cable modem 100 completely partitions data networking functions (advanced bridging/routing, NAT/firewall, VPN, web server and CableHome applications) from DOCSIS cable modem functionality. This is accomplished by localizing data networking functions in the data networking engine processor and localizing cable modem functions in the cable modem engine processor. Additionally, PacketCable VoIP functionality (embedded MTA) is implemented within cable modem engine 110 to address the facts that embedded MTA is closely coupled with cable modem MAC services and that the latency and jitter of voice packets needs to be minimized.

[27] **Flexibility.** Since the data networking and cable modem functions are decoupled and implemented in different processors 110 and 120, independent software upgrading and maintenance of these functions is feasible. From a development standpoint, the architecture can facilitate different software-partnering models, such as complete in-house development, software-components licensing and OEM vendor-differentiating design. In particular, data networking engine 120 provides third parties and OEMs with a dedicated computational platform to develop advanced services outside of the baseline cable modem and VoIP/PacketCable services, minimizing their support dependency on the cable modem provider. Moreover, the software architecture within cable modem

engine 110 is designed in a modular way so that the PacketCable E-MTA can be implemented with minimum impact on the cable modem.

[28] **Performance.** System 100 is able to support a large number of simultaneous data-application sessions originated from/terminated on multiple CPE devices. Its performance is enhanced by the pipe-lining nature of system 100: the processing-intensive functions of the cable modem and data networking are rationally distributed among three different processors: DOCSIS MAC processor 114 (ARM#2); DOCSIS controller 116 (ARM#1); and data networking engine 120 (ARM#3), according to their orders in the packet flow. To further boost downstream throughput, the downstream PDU packets are directly forwarded from the DOCSIS MAC processor 114 to the data networking engine 120 without going through DOCSIS conroller 116. This is made possible by exploiting the asymmetric nature of the DOCSIS US/DS 152 and 154. In addition, the data path for voice packets is laid entirely within cable modem engine 110 and is optimized to reduce delay and jitter.

[29] **Cost.** A chip implementing cable modem system 100 will have only a small incremental hardware cost/functional increase over current stand-alone cable modem chips. The major cost difference relative to current chips is the addition of another ARM940-type processor to the chip.

[30] **Software Re-Use.** Existing cable modem software may be carried over to system 100 without major or drastic changes. Existing software running on PCD network processors may be easily ported to run on data networking engine 120 without major adaptation.

[31] While various embodiments of the invention have been described, it will be apparent to those of ordinary skill in the art that many more embodiments and implementations are possible that are within the scope of this invention.

What is claimed is:

1. A cable modem system comprising:

a data networking engine that performs data networking functions; and

a cable modem engine that performs all other cable modem functions; the cable modem engine being completely partitioned from the data networking engine.

2. A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine that performs all crypto functions.

5. A cable modem system as claimed in claim 1, wherein the cable modem engine comprises:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller.

6. A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer comprises a hardware transmitter and receiver.

7. A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor processes downstream PDU packets and forwards the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. A cable modem system as claimed in claim 5, wherein the data networking engine is responsible for all data networking processing including advanced multi-port briding/routing with NAT/firewall and VPN, and home networking applications.

11. A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. A cable modem architecture comprising:

a cable modem engine comprising:

a DOCSIS PHY layer comprising a transmitter and receiver;

a DOCSIS MAC processor that implements real-time critical MAC functions for both upstream and downstream communications; and

a DOCSIS controller implementing VoIP functionality; and

a data networking engine implementing all data networking processing and home networking applications, wherein the data networking engine is completely decoupled from the cable modem engine.

13. A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller provides VoIP functionality in accordance with the PacketCable specification, and wherein the data networking engine provides the embedded portal services functionality of the CableHome specification, wherein the CableHome functionality is provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. A method for providing a flexible and partitioned cable modem gateway comprising:

providing data and home networking functionality in a data networking engine;

providing DOCSIS and VoIP functionality in a cable modem engine; and

partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

PATENT
PCHS Matter No. 109822-95
02CXT0070D

ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

Abstract

[32] A cable modem system and architecture. A cable modem engine performs all cable modem functions, and a data networking engine performs all data and home networking functions. The cable modem engine is completely partitioned from the data networking engine. DOCSIS and VoIP functionality is implemented in the cable modem engine. The VoIP functionality may be in accordance with the PacketCable specification. The data networking functionality provided by the data networking engine may be in accordance with the CableHome specification.

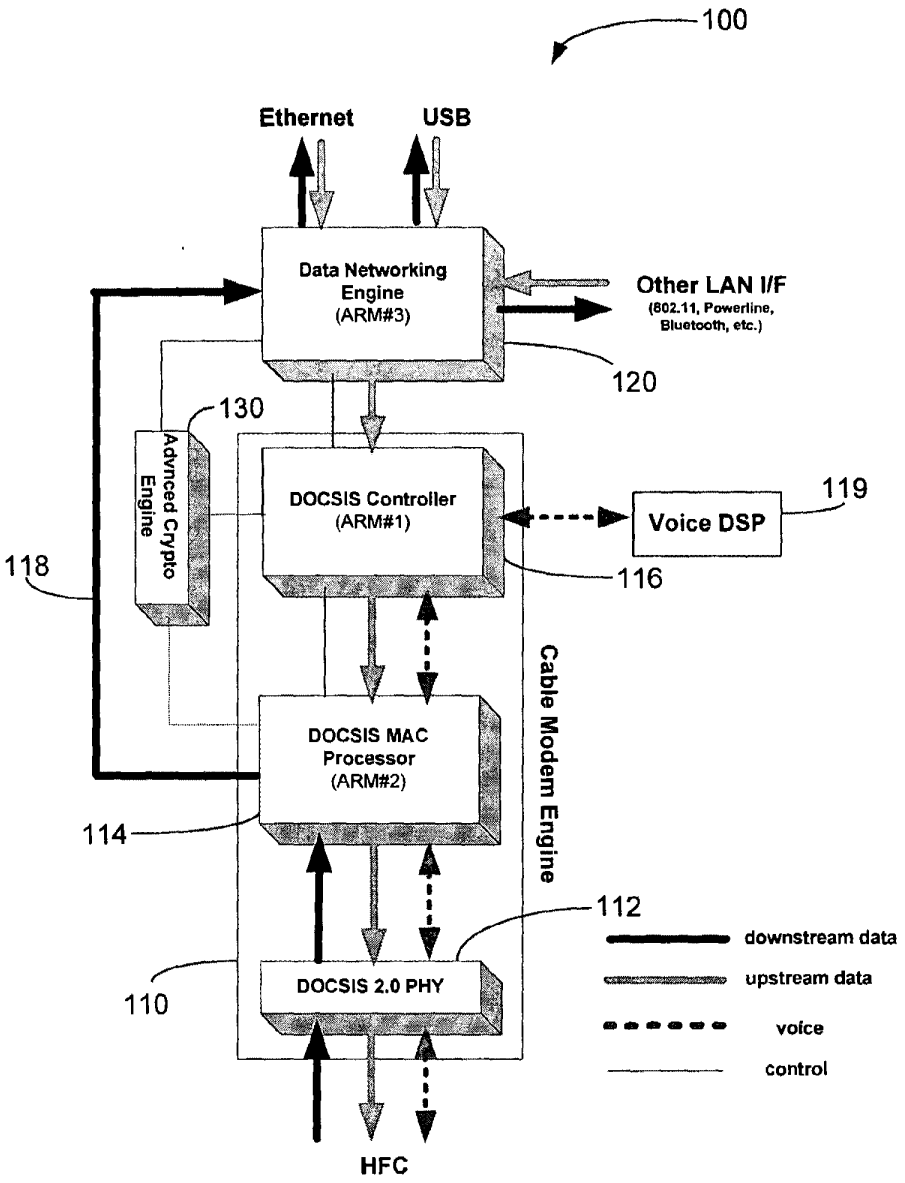

100
Ethernet
USB
Data Networking Engine (ARM#3)
Other LAN I/F
(802.11, Powerline, Bluetooth, etc.)
120
130
Advnced Crypto Engine
DOCSIS Controller (ARM#1)
Voice DSP
119
118
116
Cable Modem Engine
DOCSIS MAC Processor (ARM#2)
114
112
DOCSIS 2.0 PHY
110
HFC
downstream data
upstream data
voice
control

Figure 1

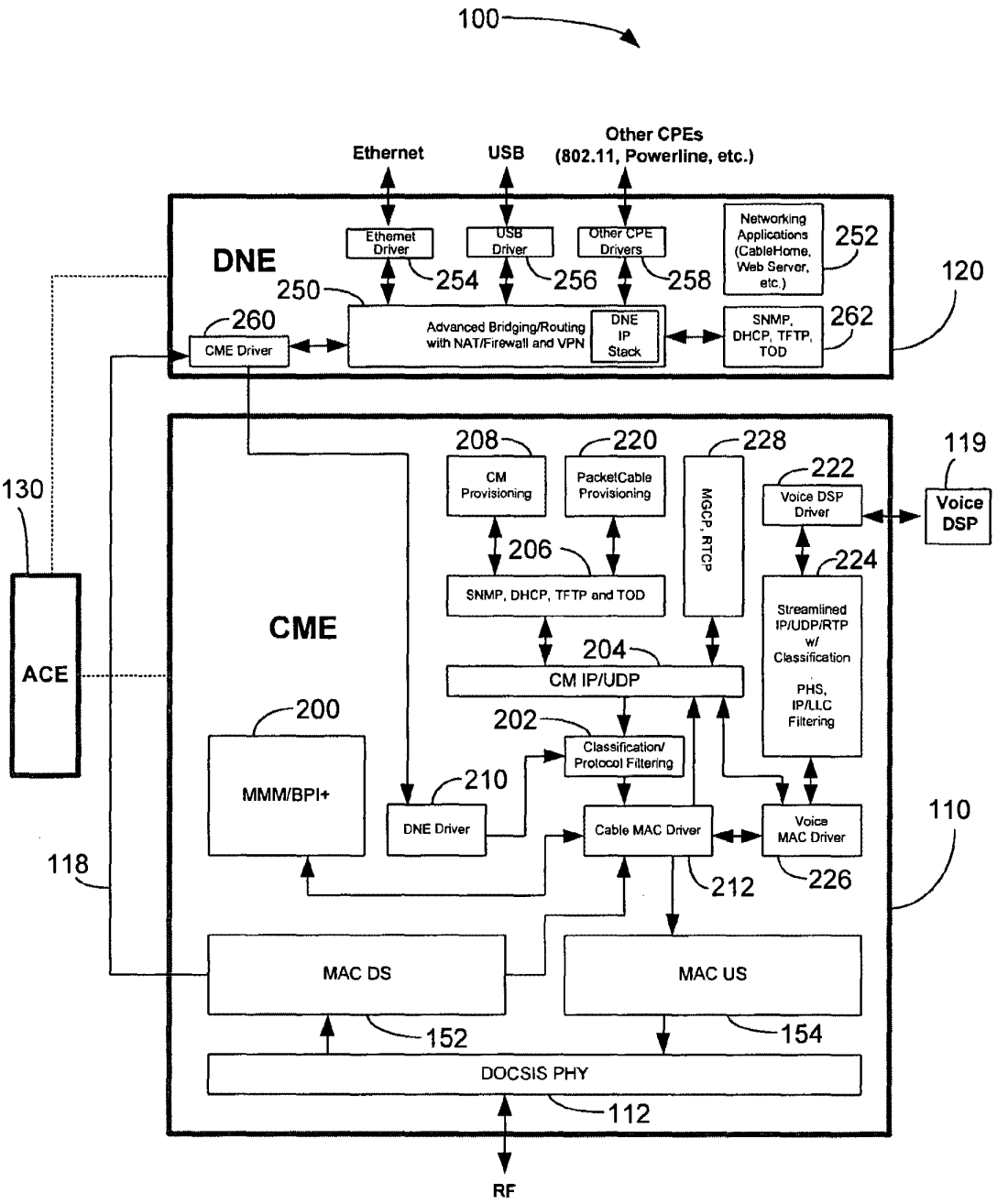

100
Ethernet
USB
Other CPEs
(802.11, Powerline, etc.)
DNE
Ethernet Driver
USB Driver
Other CPE Drivers
Networking Applications (CableHome, Web Server, etc.)
252
120
250
254
256
258
260
CME Driver
Advanced Bridging/Routing with NAT/Firewall and VPN
DNE IP Stack
SNMP, DHCP, TFTP, TOD
262
208
220
228
119
130
CM Provisioning
PacketCable Provisioning
MGCP, RTCP
222
Voice DSP Driver
Voice DSP
206
224
SNMP, DHCP, TFTP and TOD
CME
Streamlined IP/UDP/RTP w/ Classification
PHS, IP/LLC Filtering
204
CM IP/UDP
ACE
200
202
Classification/ Protocol Filtering
MMM/BPI+
210
DNE Driver
Cable MAC Driver
Voice MAC Driver
110
118
212
226
MAC DS
MAC US
152
154
DOCSIS PHY
112
RF

Figure 2

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2003

Application or Docket Number: 10675566

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	15	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	15 minus 20=	*
INDEPENDENT CLAIMS	3 minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	385.00	OR	BASIC FEE	770.00
X$ 9=		OR	X$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL		OR	TOTAL	770

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875 (Rev. 10/03) Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
10/675,566	09/30/2003	Gordon G. Li	

CONFIRMATION NO. 9980

27189
PROCOPIO, CORY, HARGREAVES & SAVITCH LLP
530 B STREET
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SAN DIEGO, CA 92101

FORMALITIES LETTER

OC000000011576390

Date Mailed: 12/29/2003

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
  Applicant must submit $ **770** *to complete the basic filing fee for a non-small entity. If appropriate, applicant may make a written assertion of entitlement to small entity status and pay the small entity filing fee (37 CFR 1.27).*
- The oath or declaration is missing.
  A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(e) of $130 for a non-small entity, must be submitted with the missing items identified in this letter.

SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is **$900** for a Large Entity

- **$770** Statutory basic filing fee.
- **$130** Late oath or declaration Surcharge.

Replies should be mailed to: Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

A copy of this notice MUST be returned with the reply.

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Initial Patent Examination Division (703) 308-1202
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OIPE JC141 MAR 01 2004 PATENT & TRADEMARK OFFICE

PTO/SB/21 (02-04)
Approved for use through 07/31/2006. OMB 0651-0031
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	10/675,566
Filing Date	09/30/2003
First Named Inventor	Gordon Y. Li
Art Unit	2833
Examiner Name	TBA
Total Number of Pages in This Submission: 14	Attorney Docket Number: 109822-95

ENCLOSURES *(Check all that apply)*

- ☒ Fee Transmittal Form
  - ☒ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☒ Response to Missing Parts/ Incomplete Application
  - ☒ Response to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s)
- ☐ After Allowance communication to Group
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to Group **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☒ Other Enclosure(s) (please Identify below): Power of Attorney, Assignment with Recordation Cover Sheet and check return receipt postcards

Remarks
Enclosures:

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Or Individual name	Troy M. Schmelzer, Reg. No. 36,667
Signature	
Date	2/27/04

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below.

Typed or printed name	Shari Herron		
Signature	Shari Herron	Date	2/27/04

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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www.USCourtForms.com

OIPE MAR 0 1 2004 PATENT & TRADEMARK OFFICE

PTO/SB/17 (10-03)
Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 940.00

Complete if Known	
Application Number	10/675,566
Filing Date	09/30/2003
First Named Inventor	Gordon Y. Li
Examiner Name	TBA
Art Unit	2833
Attorney Docket No.	109822-95

METHOD OF PAYMENT *(check all that apply)*

☒ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☐ Deposit Account:

Deposit Account Number: Procopio Cory Hargreaves & Savitch

Deposit Account Name: 50-2075

The Director is authorized to: *(check all that apply)*

☐ Charge fee(s) indicated below ☒ Credit any overpayments

☒ Charge any additional fee(s) or any underpayment of fee(s)

☐ Charge fee(s) indicated below, **except for the filing fee** to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	770.00
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

SUBTOTAL(1) ($) 770.00

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

		Extra Claims		Fee from below	Fee Paid
Total Claims	-20** =		X		=
Independent Claims	-3** =		X		=
Multiple Dependent					=

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

***or number previously paid, if greater; For Reissues, see above*

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	130.00
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
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1401	330	2401	165	Notice of Appeal	
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1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
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1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	40.00
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		2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
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1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	
Other fee (specify)					

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 940.00

SUBMITTED BY				(Complete *(if applicable)*	
Name (Print/Type)	Troy M. Schmelzer	*Registration No. (Attorney/Agent)*	36,667	*Telephone*	619-238-1900
Signature				*Date*	2/27/04

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

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American LegalNet, Inc. www.USCourtForms.com

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
10/675,566	09/30/2003	Gordon G. Li	

CONFIRMATION NO. 9980

27189
PROCOPIO, CORY, HARGREAVES & SAVITCH LLP
530 B STREET
SUITE 2100
SAN DIEGO, CA 92101

FORMALITIES LETTER

OC000000011576390

Date Mailed: 12/29/2003

OIPE JC141 MAR 0 1 2004 PATENT & TRADEMARK OFFICE

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
  Applicant must submit $ **770** *to complete the basic filing fee for a non-small entity. If appropriate, applicant may make a written assertion of entitlement to small entity status and pay the small entity filing fee (37 CFR 1.27).*
- The oath or declaration is missing.
  A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(e) of $130 for a non-small entity, must be submitted with the missing items identified in this letter.

SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is **$900** for a Large Entity

- **$770** Statutory basic filing fee.
- **$130** Late oath or declaration Surcharge.

Replies should be mailed to: Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

03/04/2004 MBERHE 00000066 10675566
01 FC:1001 770.00 OP
02 FC:1051 130.00 OP

A copy of this notice MUST be returned with the reply.

Customer Service Center
Initial Patent Examination Division (703) 308-1202
PART 2 - COPY TO BE RETURNED WITH RESPONSE

O.I.P.E. JC141 MAR 0 1 2004 PATENT & TRADEMARK OFFICE

PATENT
PCHS Ref. 109822-95
02CXT0070D

DECLARATION FOR UTILITY PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

the specification of which

☐ is attached hereto

OR

☒ was filed on September 30, 2003 as United States Application Serial No. 10/675,566 or PCT International Application No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 USC 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application Number(s)	Country	Date of Filing	Priority Claimed Yes	No

I hereby claim the benefit under 35 USC 119(e) of any United States provisional application(s) listed below:

Application Number(s)	Filing Date

I hereby claim the benefit under 35 USC 120 of any United States application(s), or 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of any claim of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

U.S. Parent Application Number	PCT Parent Number	Parent Filing Date	Status-Patented, Pending or Abandoned

PATENT
PCHS Matter No. 109822-95
02CXT0070D

Please direct all correspondence to Troy Schmelzer at Customer Number 27189:

PROCOPIO, CORY, HARGREAVES & SAVITCH, LLP
530 B Street, Suite 2100
San Diego, CA 921010-4469
Tel: 619-238-1900
Fax: 619-235-0398

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 USC 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF INVENTOR	FIRST Name Gordon		MIDDLE Initial Y.	LAST Name Li	
RESIDENCE & CITIZENSHIP	City San Diego		State or Foreign Country California	Country of Citizenship Canada	
POST OFFICE ADDRESS	Street 12346 Pathos Lane		City San Dieog	State or Country California	Zip Code 92129
INVENTOR'S SIGNATURE	Gordon Li			DATE	Nov. 12, '03

109822.000095/430534.01

PATENT
PCHS Matter No. 109822-95
02CXT0070D

FULL NAME OF INVENTOR	FIRST Name Yoav	MIDDLE Initial	LAST Name Hebron		
RESIDENCE & CITIZENSHIP	City San Diego	State or Foreign Country California	Country of Citizenship United States		
POST OFFICE ADDRESS	Street 6215 Radcliffe Drive	City San Diego	State or Country California	Zip Code 92122	

INVENTOR'S SIGNATURE _____ DATE 11/12/03

109822.000095/430534.01

ENTROPIC_CHARTER_0005475

MAR 01 2004
PATENT & TRADEMARK OFFICE

PATENT
PCHS Matter No. 109822-95
02CXT0070D

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Gordon G. Li and Yoav Hebron

Serial No. 10/675,566

Filed: September 30, 2003

For: Architecture for a Flexible and High-performance Gateway Cable Modem

POWER OF ATTORNEY

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Conexant Systems, Inc., assignee of the captioned patent application, hereby appoints as its attorneys and/or agents, with full power of substitution and revocation, to prosecute this application and transact all business in the United States Patent and Trademark Office and in countries other than the United States, and to do all things necessary or appropriate therefor before any competent international authorities in connection with any international patent applications corresponding to the captioned application, Sam Talpalatsky, Reg. No. 35,380, Joseph H. Lee, Reg. No. 37,664, and all of the registered practitioners identified by Customer Number 27189.

Please direct all correspondence to Troy M. Schmelzer at Customer No. 27189:

27189
PATENT TRADEMARK OFFICE

PROCOPIO, CORY, HARGREAVES & SAVITCH LLP
530 B Street, Suite 2100
San Diego, CA 92101-4469
Tel: (619) 238-1900
Fax: (619) 235-0398

The undersigned is authorized to sign this document on behalf of Conexant Systems, Inc.

Respectfully submitted,

Conexant Systems, Inc.

Dated: 12.4.03

By: Sam Talpalatsky
Sam Talpalatsky

109822.000095/434391.01

OIPE JC141 MAR 01 2004 PATENT & TRADEMARK OFFICE

PTO/SB/21 (02-04)
Approved for use through 07/31/2006. OMB 0651-0031
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	10/675,566
Filing Date	09/30/2003
First Named Inventor	Gordon Y. Li
Art Unit	2833
Examiner Name	TBA
Total Number of Pages in This Submission: 14	Attorney Docket Number: 109822-95

ENCLOSURES *(Check all that apply)*

- ☒ Fee Transmittal Form
  - ☒ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
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- ☐ Petition
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- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s)
- ☐ After Allowance communication to Group
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to Group **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☒ Other Enclosure(s) (please Identify below): Power of Attorney, Assignment with Recordation Cover Sheet and check return receipt postcards

Remarks
Enclosures:

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Or Individual name	Troy M. Schmelzer, Reg. No. 36,667
Signature	
Date	2/27/04

CERTIFICATE OF TRANSMISSION/MAILING

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Typed or printed name	Shari Herron		
Signature	Shari Herron	Date	2/27/04

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PTO/SB/17 (10-03)
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FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 940.00

Complete if Known	
Application Number	10/675,566
Filing Date	09/30/2003
First Named Inventor	Gordon Y. Li
Examiner Name	TBA
Art Unit	2833
Attorney Docket No.	109822-95

METHOD OF PAYMENT *(check all that apply)*

☒ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☐ Deposit Account:

Deposit Account Number: Procopio Cory Hargreaves & Savitch

Deposit Account Name: 50-2075

The Director is authorized to: *(check all that apply)*

☐ Charge fee(s) indicated below ☒ Credit any overpayments

☒ Charge any additional fee(s) or any underpayment of fee(s)

☐ Charge fee(s) indicated below, **except for the filing fee** to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

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SUBTOTAL(1) ($) 770.00

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

		Extra Claims		Fee from below	Fee Paid
Total Claims	-20** =		X		=
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SUBTOTAL (2) ($)

***or number previously paid, if greater; For Reissues, see above*

FEE CALCULATION (continued)

3. ADDITIONAL FEES

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		2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
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1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	
Other fee (specify)					

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 940.00

SUBMITTED BY				(Complete *(if applicable)*	
Name (Print/Type)	Troy M. Schmelzer	*Registration No. (Attorney/Agent)*	36,667	*Telephone*	619-238-1900
Signature				*Date*	2/27/04

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
10/675,566	09/30/2003	Gordon G. Li	

CONFIRMATION NO. 9980

27189
PROCOPIO, CORY, HARGREAVES & SAVITCH LLP
530 B STREET
SUITE 2100
SAN DIEGO, CA 92101

FORMALITIES LETTER

OC000000011576390

Date Mailed: 12/29/2003

OIPE JC141 MAR 0 1 2004 PATENT & TRADEMARK OFFICE

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

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  Applicant must submit $ **770** *to complete the basic filing fee for a non-small entity. If appropriate, applicant may make a written assertion of entitlement to small entity status and pay the small entity filing fee (37 CFR 1.27).*
- The oath or declaration is missing.
  A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(e) of $130 for a non-small entity, must be submitted with the missing items identified in this letter.

SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is **$900** for a Large Entity

- **$770** Statutory basic filing fee.
- **$130** Late oath or declaration Surcharge.

Replies should be mailed to: Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

03/04/2004 MBERHE 00000066 10675566
01 FC:1001 770.00 OP
02 FC:1051 130.00 OP

A copy of this notice MUST be returned with the reply.

Customer Service Center
Initial Patent Examination Division (703) 308-1202
PART 2 - COPY TO BE RETURNED WITH RESPONSE

FORM PTO-1083

PATENT
88537.0065



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:
Gordon Taylor et al.
Serial No: 10/675,566
Confirmation No.: 9980
Filed: September 30, 2003
For: ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

Art Unit: 2833
Examiner: Not Assigned

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450, on
October 26, 2004
Date of Deppsit
Joyce Hegeman
Name
Signature
October 26, 2004
Date

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Transmitted in the above-identified application is the following:

☒ Power of Attorney By Assignee of Entire Interest and Change of Correspondence Address

☒ Return postcard

☒ The Commissioner is hereby authorized to charge any deficiencies of fees associated with this communication or credit any overpayment to Deposit Account No. 50-1314. **A copy of this sheet is enclosed.**
- ☒ Any filing fees under 37 C.F.R. § 1.16 for the presentation of extra claims
- ☒ Any patent application processing fees under 37 C.F.R. § 1.17

Respectfully submitted,
HOGAN & HARTSON L.L.P.

Date: October 26, 2004

By: _____
Troy M. Schmelzer
Registration No. 36,667
Attorney for Applicant(s)

Biltmore Tower
500 South Grand Avenue, Suite 1900
Los Angeles, California
90071
Telephone: 213 337-6700
Facsimile: 213 337-6701

\\LA - 88537/0065 - 219246 v1



PATENT
88357.0002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Matters of:

Assignee: Conexant Systems, Inc.

Please see Schedule A (attached)

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450, on
7.14.04
Date of Deposit
Joyce Hegeman
Name
Signature 7.14.04
Date

POWER OF ATTORNEY BY ASSIGNEE OF ENTIRE INTEREST AND CHANGE OF CORRESPONDENCE ADDRESS

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Conexant Systems, Inc., assignee of the patent applications listed on the attached Schedule A, revokes all previous powers of attorney or authorizations of agent and appoints as its attorneys and/or agents, with full power of substitution and revocation, to prosecute these applications and transact all business in the United States Patent and Trademark Office, and in countries other than the United States, and to do all things necessary or appropriate therefore before any competent international authorities in connection with any international patent applications and patents corresponding to these applications:

Troy M. Schmelzer, Reg. No. 36,667; Stuart Lubitz, Reg. No. 20,680; Anthony J. Orler, Reg. No. 41,232; Lawrence J. McClure, Reg. No. 44,228; Barry Shuman, Reg. No. 50,220; Jeffrey Hopkins, Reg. No. 53,034; Yanan Luo, Reg. No. 54,284; Olga Berson, Reg. No. 55,001; Sam Talpalatsky, Reg. No. 35,380; and Joseph H. Lee, Reg. No. 37,664.

Please direct all correspondence in the applications listed in the attached Schedule A to:

Troy M. Schmelzer
HOGAN & HARTSON L.L.P.
500 South Grand Avenue, Suite 1900
Los Angeles, California 90071
Phone: 213-337-6700
Fax: 213-337-670

Date: 7-9-04

Sam Talpalatsky
IP Counsel
Conexant Systems, Inc.
4000 MacArthur Road
Department 927, K10-171
Newport Beach, CA 92660

SCHEDULE A



1	U.S. Application No. 09/239,501
2	U.S. Application No. 09/828,568
3	U.S. Application No. 09/634,265
4	U.S. Application No. 09/588,992
5	U.S. Application No. 10/786,921
6	U.S. Application No. 10/210,591
7	U.S. Application No. 10/214,960
8	U.S. Application No. 10/245,982
9	U.S. Application No. 10/000,878
10	U.S. Application No. 09/865,300
11	U.S. Application No. 09/428,953
12	U.S. Application No. 09/537,967
13	U.S. Application No. 10/325,618
14	U.S. Application No. 10/353,538
15	U.S. Application No. 10/376,824
16	U.S. Application No. 09/989,100
17	U.S. Application No. 09/547,424
18	U.S. Application No. 10/637,324
19	U.S. Application No. 10/675,566
20	U.S. Application No. 10/677,110
21	U.S. Application No 10/676,900
22	U.S. Application No. 10/749,571
23	U.S. Application No. 10/749,570

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	109822-95

CONFIRMATION NO. 9980

OC000000014379272

OC000000014379272

TROY M SCHMELZER
HOGAN & HARTSON
500 SOUTH GRAND AVENUE
SUITE 1900
LOS ANGELES, CA 90071

Date Mailed: 11/16/2004

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/01/2004.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

TRACEY M YOUNG
2800 (571) 272-1644

OFFICE COPY

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	109822-95

CONFIRMATION NO. 9980

OC000000014379227
OC000000014379227

27189
PROCOPIO, CORY, HARGREAVES & SAVITCH LLP
530 B STREET
SUITE 2100
SAN DIEGO, CA 92101

Date Mailed: 11/16/2004

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/01/2004.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

TRACEY M YOUNG
2800 (571) 272-1644

OFFICE COPY

PLUS Search Results for S/N 10675566, Searched Mon Jul 30 12:49:22 EDT 2007

The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

20050071492 76
20060280197 58
7164690 54
20010030975 54
6629288 52
20020073431 52
20020196796 50

PLUS Search Results for S/N 10675566, Searched Mon Jul 30 12:49:37 EDT 2007

The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

6434141 99
20050071492 99
6011548 88
6802032 88
6941576 88
7127734 88
20020013852 88
20020075806 88
20040107445 88
20040253945 88
20050005154 88
20050055708 88
6629288 81
6763025 81
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7113502 81
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7194001 81
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20060256799 79
6230326 72
4783137 72
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5994998 72
6006318 72
6017238 72
6019630 72
6026150 72

PTO/SB/81 (07-08)
Approved for use through 12/31/2008. OMB 0651-0035
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POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	10675566
Filing Date	Sep 30, 2003
First Named Inventor	Gordon Li
Title	Architecture for a flexible and high-performance gateway cable modem
Art Unit	2153
Examiner Name	LIM, KRISNA
Attorney Docket Number	109822-95

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

65913

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant/Inventor.

OR

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) (Form PTO/SB/96) submitted herewith or filed on _____.

SIGNATURE of Applicant or Assignee of Record

Signature	/Peter Zawilski/	Date	Sep 17, 2008
Name	Peter S. Zawilski, Reg. No. 43,305	Telephone	(408) 474-9063
Title and Company	Authorized Representative, NXP, B.V.		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/96 (09-06)
Approved for use through 03/31/2007. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: NXP, B.V.

Application No./Patent No.: 10675566 Filed/Issue Date: Sep 30, 2003

Entitled: Architecture for a flexible and high-performance gateway cable modem

NXP, B.V., a corporation
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. [X] the assignee of the entire right, title, and interest; or

2. [ ] an assignee of less than the entire right, title and interest
(The extent (by percentage) of its ownership interest is_____ %)

in the patent application/patent identified above by virtue of either:

A. [X] An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 021531, Frame 0523, or for which a copy thereof is attached.

OR

B. [ ] A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

3. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

[ ] Additional documents in the chain of title are listed on a supplemental sheet.

[ ] As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Peter Zawilski/	Sep 17, 2008
Signature	Date
Peter S. Zawilski, Reg. No. 43,305	(408) 474-9063
Printed or Typed Name	Telephone Number
Authorized Representative	
Title	

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	3961639
Application Number:	10675566
International Application Number:	
Confirmation Number:	9980
Title of Invention:	Architecture for a flexible and high-performance gateway cable modem
First Named Inventor/Applicant Name:	Gordon Y. Li
Customer Number:	26021
Filer:	Peter Zawilski
Filer Authorized By:	
Attorney Docket Number:	109822-95
Receipt Date:	17-SEP-2008
Filing Date:	30-SEP-2003
Time Stamp:	20:25:02
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	10675566_SB-81_96_XML-Combo_2008-SEP-17.pdf	42541 6a4d7fcfcf44fc5f10c019a4266ad6ac241f761e2	no	2
Warnings:					
Information:					

Total Files Size (in bytes):	42541

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	109822-95

CONFIRMATION NO. 9980

65913
NXP, B.V.
NXP INTELLECTUAL PROPERTY DEPARTMENT
M/S41-SJ
1109 MCKAY DRIVE
SAN JOSE, CA 95131

POA ACCEPTANCE LETTER

OC000000032246462

Date Mailed: 09/26/2008

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/17/2008.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/sleutchit/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	109822-95

CONFIRMATION NO. 9980

26021
HOGAN & HARTSON L.L.P.
1999 AVENUE OF THE STARS
SUITE 1400
LOS ANGELES, CA 90067

POWER OF ATTORNEY NOTICE

OC000000032246436

Date Mailed: 09/26/2008

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/17/2008.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/sleutchit/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

To: ip.department.us@nxp.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 65913

Sep 26, 2008 05:52:38 AM

Dear PAIR Customer:

NXP, B.V.
NXP INTELLECTUAL PROPERTY DEPARTMENT
M/S41-SJ
1109 MCKAY DRIVE
SAN JOSE, CA 95131
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 65913 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:
The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
10675566	N570	09/26/2008	109822-95
	N570	09/26/2008	109822-95

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D	9980

65913 7590 02/19/2009

NXP, B.V.
NXP INTELLECTUAL PROPERTY DEPARTMENT
M/S41-SJ
1109 MCKAY DRIVE
SAN JOSE, CA 95131

EXAMINER	
HOSSAIN, TANIM M	
ART UNIT	**PAPER NUMBER**
2445	

NOTIFICATION DATE	DELIVERY MODE
02/19/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ip.department.us@nxp.com

Office Action Summary	Application No.	Applicant(s)	
	10/675,566	LI ET AL.	
	Examiner	Art Unit	
	Tanim Hossain	2445	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 September 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *30 September 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-15 are rejected under 35 U.S.C. 102(e) as being anticipated by Brooks (U.S. 2001/0039600)

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

As per claim 1, Brooks teaches a cable modem system comprising: a data networking engine that performs data networking functions (Abstract; paragraphs 0013-0016); and a cable modem engine that performs all other cable modem functions (Abstract; paragraphs 0013-0016); the cable modem engine being completely partitioned from the data networking engine (Abstract; paragraphs 0013-0016).

As per claim 2, Brooks teaches a cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine (0024-0026).

As per claim 3, Brooks teaches a cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine (0024-0026).

As per claim 4, Brooks teaches a cable modem system as claimed in claim 1, and further comprising an advanced crypto engine that performs all crypto functions (0013).

As per claim 5, Brooks teaches a cable modem system as claimed in claim 1, wherein the cable modem engine comprises: a DOCSIS PHY layer (0024-0026); a DOCSIS MAC processor (0024-0026); and a DOCSIS controller (0024-0026).

As per claim 6, Brooks teaches a cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer comprises a hardware transmitter and receiver (0024-0026).

As per claim 7, Brooks teaches a cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor processes downstream PDU packets and forwards the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput (0024-0026).

As per claim 8, Brooks teaches a cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller (0024-0026).

As per claim 9, Brooks teaches a cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification (0024-0026).

As per claim 10, Brooks teaches a cable modem system as claimed in claim 5, wherein the data networking engine is responsible for all data networking processing including advanced

multi-port briding/routing with NAT/firewall and VPN, and home networking applications (0024-0026).

As per claim 11, Brooks teaches a cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification (0024-0026).

As per claim 12, Brooks teaches a cable modem architecture comprising: a cable modem engine comprising: a DOCSIS PHY layer comprising a transmitter and receiver (0024-0026); a DOCSIS MAC processor that implements real-time critical MAC functions for both upstream and downstream communications (0024-0026); and a DOCSIS controller implementing VoIP functionality (0024-0026); and a data networking engine implementing all data networking processing and home networking applications, wherein the data networking engine is completely decoupled from the cable modem engine (0024-0026).

As per claim 13, Brooks teaches a cable modem architecture as claimed in claim 12, wherein the DOCSIS controller provides VoIP functionality in accordance with the PacketCable specification, and wherein the data networking engine provides the embedded portal services functionality of the CableHome specification, wherein the CableHome functionality is provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine (0013-0016, 0024-0026).

As per claim 14, Brooks teaches a cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor (0013-0016, 0024-0026).

As per claim 15, Brooks teaches a method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VolP functionality in a cable modem engine (0013-0016, 0024-0026); and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VolP functionality (0013-0016, 0024-0026).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tanim Hossain whose telephone number is (571)272-3881. The examiner can normally be reached on 8:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenton Burgess can be reached on 571/272-3949. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Tanim Hossain
Patent Examiner
Art Unit 2445
/Larry D Donaghue/
Primary Examiner, Art Unit 2454

Notice of References Cited	Application/Control No. 10/675,566	Applicant(s)/Patent Under Reexamination LI ET AL.	
	Examiner Tanim Hossain	Art Unit 2445	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2001/0039600	11-2001	Brooks et al.	710/126
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10675566	LI ET AL.
	Examiner	**Art Unit**
	Tanim Hossain	2445

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/16/2009								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10675566	LI ET AL.
	Examiner	Art Unit
	Tanim Hossain	2445

SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
EAST	2/16/09	TH

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	28271	cable$4 near2 modem $4	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:09
S2	2625	(cable$4 near2 modem $4) and docsis	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:09
S3	482	(cable$4 near2 modem $4).ab. and docsis	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:10
S4	91	(cable$4 near2 modem $4).ab. and docsis and ((integrat$4 with (function $4 or service $4) same modem$4))	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:12
S5	21	(cable$4 near2 modem $4).ab. and docsis and ((integrat$4 with (function $4 or service $4) same modem$4)) and partition $4	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:12

ENTROPIC_CHARTER_0005505

S6	13	(cable$4 near2 modem $4).ab. and docsis and ((integrat$4 with (function $4 or service $4) same modem$4)) and partition $4 and voip $4	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:12
S7	230	(cable$4 near2 modem $4).ab. and docsis and ((integrat$4 or multipl$4 or pluralit$4) with (function $4 or service $4) same modem$4)	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:25
S8	35	(cable$4 near2 modem $4).ti. and docsis and ((integrat$4 with (function $4 or service $4) same modem$4))	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:26
S9	94	(cable$4 near2 modem $4).ti. and docsis and ((integrat$4 or multipl$4 or pluralit$4) with (function $4 or service $4) same modem$4)	US-PGPUB; USPAT	OR	OFF	2009/02/16 05:27

2/16/09 12:08:56 PM
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ENTROPIC_CHARTER_0005506

\10675566 Li - Multiple Function Cable Modem.wsp

ENTROPIC_CHARTER_0005507

To: ip.department.us@nxp.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 65913

Feb 19, 2009 05:49:24 AM

Dear PAIR Customer:

NXP, B.V.
NXP INTELLECTUAL PROPERTY DEPARTMENT
M/S41-SJ
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SAN JOSE, CA 95131
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 65913 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

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Application	Document	Mailroom Date	Attorney Docket No.
10675566	CTNF	02/19/2009	81373818US01-02CXT0070D
	892	02/19/2009	81373818US01-02CXT0070D

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UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Confirmation No. 9980

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	LI *et al.*	Examiner:	Hossain, Tanim
Serial No.:	10/675,566	Group Art Unit:	2445
Filed:	September 30, 2003	Docket No.:	81373818US01 (NXPS.615PA)
Title:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM		

AMENDMENT AND RESPONSE TO OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Customer No.
65913

Dear Sir:

In acknowledgement of the non-final Office Action dated February 19, 2009, please reconsider the application in view of the following amendments and remarks.

A complete listing of the claims, including any amendments, and Remarks/Arguments follow.

In the Claims:

Please amend the claims as indicated below.

1. (Currently Amended) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform ~~that performs~~ home ~~data~~ networking functions including interfacing with customer provided equipment; ~~and~~

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable mode engine to perform ~~that performs all other~~ cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and

a data bus that connects the data networking engine to the cable modem engine,

wherein the cable modem functions performed by the cable modem engine are ~~being~~ completely partitioned from the home networking functions performed by the data networking engine.

2. (Original) A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. (Original) A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. (Currently Amended) A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine configured to perform ~~that performs~~ all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem

engine.

5. (Currently Amended) A cable modem system as claimed in claim 1, wherein the cable modem engine includes ~~comprises~~:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller, and

wherein the at least one processor of the data networking engine is a RISC processor.

6. (Currently Amended) A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer includes ~~comprises~~ a hardware transmitter and receiver.

7. (Currently Amended) A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor is configured to process ~~processes~~ downstream PDU packets and forward ~~forwards~~ the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. (Original) A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. (Original) A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. (Currently Amended) A cable modem system as claimed in claim 5, wherein the data networking engine is configured to perform ~~responsible for~~ all data networking processing including advanced multi-port bridging ~~briding~~/routing with NAT/firewall and VPN, and home networking applications.

11. (Original) A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. (Currently Amended) A cable modem architecture comprising:

a cable modem engine that includes ~~comprises~~:

a DOCSIS PHY layer comprising a transmitter and receiver;

a DOCSIS MAC processor configured to implement ~~that implements~~ real-time critical MAC functions for both upstream and downstream communications; and

a DOCSIS controller configured to implement ~~implementing~~ VoIP functionality; and

a data networking engine that includes a RISC processor configured to implement ~~implementing~~ all data networking processing and home networking applications, wherein the implementation of the data networking processing and home networking applications by the data networking engine is completely decoupled from the implementation of the MAC functions and the VoIP functionality by the cable modem engine.

13. (Currently Amended) A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller is configured to provide ~~provides~~ VoIP functionality in accordance with the PacketCable specification, ~~and~~ wherein the data networking engine is configured to provide ~~provides~~ the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality ~~is~~ provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. (Original) A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. (Original) A method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VoIP functionality in a cable modem engine; and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

16. (New) A cable modem system as claimed in claim 5, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

Remarks

In the non-final Office Action dated February 19, 2009, the following grounds of rejection are presented: claims 1-15 stand rejected under 35 U.S.C. § 102(e) over Brooks (U.S. Patent Pub. 2001/0039600). In the following discussion, Applicant does not acquiesce in any regard to averments in this Office Action (unless Applicant expressly indicates otherwise).

Applicant respectfully traverses the § 102(e) rejection of claims 1-15 because the cited portions of the '600 reference do not correspond to aspects of the claimed invention directed to the data networking functions performed by a data networking engine being completely partitioned/decoupled from the other cable modem functions performed by a cable modem engine. The cited portions of the '600 reference teach a cable modem device 100 that includes two separate processors 102 and 104 (*see, e.g.,* Figure 1 and paragraphs 0024-0026, which are apparently being asserted as corresponding to the DOCSIS MAC processor and the DOCSIS controller of Applicant's cable modem engine (*see, e.g.,* claims 5-14). Applicant submits that the '600 reference does not teach a separate data networking engine (as claimed) that implements certain functionality in a manner that is completely partitioned/decoupled from the functionality performed by processors 102 and 104 of cable modem device 100. Specifically, the '600 reference teaches that the home-networking functionality is implemented by the same processors that implement the DOCSIS and VoIP functionality, instead of implementing these functionalities in a partitioned manner in separate engines, as claimed. Thus, the cited portions of the '600 reference do not correspond to the claimed invention.

Applicant notes that the Office Action does not identify what element of the '600 reference is being asserted as corresponding to Applicant's data networking engine. In fact, the Office Action fails to provide any explanation regarding which specific elements of the '600 reference (*e.g.,* processors 102 and 104) are alleged to correspond to any element of the claimed invention (*e.g.,* Applicant's data networking engine, cable modem engine, DOCSIS MAC processor and the DOCSIS controller). In order to comply with 35 U.S.C. § 132, sufficient detail must be provided by the Examiner regarding the alleged correspondence between the claimed invention and the cited reference to enable Applicant to adequately respond to the rejections. *See, also,* 37 CFR 1.104 ("The pertinence of each reference, if not apparent, must be clearly explained and each rejected

claim specified.") and M.P.E.P. § 706.02(j), ("It is important for an Examiner to properly communicate the basis for a rejection so that the issues can be identified early and the applicant can be given fair opportunity to reply."). As such, should any rejection based on the '600 reference be maintained, Applicant respectfully requests that the Examiner specifically identify which element of the '600 reference is being alleged to correspond to each element of the claimed invention.

In view of the above, the § 102(e) rejection of claims 1-15 is improper and Applicant requests that it be withdrawn.

Applicant further traverses the § 102(e) rejection of various dependent claims because the Office Action fails to adequately address these claims. Regarding claim 7, the '600 reference does not teach that processor 102 (taught by the '600 reference to implement MAC functionality) processes PDU packets and forwards these packets to an apparently nonexistent data networking engine (as claimed) without the involvement of some other processor, which is not identified by the Office Action. Regarding claims 9, 11 and 13-14, the '600 reference does not teach that cable modem device 100 implements functionality of the PacketCable specification or functionality of the CableHome specification. In fact, the '600 reference does not make any mention of either the PacketCable specification or the CableHome specification. Accordingly, the § 102(e) rejection of claims 7, 9, 11 and 13-14 is improper and Applicant requests that it be withdrawn.

In view of the above, Applicant believes that each of the rejections is improper and should be withdrawn and that the application is in condition for allowance. Should there be any remaining issues that could be readily addressed over the telephone, the Examiner is asked to contact the agent overseeing the application file, David Cordeiro, of NXP Corporation at (408) 474-9063 (or the undersigned).

Please direct all correspondence to:

Corporate Patent Counsel
NXP Intellectual Property & Standards
1109 McKay Drive; Mail Stop SJ41
San Jose, CA 95131

CUSTOMER NO. 65913

By: _____
Name: Robert J. Crawford
Reg. No.: 32,122
651-686-6633
(NXPS.615PA)

Electronic Acknowledgement Receipt

EFS ID:	5362874
Application Number:	10675566
International Application Number:	
Confirmation Number:	9980
Title of Invention:	Architecture for a flexible and high-performance gateway cable modem
First Named Inventor/Applicant Name:	Gordon Y. Li
Customer Number:	65913
Filer:	Robert J. Crawford/Kelly Davis
Filer Authorized By:	Robert J. Crawford
Attorney Docket Number:	81373818US01-02CXT0070D
Receipt Date:	19-MAY-2009
Filing Date:	30-SEP-2003
Time Stamp:	17:01:02
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		81373818US01_response.pdf	326820 0a183edcebd36c4d5747626605e5741e9ddfb039	yes	7

and functions, different frequency shifter modules **412**A-C can be used to e.g., avoid interference by increasing noise isolation of each signal from one another, and also eliminate the need to coordinate the shifters. In the illustrated architecture, each 802.11ax AP **408** can act independently of the other(s), and be allocated for downstream and upstream transmission of data, as described in greater detail elsewhere herein.

[0168] It will be appreciated that, as further advancement is made in the related technology ecosystem (802.11ax in the exemplary embodiment), new bandwidth-related functions such as channel bonding or carrier aggregation can be applied to the aforementioned 160-MHz channels to create even larger capacity channels for data communication, thereby allowing further scalability of parameters or constraints of the system, such as the number of Wi-Fi modules/APs **408** to be used, and any associated number of frequency shifters (or other node components such as baluns, splitters and bidirectional amplifiers) to be used.

[0169] Similarly, separate, different bidirectional amplifiers **416** can be utilized to process the e.g., LBT, FDD, and TDD signals of the different US and DS frequency bands. It is noted that the configuration of each bidirectional amplifier in the illustrated embodiment of the node **302** is heterogeneous or asymmetric with respect to its US and DS directions; i.e., each amplifier will operate differently in the US versus the DS, as necessitated by the different signals carried in each direction and the topology of the node (i.e., configuration of the baluns, diplexers, splitters and bidirectional amplifiers relative to one another). As a brief aside, a bidirectional amplifier for an FDD carrier would continuously amplify a different portion of spectrum on the cable for each direction (i.e., upstream and downstream). Conversely, a bidirectional amplifier for a TDD carrier would alternate between amplifying the same portion of spectrum on the cable in the upstream or downstream direction according to e.g., a fixed, configurable or adaptive duty cycle. For fixed or configurable duty cycles, the amplifier can switch between downstream and upstream modes based on e.g., a phase lock loop (PLL) trained on the presence of downstream energy. For adaptive duty cycles, such as with dynamic TDD in 5G NR, the downstream direction can be amplified when the presence of energy in that direction within the allocated spectrum of the cable is detected. The upstream direction can be amplified when energy is not detected in the downstream direction.

[0170] A bidirectional amplifier for an LBT carrier would operate the same way as a bidirectional amplifier for a TDD carrier with an adaptive duty cycle. The downstream direction can be amplified when the presence of energy in that direction within the allocated spectrum of the cable is detected. The upstream direction can be amplified when energy is not detected in the downstream direction.

[0171] Moreover, depending on placement within that topology, the bidirectional amplifier **416**A associated with the first frequency shifter **412**A may be different than that **416**B of the second frequency shifter **412**B, and different than that **416**C of the third frequency shifter **412**C. It will also be appreciated that the implementation of each bidirectional amplifier apparatus will be readily accomplished by those skilled in the art given the present disclosure.

[0172] Furthermore, it will also be appreciated that while 802.11ax AP modules **412** are discussed herein for the advantage of e.g., their developed ecosystem, and ability to use 256-QAM with Wi-Fi 6 (thereby enhancing data rate due to higher order modulation as compared to e.g., 64 QAM of other types of ecosystems), different types of chipsets or ecosystems may be substituted depending on the nature and requirements of the application.

[0173] Moreover, it will be recognized that the actual over-the-cable RF frequency for the cellular carrier (e.g., of 5-85 MHz as shown in FIG. **2**) can be utilized to e.g., support cellular frequency bands other than nominal cellular frequencies on the order of 1 to 2 GHz, including for example emerging standards operating in higher frequencies such as sub-6 GHz 5G or mmWave 5G devices.

[0174] In operation, the diplexers **417**A, **417**B are tiered or arranged in a hierarchy such that the first diplexer **417**A is coupled to the first and second frequency shifters (via the bidirectional amps **416** and the baluns and splitters **414**) as well as the second diplexer **417**B, the latter also coupled to third frequency shifter **412**C and the downstream port (via the signal and power couplers). In this fashion, the signals (e.g., those from the frequency shifters) can be frequency-domain multiplexed onto the output of each diplexer as appropriate for transmission via the downstream port to the amplifier and ultimately the recipient CPE. Similarly, upstream signals received via the couplers are diplexed via diplexer **2 417**B to (i) the first diplexer **417**A, and (ii) the balun and splitter associated with the third frequency shifter **412**C. The first diplexer **417**A allows splitting of the signal based on frequency into the cellular components (for the first frequency shifter **412**A) and those for the first Wi-Fi AP **408**, while the second diplexer **417**B splits off the second Wi-Fi AP signals. So, in effect, the node acts as an aggregator or combiner in the DS direction (toward the amplifier and CPE) and a dis-aggregator in the US direction.

[0175] In another embodiment of the node apparatus, as shown in FIG. **5**, an external cellular source **406**B can be utilized, instead of an integrated cellular source **406**A of the embodiment of FIG. **4**. For example, a "first tier" network node vendor which can provide macro cellular capacities (e.g., components capable of serving hundreds or thousands of simultaneously connected users) with appropriate baseband capabilities in hardware and software to support such high capacities, can utilize its own cellular solution as an integrated part of the network node **302**. However, for a second-tier network node vendor which lacks the expertise or capacity (e.g., in 3GPP technology) to integrate a cellular solution into its network node **302**, it can obtain the cellular solution from an external source, and utilize this solution in conjunction with the network node **302** of FIG. **5**. For example, a femtocell for serving 64 or 128 users (e.g., in a small MDU) can be used as an external cellular source **406**B for a such Tier 2 node vendor, thereby enabling a broader range of use cases and applications of the various functions of the apparatus and methods of the present disclosure.

[0176] As previously discussed, the ISM transceiver **410** of the exemplary node **302** can be used to encode data related to identifying the node, and/or enabling a correct configuration of a switch component of one or more CPE, as described in e.g., co-pending U.S. patent application Ser. No. 16/788,138, incorporated supra. In one implementation, the ISM transceiver **410** can be used to encode data identifying the node so that such information can be used for pinpointing the location of any RF signal leakage within the signal via e.g., portable or fixed monitor. Per FCC (as outlined at e.g., https://www.fcc.gov/consumers/guides/

cable-signal-leakage), there are requirements imposed on network operators to detect any RF signal leakage. Such RF signal leakage can cause for example interference with the licensed frequency spectrum allocated to MNOs. Although the RF signal on any portion of the cables within an HFC network should be contained, any event that may expose the RF signal on the cables to the surroundings (e.g., by mechanical damage to the cable or connectors), the node identifying information communicated via the ISM band can be useful in pinpointing the location of the leak by allowing any entity receiving this information via the ISM band to be able to identify each node by such identifying information.

[0177] As previously noted, if RF signal leakage occurs at a higher frequency spectrum of the cable, then leakage will typically also occur within the ISM band, and the controller **402** can radiate ISM-band energy via the ISM transceiver **410** including the identifying information (e.g., MAC address) of the transmitting network node. Because the ISM band is specifically to be used for transmission of these signals, the ISM transceiver **410** need not be connected to any frequency shifter as with the other signal sources (i.e., 802.11ax chipsets and cellular source), as the ISM signal does not require any shift in its frequency. It will be appreciated, however, that different frequencies can be used, and/or some degree of frequency shift can be applied if desired, such as in cases where the available spectrum of the frequency plan is at a higher frequency (e.g., an unlicensed band such as 2.4 GHz). As previously referenced, one benefit of using unlicensed frequency bands for such transmissions is that the transceiver **410** and any receiver used to monitor for leakage of the signals, or receive control information (such as in the CPE), are highly commoditized and hence low cost. Moreover, any "intentional" ISM signals which may leak cause no deleterious radiation in the surrounding environs where the leakage occurs (other than perhaps some additional ISM band interference), and hence the leakage can be detected readily, at low cost, and with no effects on licensed bands.

[0178] FIG. **6** illustrates yet another exemplary embodiment of a network node apparatus **302** configured according to the present disclosure. As shown, this embodiment of the network node **302** includes, inter alia, only one (1) 4×4 802.11ax chipset **408** when compared to the embodiments of FIGS. **4** and **5**. Accordingly, the network node apparatus **302** of FIG. **6** can be configured and operated in generally the same way as the exemplary embodiment shown in FIG. **4**, with an exception of requiring less complexity in configuration and operation. For example, the lone 4×4 802.11ax chipset **408** can be operated to process the divided sub-band **226** with a bandwidth of approximately 640 MHz as discussed elsewhere herein. Because only one (1) 4×4 802.11ax chipset **408** is utilized, the extra components such as an additional frequency shifter **412** used to down-convert a signal from a second 4×4 802.11ax chipset **408** to be transmitted via coaxial infrastructure for DS direction and to up-convert a signal to be processed by the second 4×4 802.11ax chipset **408** for US direction, as well as an additional Balun & Splitter **414**, amplifier **416**, and diplexer **417** used for combining/splitting the data signals from/for the second 4×4 802.11ax chipset **408**, are obviated. The exclusion of the extra components for the network node **302** as described above can e.g., lower the complexity, reduce the form factor, draw less power, and associated cost of the node **302**, such as for use in applications where the capacity of only one chipset is required.

[0179] Furthermore, as described subsequently herein in greater detail, the foregoing apparatus of the embodiment of FIG. **6** can be useful for e.g., providing redundancy when used in tandem with another one of such node apparatus with reduced capacity. For example, the node **302** can utilize carrier signals of the 3GPP source **406**A within one frequency band, while another node **302** can also utilize only carrier signals of its 3GPP source **406**A within another frequency band, so as to e.g., provide redundancy of processed data within a user premises (see FIG. **12** for more details).

[0180] It will be appreciated that in the foregoing use case scenario (e.g., use of two or more nodes proximate to one another), the ISM band communications (which may use e.g., LoRa as one exemplary solution) will not be impacted because the different ISM transceivers of two or more nodes can transmit signals in the same ISM band without interference with one another such as via use of different carrier frequencies, or alternatively via use of media access protocols.

[0181] Similar to the embodiment of FIG. **5**, an external cellular source **406**B can be utilized in the node configuration **302** of FIG. **7**, which uses only one (1) 802.11ax chipset **408**. The aforementioned second-tier node vendor can utilize such node to support various use cases such as those described further herein (see e.g., FIG. **12**).

[0182] FIG. **8** illustrates one embodiment of an exemplary IEEE Std. 802.11ax chipset used in conjunction with the nodes **302** of FIGS. **4-7**. As shown, the chipset **408** includes a digital network interface **801** (e.g., Ethernet or other protocol), a CPU **802**, a digital baseband processor **804**, DAC **808** and ADC **806** for digital to analog domain (and vice versa, respectively) conversion of the baseband signals, two RF front ends **810**, **812** for the 2.4 GHz and 5 GHz bands respectively, one or more antenna elements **418** for the lower band front end **810**, and one or more frequency shifters **412** for the upper band front end **812**. A power supply module **814** is also included.

[0183] In operation, the baseband chipset processes baseband data received via the digital interface **801** for transmission over one of the two transceiver chains (2.4 GHz OTA, or 5 GHz OTC), as well as signals received thereby for transmission upstream (e.g., via SFP connector/optical modulator to the optical domain, as discussed with respect to FIGS. **4-7**). In that chipsets of the type shown in FIG. **8** are readily available and effectively commoditized, they have excellent data bandwidth performance, are readily available at comparatively low cost, and are fully featured in terms of support for various protocols and functions, thereby making them highly useful choices for including with the node **302** (and CPE) of the exemplary embodiments of the present disclosure.

[0184] Moreover, the presence of the 2.4 GHz band capability enables each node **302** to act as an ad hoc node for e.g., MSO subscribers who happen to be proximate thereto, with no significant added engineering or implementation costs, and using the same form factor of device. For example, a pole-mounted node "pod" may be used in some applications which may also act as "street level free Wi-Fi" for MSO customers (or even others if permitted) within the footprint of the pole pod (whether transiently within the footprint, or

permanently there, such as where a business or residence is within 2.4 GHz WLAN range of the pole pod.

[0185] Likewise, through simple addition of appropriate cellular antennae, the pod can act as a cellular extender or repeater, which is particularly advantageous in cases where the extant cellular service from an MNO (or unlicensed/quasi-licensed "cellular" offered by the MSO) is poor in that area due to extended range from the closest base station, in dense urban environments where signal propagation may be poor in certain areas, etc.

Exemplary Use Cases

[0186] FIG. **9** is a functional block diagram illustrating an exemplary embodiment of a network architecture **900** for providing small cell service by using the node apparatus of the present disclosure. Exemplary applications of this use case include extant coaxial cable infrastructure such as overhead cable runs (e.g., on telephone poles or similar structures), as well as underground cable runs.

[0187] As a brief aside, a small cell is typically a low-powered cellular radio access node that operates in licensed and unlicensed spectrum, e.g., with a range of 10 meters to a few kilometers. The FCC defines small cell equipment further at e.g., https://www.fcc.gov/document/fcc-facilitates-wireless-infrastructure-deployment-5g. As such, exemplary applications of the node apparatus **302** of the present disclosure can utilize relatively low powered devices which operate in unlicensed or quasi-licensed (e.g., CBRS or C-Band) spectrum which provide enhanced coverage for e.g., MSO subscribers.

[0188] As shown in the exemplary application of FIG. **9**, a first node **302** is disposed between a backhaul network (such as e.g., fiber network shown in FIG. **9**) and an existing wireline (e.g., coaxial cable) infrastructure. In one variant, such network architecture can provide an improved data services at an edge of e.g., an access network such as that provided via cellular radio technology like 3GPP 4G/5G by an MNO or even the MSO itself, as long as the existing wireline infrastructure is accessible. Hence, even though user devices disposed at the edge of such network may not be able to receive high-rate data services from the access network itself (due to e.g., lack of cable drops or wireless access nodes such as NodeBs or CBSDs), the architecture **900** of FIG. **9** utilizes the inventive node **302** coupled to an existing coaxial cable infrastructure to provide the high-rate data services enabled by e.g., the 4×4 802.11ax chipset capabilities. For example, once a given node **302** is coupled to the existing coaxial cable infrastructure by a coupler **902**, any user devices at a premises with access to the coaxial cable can utilize a CPE **308**, which can be coupled to the coaxial cable to receive and send data via e.g., connecting to the CPE itself (e.g., an Ethernet connection) or a connected Wi-Fi AP **906**. Likewise, a CPE **308**, cable and node **302** can act in effect as a backhaul for MSO small cell devices such as CBRS CBSDs **309** as shown.

[0189] Hence, multiple different coupler/CPE "sub-node" equipment **910** can be used to support various types of wireline and wireless services at each individual premises.

[0190] It will be appreciated that based on configuration of the node(s) **302**: (i) cellular-enabled UE and/or WLAN clients local to the node **302** itself can be serviced, and (ii) premises connected to or tapped off the coaxial cable and having suitable CPE **308** can provide unlicensed/quasi-licensed small-cell functionality and Wi-Fi functionality at end-user premises. Thus, the node(s) **302** can support both incidental or ad hoc users in proximity thereto (e.g., who happen to be walking by or situated near a node on a telephone poll or neighborhood box), as well as a number of end-user premises with CPE **308** and associated WLAN or small-cell wireless transceivers, as shown in FIG. **9**.

[0191] FIG. **10** is a functional block diagram illustrating another exemplary embodiment of a network architecture **1000**, in this scenario for providing a DAS (distributed antenna system) for an enterprise or similar premises (e.g., one with multiple structures, rooms, speces or departments, which may be distributed within a larger campus or area).

[0192] As previously described with respect to e.g., FIG. **3**B herein, the DAS architecture includes one or more "local" nodes **302** which is/are disposed at the enterprise premises and used to deliver MSO data and signals directly to the enterprise premises and its local (premises) coaxial distribution network, including in some cases without need of any interposed amplifier. For example, the enterprise premises may have an optical fiber drop (e.g., FTTC or FTTH) node **302** proximate thereto or serving the premises, such that the inventive node **302** can be used to directly serve the enterprise premises, such as by being mounted on a utility pole proximate the premises, or in the case where the node **302** serves only the premises, integrated within the premises itself (e.g., in a telecommunications service ingress/egress room or similar). In this configuration, the optical node delivers signals to the 802.11ax node **302**, the latter which transforms the signals to the RF domain for delivery on the premises coaxial network of the enterprise (e.g., to different rooms or departments or structures thereof) to individual CPE **308** via one or more couplers **902**. To the degree that the node **302** is physically/topologically proximate to the various CPE **308** it serves, the use of an amplifier as in other more distant configurations can be avoided, thereby further reducing cost, complexity and CAPEX.

[0193] It should be appreciated that the architecture of the premises network and topology thereof can be literally of any shape or size, and advantageously may be pre-existing such that it can be "repurposed" rather than having to be rewired with e.g., optical fiber or CAT-5/6 cabling. The different areas of the premises are served by the existing coaxial infrastructure, and a multitude of couplers **902** may be used to branch into different areas of the premises (if not present) to allow CPE **308**, as well as optional Wi-Fi APs **906** or small cells **909** to be connected to provide the high-rate data services as enabled by the 4×4 802.11ax chipset capabilities of the node **302** (and the CPE **308**).

[0194] Such architecture would be especially useful in e.g., network edge deployments which do not have good cellular coverage otherwise. For example, such buildings would not require any additional fiber installation or additional cellular towers be placed nearby by an MNO; the node **302** and the CPE **308** can provide the high-rate data wireless and wireline services via utilization of the existing coaxial cable infrastructure.

[0195] FIG. **11** is a functional block diagram illustrating another exemplary embodiment of a network architecture **1100** for providing a DAS, in this case for a venue such as a sports stadium, convention center, or other similar application.

[0196] Similar to the architecture of FIG. **10**, the present embodiment includes one or more "local" nodes **302** disposed at the venue. The venue of FIG. **11** includes an

existing or added wireline infrastructure made up of multiple paths branching out or otherwise distributed from the local nodes **302**. In one variant, the nodes **302** are coupled onto an existing coaxial cable infrastructure branching into various parts of the venue. A plurality of network sub-nodes **910**, each including a coupler **902**, CPE **308**, and an optional small-cell (e.g., CBSD) or Wi-Fi AP (see FIG. **9**) are coupled onto various parts of the existing coaxial cable infrastructure by a plurality of centralized couplers **902** (although the sub-nodes **910** may couple directly to cable, as in the embodiment of FIG. **9**). As with previously described embodiments, the local nodes **302** can be used in conjunction with the coaxial infrastructure to provide high-rate data services to user devices disposed at different parts of such venue, such as to ensure adequate wireless coverage of all seating or other areas (which may have very high user density and hence prospective levels of interference), including to account for physical or environmental factors specific to the venue (e.g., "dead" spots due to certain types of materials, added structures, etc. The ability to couple onto the existing or extended coaxial cable of the venue at literally any free location can also aid in ad hoc placements which were not necessarily contemplated at time of the cable installation or venue construction.

[0197] In one variant, a fiber drop within the HFC network which runs all the way to the venue may be used as the basis for supporting the local node(s) **302**. As such, the nodes can be placed at locations within the venue where such fiber drop(s) come in, including placement of two or more nodes in a common location of the venue (not shown) which each serve respective portions of the extant (or added) cable topology of the venue.

[0198] It should be appreciated that the architecture of the venue can also be of any shape or size. The different areas of the venue can be served by the coaxial infrastructure, including any extensions thereof which may be added to ensure more complete coverage consistent with the physical attributes (range, directionality, etc.) of the installed CPE **308** and supported end-user devices such as small cells or WLAN APs. As long as the CPE can couple onto the coaxial infrastructure, the CPE can provide network connection to any user devices that can connect to the CPE (or its daughter devices).

[0199] FIG. **12** is a functional block diagram of another exemplary architecture is described. In this architecture **1200**, reliability of data services is provided via redundancy. Such redundancy/reliability is useful in e.g., industrial or other critical applications. For instance, for many chemical processes, loss of electrical power or process data can result in significant costs or material losses. Similarly, for certain data-intensive industrial applications (such as cloud services, server farms, distributed storage, etc.), data reliability/redundancy may be a significant or even critical feature. Hence, as used herein, the terms "reliability" and "redundancy" are meant to broadly encompass, without limitation: (i) provision of additional capability over that provided or capable of being provided by a single distribution infrastructure (such as e.g., a single branch of a coaxial cable topology), as well as (ii) provision of backup or fail-over capability to the capacity provided by said single distribution infrastructure.

[0200] With the foregoing as a backdrop, the embodiment of the architecture **1200** of FIG. **12** includes a control device **301** in data communication with each of Node **1** and Node **2** **1202** of FIG. **12** via fiber network; the control device **301** can for example implement the band allocation plan **220** so as to allocate e.g., half of the aforementioned exemplary 1.6 GHz of bandwidth to Node **1** while allocating the other half to Node **2**. In one variant, Node **1** can process one set of data via signaling over ~700 MHz of bandwidth, while Node **2** processes another set of data via signaling over the other ~700 MHz of bandwidth. Then, the processed signals can be distributed to the various CPE **308** at the premises and/or optional Wi-Fi AP **906** (or small cell **909**, not shown) after being combined through a combiner **1207**, to provide network coverage to user devices such as UE **372**A, or factory/automation or data processing equipment **1218**, **1220**.

[0201] As a brief aside, the attenuation associated with any coaxial cable infrastructure is a function of, inter alia, coaxial conductor length. Accordingly, by dividing the data set to be transmitted to various parts of the industry venue shown in FIG. **12**, the network architecture **1200** can take advantage of the two (or by extension any number of) paths **1212**, **1214** of an existing coaxial infrastructure, by which the signal sent out of Node **1** can reach one part of the infrastructure, and likewise signals sent out of other nodes can reach other parts of the infrastructure (as contrasted with a single long coaxial cable). Through coordination of node and CPE placement, both redundancy and reliability can be achieved by having nodes service different sub-portions of the coaxial cable topology, including variants where signals transmitted from two different nodes are distributed to common CPE (albeit from different cable runs) so as to minimize the amount of attenuation and potential loss of data by sending and combining data as sent over the paths **1212** and **1214**. Moreover, if the signals are redundant of one another, the signals distributed to a given CPE **308** can be selectively used in cases where one signal is lost; i.e., the signals may be delivered redundantly to the same node, and the secondary or backup signals used only in the event of the loss of primary signals delivered via another cable segment (e.g., in the even of one branch's node failure, cable cut, etc.)

Exemplary Methods

[0202] Referring now to FIG. **13**, one embodiment of a general methodology for providing high data rate services via one or more node apparatus **302** over a content distribution network (such as via the architectures **300**, **320**, **340**, **360** previously described with respect to FIGS. **3**A-**3**D) is described.

[0203] As shown, per step **1302**, one or more signals are received at the network node(s) **302**. In one variant, the signals are received via an optical interface such as one connected to DWDM ring or the like. Alternatively (or concurrently), a wireless link such as an mmWave system may deliver the signals to the node **302**.

[0204] Per step **1304**, the received signals are processed at the network node(s) **302**. In one variant, one or more 802.11ax-based components are utilized to process the received optical domain signal (e.g., via an SFP port of the node **302**) to the RF domain. For example, as discussed elsewhere herein, one or more 4×4 802.11ax modules **408** (FIG. **4**) can be used to process the signal to e.g., enable an enhanced feature set as supported by the 802.11ax technology ecosystem. The foregoing feature set includes, but is not limited to, e.g., symmetric high-bandwidth data operation and data processing scheduling (e.g., prioritization of real-time data over non-real-time data, QoS prioritization, etc.).

Exemplary protocols for the APs are set forth in "P802.11ax—IEEE Draft Standard for Information Technology—Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks—Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment Enhancements for High Efficiency WLAN" dated Dec. 6, 2017, which is incorporated herein by reference in its entirety.

[0205] In this variant, one or more frequency shifter modules **412** (FIG. **4**) are also utilized to down-convert the signal to be transmitted at a frequency appropriate for downstream communications (e.g., from the 5 GHz band signals generated by the 802.11ax AP, to be put on coaxial cable infrastructure at the appropriate portion of the bands shown in the frequency plan **200** of FIG. **2**).

[0206] Per step **1306**, the processed and down-converted signals are transmitted downstream towards the served CPE **308**. In one variant, the signal is transmitted downstream via coaxial cable infrastructure. Such transmission via the coaxial cable allows the signal to be propagated via e.g., an extant coaxial cable infrastructure of an MSO, so that the data can travel downstream at a high data rate even though the coaxial cable infrastructure is used.

[0207] It will be appreciated that generally speaking, the methodology for UL/US transmissions is analogous to that for DS/DL, yet inverted.

[0208] Moreover, per step **1306**, the received signals from the optical source (and 4G/5G source—see e.g., FIG. **4**) can also be distributed locally via the WLAN and 3GPP (4G/5G) antennae of the node **302**, such as to provide local WLAN and cellular service to MSO users who are proximate to the node **302** (as contrasted from downstream CPE which may not be in wireless range of the node **302**). Such signals can also be sent downstream in the assigned cellular bands at lower end of the spectrum **220** for distribution via the CPE **308** at the user/customer premises.

[0209] FIG. **14** illustrates one exemplary implementation of the general method of FIG. **13**, in this instance to take received 3GPP source data and distribute it locally or remotely via 3GPP and cable band frequencies, respectively. In this scenario, the 3GPP signals bypass the 802.11ax chipset, and are processed entirely by the 4G/5G chipset (and subsequent frequency shift logic for signals distributed downstream on the cable).

[0210] As shown, the method **1400** of FIG. **14** includes first receiving e.g., 3GPP signals per step **1402**. For instance, the signals may carry data destined for a 3GPP UE user served by either the node **302** directly, or by a downstream CPE **308** with associated 3GPP capability (either indigenously, or by way of e.g., a connected femto-cell or the like). Depending on how received (e.g., via the optical/SFP interface or directly as electrical domain data at the 3GPP chipset), conversion to the electrical domain may be required (not shown).

[0211] Next, per step **1404**, the 3GPP source **406**A, **406**B (see FIGS. **4** and **5**) is used to generate 3GPP compliant waveforms for transmission over the local antennae of the node **302**. For instance, the source may comprise a 4G or 5G chipset configured to convert the baseband data extracted from received optical signals and passed to the chipset that are destined for a node-local cellular user to 4G or 5G (e.g., unlicensed NR-U) frequency bands for transmission over the antennae. Depending on the chipset used and relevant standards, such RF bands may be anywhere from e.g., 1.6 GHz up to mmWave frequencies (e.g., 40 GHz or above). In one variant, opto-electric converters/modulators or similar devices of the type known in the art may be used for the domain transformation.

[0212] Per steps **1406** and **1408**, if the UE is communicative with a downstream CPE **308** or associated device, the electrical domain signals are converted to cable RF band frequencies (e.g., 1.6 GHz or less) for transmission to downstream CPE, and per step **1410**, the cable RF signals are transmitted downstream on the coaxial cable to one or more CPE **308**.

[0213] It will be appreciated that the present disclosure contemplates use of either (i) active or passive determination of UE or client location as part of step **1406** of FIG. **14**, or (ii) no UE location determination (FIG. **14**A discussed below). That is, UE location may be determined, if desired, based on e.g., an association with or connection to (or attempted association or connection) a given node or CPE (or associated small cell), such as according to extant 3GPP RACH protocols, or authentication protocols. Once such association or connection is detected, the given UE is presumed to be located in proximity to that node or CPE/small cell, and signals received from or transmitted to the UE via the appropriate node or CPE/cell will occur (as opposed to via the other device). Accordingly, in one such scenario, the node **302** may detect a local UE via signals transacted over the local antenna/ports, and is configured to obviate further transmission of those signals downstream so as to conserve downstream bandwidth on the cable (since there will be no UE at the CPE/small cell to utilize such downstream signals). Conversely, data signals transacted by the cellular source chipset destined for a downstream CPE/small cell where the UE is located may obviate transmission of signals over the local antennae of the node **302**.

[0214] Alternatively, if per step **1406** the UE is communicative with the local node **302**, then per step **1412**, the converted signals in the 3GPP RF domain are transmitted via the 3GPP antennas **419** of the node to the local UE. It will be noted that the foregoing implementation can be used to provide a high-capacity cellular data service for e.g., 3GPP-capable user equipment disposed proximate to the node (wherever that may be positioned within the network topology) as well as those disposed proximate to a CPE (e.g. at the distribution network edge), the CPE **308** distributing the 3GPP RF waveforms either by indigenous 3GPP chipset or attached small-cell or femto-cell. If the node and CPE are geographically local, the node and/or CPE can also be tuned to co-exist (e.g., such that each provides complementary coverage for the other without undue overlap or interference, and such that the UE can affirmatively associate with one or the other so as to avoid "dither" between being serviced by the node and servicing by the CPE/small-cell).

[0215] However, as noted above, the signals may be "broadcast" to both locations (see FIG. **14**A). This approach also underscores another advantageous aspect of the exemplary node configuration and delivery model of the present disclosure; i.e., the signal being radiated at the node (ostensibly to any nearby UE) will be a different frequency to that which is being transmitted down the coaxial infrastructure by virtue of the frequency shifting. A single UE is not going to receive the transmission from the node (which will typically be outdoors), and the signal sent down the coaxial

infrastructure and subsequently up-converted is geographically removed from the node, and is generally transmitted indoors.

[0216] FIG. **14**A illustrates one exemplary implementation of the method of FIG. **14**, in this instance to take received 3GPP source data and distribute it both locally and remotely via 3GPP and cable band frequencies, respectively. As shown, the method **1450** of FIG. **14**A includes first receiving e.g., 3GPP signals per step **1452**.

[0217] Next, per step **1454**, the 3GPP source **406**A, **406**B (see FIGS. **4** and **5**) is used to generate 3GPP compliant waveforms for transmission over the local antennae of the node **302**, as previously described.

[0218] Per step **1458**, the electrical domain signals are converted to cable RF band frequencies (e.g., 1.6 GHz or less) for transmission to downstream CPE, and per step **1460**, the cable RF signals are transmitted downstream on the coaxial cable to one or more CPE **308**.

[0219] Additionally, per step **1462**, the converted signals in the 3GPP RF domain are transmitted via the 3GPP antennas **419** of the node to the local UE. As with FIG. **14**, the foregoing implementation can be used to provide a high-capacity cellular data service for e.g., 3GPP-capable user equipment disposed proximate to the node (wherever that may be positioned within the network topology) as well as those disposed proximate to a CPE (e.g. at the distribution network edge), the CPE **308** distributing the 3GPP RF waveforms either by indigenous 3GPP chipset or attached small-cell or femto-cell.

[0220] FIG. **15** illustrates another exemplary implementation of the general method of FIG. **13**. In this case, received signals (which may be destined for e.g., for WLAN-enabled user mobile or premises devices such as PCs or tablets, or smart TVs) are processed by the 802.11ax chipset and distributed locally or downstream to the 802.11ax-enabled CPE **308** for distribution at the premises.

[0221] As shown, the method **1500** of FIG. **15** includes first receiving an optical domain signal per step **1502**.

[0222] At step **1504**, the received signal is converted from the optical domain to electrical (e.g., Ethernet), such as by an Ethernet MAC chipset within the node **302**.

[0223] Then, the converted signal is processed by an 802.11 AP module per step **1506**. The processing by the 802.11 AP module enables inter alia, implementation of one or more enhanced features available via 802.11 Wi-Fi protocols. The 802.11ax chipset outputs waveforms in the chipset's RF domain (e.g., 5 GHz band WLAN waveforms according to 802.11ax protocols).

[0224] Per steps **1508** and **1514**, if destined for a local client, the chipset RF domain signals are transmitted over the local WLAN antennae of the node **302**, such as to nearby incidental WLAN users. To this end, an MSO may position its nodes at certain prescribed locations relative to higher densities of users (e.g., within 100 feet or so of areas of high user traffic or participation, such as at a train station, shopping mall, etc.), such that these incidental users may be advantageously exposed to the MSO's WLAN services (e.g., "free MSO Wi-Fi").

[0225] Moreover, since different ports on the WLAN chipset are used for local transmission, the chipset itself can differentiate between local and downstream (CPE-based) users for purposes of differentiating local versus premises delivery, such as when implementing the logic of method step **1508**.

[0226] Alternatively, if a CPE-based user device is being served, then per step **1510**, the processed signal from step **1506** is down-converted to an appropriate cable RF band (e.g., per frequency plan **200** of FIG. **2**), and per step **1512**, the down-converted processed signal is transmitted to the CPE of the served premises for use by the user's equipment (e.g., to supply WLAN service to the user device at the premises).

[0227] It will be appreciated that once the location of the UE or client of FIG. **14** or **15** respectively is established, the US transmission path is also established similar to the methodologies **1400**, **1500** described above, and hence two-way communication between the UE/client and a distant entity (e.g., another UE or internetwork server) is used, with frequency/domain conversion in effect operating in reverse from that described above. For instance, a distant WLAN client at a premises device will interface with the CPE **308** using 802.11ax waveforms and the local 802.11ax chipset, and the chipset will convert the received waveforms to baseband data for subsequent frequency shifting, diplexing, etc. for transmission upstream to the node **302** at cable domain frequencies (e.g., less than 1.6 GHz).

[0228] FIG. **15**A illustrates an exemplary implementation of the general method of FIG. **15**. In this case, received signals (which may be destined for e.g., for WLAN-enabled user mobile or premises devices such as PCs or tablets, or smart TVs) are processed by the 802.11ax chipset and distributed locally as well as downstream to the 802.11ax-enabled CPE **308** for distribution at the premises.

[0229] As shown, the method **1550** of FIG. **15**A includes first receiving an optical domain signal per step **1552**.

[0230] At step **1554**, the received signal is converted from the optical domain to electrical (e.g., Ethernet), such as by an Ethernet MAC chipset within the node **302**.

[0231] Then, the converted signal is processed by an 802.11 AP module per step **1556**. The processing by the 802.11 AP module enables inter alia, implementation of one or more enhanced features available via 802.11 Wi-Fi protocols. The 802.11ax chipset outputs waveforms in the chipset's RF domain (e.g., 5 GHz band WLAN waveforms according to 802.11ax protocols).

[0232] Per step **1564**, the chipset RF domain signals are transmitted over the local WLAN antennae of the node **302**, such as to nearby incidental WLAN users.

[0233] Additionally, per step **1560**, the processed signal from step **1556** is down-converted to an appropriate cable RF band (e.g., per frequency plan **200** of FIG. **2**), and per step **1562**, the down-converted processed signal is transmitted to the CPE of the served premises for use by the user's equipment (e.g., to supply WLAN service to the user device at the premises).

[0234] FIG. **16** is a logical flow diagram representing a first embodiment of a generalized method for providing redundancy of data service over a content delivery network, according to the present disclosure. For instance, in the context of FIG. **12**, the methodology **1600** can be used to provide redundancy over such infrastructure at e.g., a venue, enterprise, industrial facility, or other such application.

[0235] As shown, per step **1602**, a first cable RF band signal is sent from a first node over a first cable path. For instance, the first signal may occupy a first frequency band of the frequency plan **220** of FIG. **2**A or **2**B.

[0236] Per step **1604**, a second cable RF band signal is sent from a second node over a second cable path. In one

variant, the second cable RF band signals include signals of a different frequency band (e.g., as shown in frequency plan **220** such that the first and second signals do not overlap in frequency).

[0237] In one implementation, the two cable RF band signals (transmitted over two different cable paths of the extant coaxial cable infrastructure) are received at a common combiner **1207** via a plurality of couplers **902** (e.g., as shown in FIG. **12**).

[0238] Per step **1606**, the two cable RF band signals are then combined at the signal combiner **1207**. Thereafter, the combined signal is transmitted to the CPE **308** per step **1608** for transmission to user equipment.

[0239] In the case where the first and second signals occupy different frequency bands, the combination may be as simple as use of an RF combiner/diplexer arrangement, such that the CPE **308** is presented (in the DS) with signals of both bands.

[0240] Alternatively, if there is some (or complete) overlap in the signals, such as where the total available bandwidth on the cable is restricted, or for other purposes, the signals may be multiplexed in time, such as according to a TDD type approach. Yet other multiple access type techniques may be used as well, as will be appreciated by those of ordinary skill given the present disclosure.

[0241] FIG. **17** is a logical flow diagram representing a second embodiment of a generalized method for providing redundancy of data service over a content delivery network, according to the present disclosure. For instance, in the context of FIG. **12**, the methodology **1700** can be used to provide redundancy over such infrastructure at e.g., a venue, enterprise, industrial facility, or other such application.

[0242] As shown, per step **1702**, a first cable RF band signal is sent from a first node over a first cable path. For instance, the first signal may occupy a first frequency band of the frequency plan **220** of FIG. **2**A, or alternatively may occupy all available bands (e.g., first and second bands **226** and **230** or portions thereof), so as to maximize available utilization of the cable medium.

[0243] Per step **1704**, a second cable RF band signal may be sent from a second node over a second cable path. In one variant, the second cable RF band signals include signals of a different frequency band (e.g., as shown in frequency plan **220** such that the first and second signals do not overlap in frequency). In another variant, the signals occupy the same band (or bands) as the first signals, and are sent only in the event that e.g., the first node becomes inoperative.

[0244] In one implementation, the two cable RF band signals (transmitted over two different cable paths of the extant coaxial cable infrastructure) are received at a common combiner **1207** via a plurality of couplers **902** (e.g., as shown in FIG. **12**) of a sub-node **1210**, and each cable/band can be used to provide bandwidth to users (e.g., WLAN clients) proximate to each sub-node **910**.

[0245] Per step **1706**, the two cable RF band signals are then combined at the signal combiner **1207**. Thereafter, the combined signal is transmitted to the CPE **308** per step **1708** for transmission to user equipment.

[0246] In the event that one node **1202** fails, the other node and its sub-nodes **1210** with respective CPE can provide redundant coverage to the various locations of the premises, albeit with e.g., half the bandwidth otherwise previously available with both nodes/cables operative. For instance, in one such scenario, sub-nodes are allocated to the same frequency bands as they would be otherwise with both nodes/cables operational, yet at basically half the bandwidth availability. In such instance, the signals need not be combined at the combiner **1207** since only one "loop" is operative.

[0247] It will be recognized that while certain aspects of the disclosure are described in terms of a specific sequence of steps of a method, these descriptions are only illustrative of the broader methods of the disclosure, and may be modified as required by the particular application. Certain steps may be rendered unnecessary or optional under certain circumstances. Additionally, certain steps or functionality may be added to the disclosed embodiments, or the order of performance of two or more steps permuted. All such variations are considered to be encompassed within the disclosure disclosed and claimed herein.

[0248] While the above detailed description has shown, described, and pointed out novel features of the disclosure as applied to various embodiments, it will be understood that various omissions, substitutions, and changes in the form and details of the device or process illustrated may be made by those skilled in the art without departing from the disclosure. This description is in no way meant to be limiting, but rather should be taken as illustrative of the general principles of the disclosure. The scope of the disclosure should be determined with reference to the claims.

[0249] It will be further appreciated that while certain steps and aspects of the various methods and apparatus described herein may be performed by a human being, the disclosed aspects and individual methods and apparatus are generally computerized/computer-implemented. Computerized apparatus and methods are necessary to fully implement these aspects for any number of reasons including, without limitation, commercial viability, practicality, and even feasibility (i.e., certain steps/processes simply cannot be performed by a human being in any viable fashion).

1. Node apparatus comprising:

a first port for interfacing with a first portion of a network topology using at least a first type of network medium for data transmission;

a second port for interfacing with a second portion of the network topology using at least a second type of network medium for data transmission;

first network interface logic in communication with the first port;

first RF (radio frequency) integrated circuit (IC) apparatus in data communication with the first network interface logic, the at least one RF integrated circuit configured to at least generate RF waveforms within a first prescribed frequency band;

frequency shifter apparatus configured to shift the RF waveforms within the first prescribed frequency band to a frequency lower than the first prescribed frequency band; and

second RF IC apparatus in data communication with the first network interface logic, the second IC apparatus configured to at least generate RF waveforms within a second prescribed frequency band.

2. The node apparatus of claim **1**, wherein the first portion of the network topology comprises a fiber-optic distribution portion of the network topology, and the second portion comprises a coaxial cable portion of the network topology.

3. The node apparatus of claim 2, wherein the network topology comprises a hybrid fiber coaxial (HFC) cable television network topology operated by a multiple systems operator (MSO).

4. The node apparatus of claim 1, wherein the first RF integrated circuit apparatus comprises at least one IEEE-Std. 802.11ax compliant IC or chipset configured to generate at least part of the RF waveforms within a first sub-band of the first prescribed frequency band.

5. The node apparatus of claim 4, wherein the first RF integrated circuit apparatus further comprises a second IC or chipset configured to generate at least part of the RF waveforms within a second sub-band of the first prescribed frequency band, the first and second sub-bands being non-overlapping in frequency.

6. The node apparatus of claim 5, wherein the first and second sub-bands each comprise frequency band below 1.6 GHz, said frequency bands below 1.6 GHz suitable for transmission over a coaxial cable portion of the network topology, the coaxial cable portion comprising the second portion of the network topology.

7. The node apparatus of claim 5, wherein the first IC or chipset is configured to generate the at least part of the RF waveforms within the first sub-band for output via four (4) first ports or spatial diversity channels, and the second IC or chipset is configured to generate the at least part of the RF waveforms within the second sub-band for output via four (4) second ports or spatial diversity channels.

8. The node apparatus of claim 1, wherein the second RF IC apparatus comprises an IC or chipset configured to support at least one of 3GPP (Third Generation Partnership Project) Long Term Evolution (LTE) or 3GPP 5G NR (New Radio) protocols.

9. The node apparatus of claim 8, wherein the generated RF waveforms within the second prescribed frequency band comprises an unlicensed or quasi-licensed spectrum band selected from the group consisting of: (i) NR-U bands, (ii) CBRS bands, and (iii) C-Bands.

10. The node apparatus of claim 8, wherein the RF waveforms within the second prescribed frequency band are coupled to the second port via a signal path comprising at least a second frequency shifter apparatus and amplification logic; and

wherein the second frequency shifter apparatus is configured to shift the RF waveforms within the cellular band to a third sub-band within the first prescribed frequency band.

11.-20. (canceled)

21. A computerized apparatus comprising:

a first data interface and a second data interface configured for data transmission with respective first and second portions of a network;

a first integrated circuit (IC) in data communication with the first data interface, the first IC configured to at least one of (i) produce a first type of signals within a first frequency band, or (ii) receive the first type of signals via the first data interface; and

a frequency shifter configured to convert a frequency associated with the first type of signals from the first frequency band to a frequency within a second frequency band, the second frequency band adapted for transmission to the second portion of the network via the second data interface, at least a portion of the second portion of the network comprising a coaxial cable infrastructure.

22. The computerized apparatus of claim 21, wherein:

the first type of signals comprises IEEE Std. 802.11ax-compliant waveforms;

the first IC is configured to receive the IEEE Std. 802.11ax-compliant waveforms from an upstream portion of the network; and

the conversion of the frequency comprises conversion of a frequency associated with the IEEE Std. 802.11ax-compliant waveforms to a frequency compatible with transmission via the coaxial cable infrastructure.

23. The computerized apparatus of claim 21, further comprising a second IC in data communication with the first data interface, the second IC configured to produce a second type of signals capable of wireless transmission within a third frequency band, the first and third frequency bands overlapping at most partially.

24. The computerized apparatus of claim 23, wherein the second type of signals comprises waveforms compliant with 3GPP (Third Generation Partnership Project) Long Term Evolution (LTE) or 3GPP 5G NR (New Radio) protocols.

25. The computerized apparatus of claim 23, further comprising a second frequency shifter configured to convert a frequency associated with the second type of signals from the third frequency band to a frequency within the second frequency band.

26. A method for delivering mobility service through a node apparatus of an extant network infrastructure, the method comprising:

obtaining first radio frequency (RF) waveforms via a first integrated circuit (IC), the first RF waveforms associated with a first frequency and compliant with a first data transmission protocol usable in at least a first portion of the extant network, the at least first portion of the extant network comprising one or more wireless nodes;

converting the first RF waveforms to a second frequency different from the first frequency; and

transmitting the converted first RF waveforms to a second portion of the extant network infrastructure via at least a second data transmission protocol, the second portion of the extant network infrastructure comprising at least a portion of an extant wireline data network.

27. The method of claim 26, wherein converting to the second frequency comprises converting such that the second frequency of the first RF waveforms comprises a frequency lower than the first frequency.

28. The method of claim 26, further comprising:

obtaining second RF waveforms via a second the second RF waveforms occupying at least a different portion of a spectrum associated with the first RF waveforms, the first and second RF waveforms being compliant with respective wireless data transmission protocols; and

converting the second RF waveforms to the second frequency.

29. The method of claim 26, wherein:

the obtaining of the first RF waveforms via the first IC comprises one or more of receiving or generating the first RF waveforms via an IEEE Std. 802.11ax-compliant chipset; and

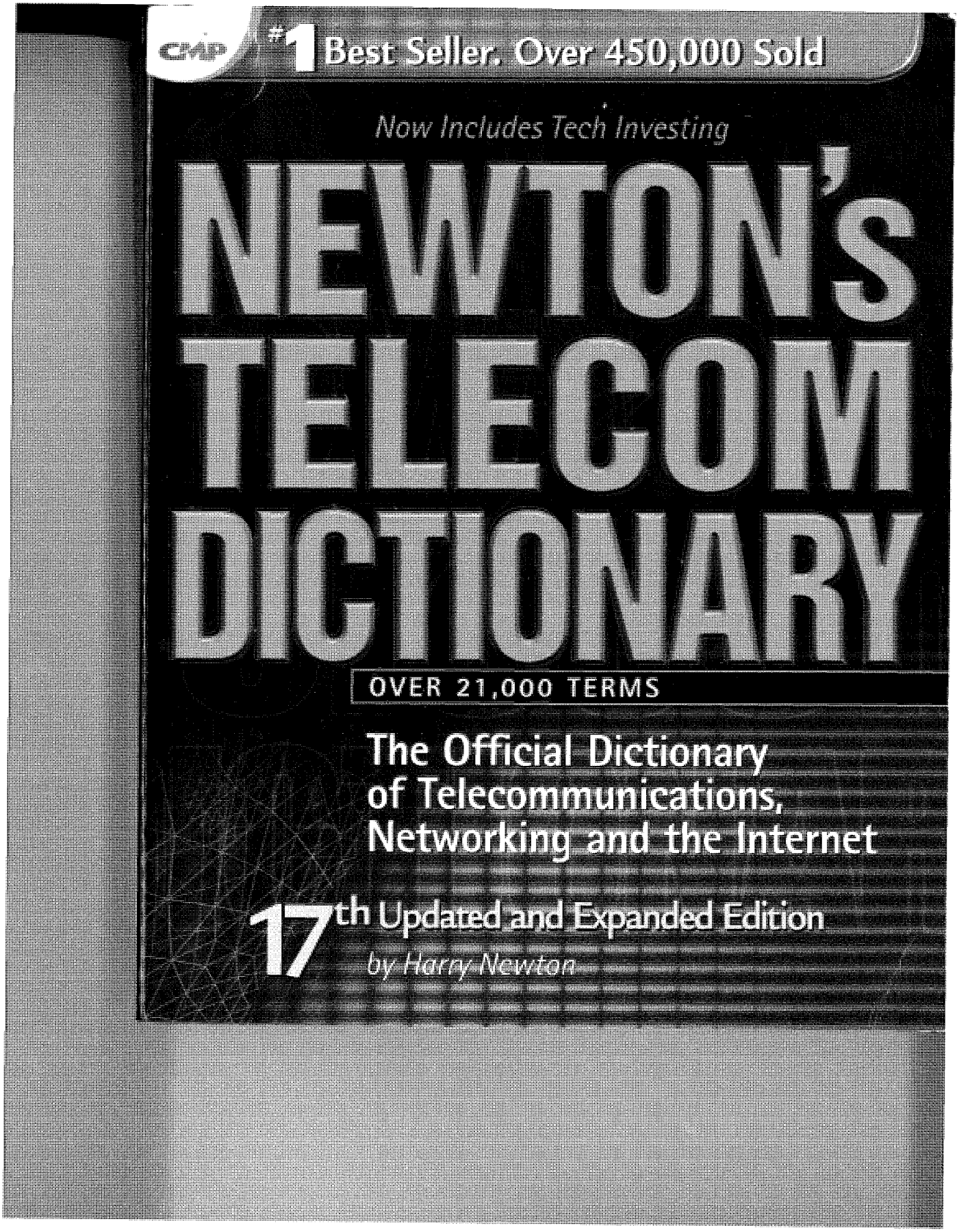
the obtaining of the second RF waveforms via the second IC comprises one or more of receiving or generating

the second RF waveforms via a 3GPP (Third Generation Partnership Project)-compliant chipset.

26. The method of claim **26**, further comprising, responsive to a determination that a wireless node is within communicative range of the first IC, enabling transmission of the converted first RF waveforms via a third data transmission protocol, the third data transmission protocol comprising a wireless data transmission protocol different from the first data transmission protocol.

* * * * *

EXHIBIT 13


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Snuggling Snuggling is a method used by operators of surveillance equipment. A surveillance equipment operator, when building radio transmitters, will select a transmitter frequency close to that of a nearby high powered transmitter, usually, a commercial radio station. Most ordinary radio gear will automatically tune into the stronger of the two signals. The operator must use a specially modified receiver capable of detecting and isolating the weaker signal. "Snuggling" will be difficult to detect by low quality RF receivers when making a countermeasure sweep.

SO Serving Office. Central office where IXC (IntereXchange Carrier) has POP (Point Of Presence).

Soak A means of uncovering problems in software and hardware by running them under operating conditions while they are closely supervised by their developers.

Soap Simple Object Access Protocol (SOAP) is new "open" software developed by Microsoft for exchanging information over the Web based on a standard call the Extensible Markup Language (XML). SOAP will be open if it's ever adopted by a standards body or sufficient number of programmers program to it and it becomes a defacto standard. SOAP is actually a network protocol that lets software objects developed using different languages communicate with each other. Microsoft sees it as leveling the playing field between Windows and development strategies based on Java. Instead of being forced to chose one model, companies will be free to select whichever is best suited to solving the problem at hand, Microsoft argues.

At issue is the slugfest between Microsoft and its competitors over the programming models software developers use. Microsoft has its own programming model based on the Windows operating system, called the Component Object Model (COM). Its competitors support Enterprise JavaBeans (EJBs) and Comman Object Request Broker Architecture (CORBA), two programming models that are tightly integrated with each other.

SOAP would replace Microsoft's current proprietary protocol called DCOM for communication over the Internet. Because SOAP is based on XML, it's compatible with all programming models and allows businesses to exchange data with each other over the Internet.

SOC System-On-a-Chip. A silicon integrated circuit which combines generic functions (e.g., microcontrollers, UARTs, memory, FIFOs, and other analog and digital logic functions) with custom design elements to create a device that contains all major elements of a system on one integrated chip. This is one method of increasing design productivity. The SOC designer collects and integrates pre-defined (and pre-tested) components similar to the way hardware designers collect and interconnect integrated circuits on a circuit board design. The final implementation of an SOC may be in an ASIC or FPGA. Also see ASIC and FPGA. Thanks to Ken Coffman for this definition.

Social Computing A term that emerged in the summer of 1993. Defined by Peter Lewis in the New York Times of September 19, 1993, social computing is a "communications-rich brew," which is "expected to create new ways for businesses and their customers to communicate, over new types of wireless as well as wired pathways, using new types of computers called personal communicators." According to Peter Lewis, "The rise of social computing is expected to shift the emphasis of computing devices away from simple number crunching and data base management to wider-ranging forms of business communications...Where client server broke away from mainframe-based systems and distributed computing power to everyone in the organization, social computing goes the next step and extends the distribution of computing power to a company's customers."

Social Contract An arrangement between the local telephone company and its local regulatory authority whereby the telephone company's services are detariffed, but cannot be priced at less than cost. Quality of service standards apply.

Social Engineering Gaining privileged information about a computer system (such as a password) by skillful lying — usually via a phone call. Often done by impersonating on authorized user.

Socket 1. A synonym for a port.

2. A technology that serves as the endpoint when computers communicate with each other.

3. The socket in a PC which is responsible for accepting a PCMCIA Card and mapping the host's internal bus signals to the PCMCIA interface signals.

4. An operating system abstraction which provides the capability for application programs to automatically access communications protocols. Developed as part of the early work on TCP/IP.

Socket Interface The Sockets Interface, introduced in the early 1980s with the release of Berkeley UNIX, was the first consistent and well-defined application programming interface (API). It is used at the transport layer between Transmission Control Protocol (TCP) or User Datagram Protocol (UDP) and the applications on a system. Since 1980, sockets have been implemented on virtually every platform.

Socket Number In TCP/IP, the socket number is the joining of the sender's (or receiver's) IP address and the port numbers for the service being used. These two together uniquely identifies the connection in the Internet.

Socket Services The software layer directly above the hardware that provides a standardized interface to manipulate PCMCIA Cards, sockets and adapters. Socket Services is a BIOS level software interface that provides a method for accessing the PCMCIA slots of a computer, desktop or laptop (but most typically a laptop). Ideally, socket services software should be integrated into the notebook's BIOS, but few manufacturers have done so to date. For PCMCIA cards to operate correctly you also need Card Services, which is (not are) a software management interface that allows the allocation of system resources (such as memory and interrupts) automatically once the Socket Services detects that a PC Card has been inserted. You can, however, happily operate PCMCIA cards in your laptop without using socket and card services. You simply load the correct device drivers for those cards. Such drivers always come with PCMCIA cards when you buy the cords. You will, however, have to load new drivers every time you change cards and allocate the correct memory exclusions. You will have to reboot if you disconnect your network card. Theoretically, with socket and card services loaded, you do not have to reboot every time you change cards. My experience is that this works, except with network cards, which cannot be hotswapped. See PCMCIA.

Sockets An application program interface (API) for communications between a user application program and TCP/IP. See Socket and Socket Number.

SOCKS A circuit-level security technology developed by David Koblas in 1990 and since made publicly available by the IETF (Internet Engineering Task Force. SOCKSv5, the current version, provides security in a client/server environment, running at the Session Layer, Layer 5 of the OSI Reference Model. SOCKSv5 supports multiple means of authentication, negotiated between client and server over a virtual circuit, and on a session-by-session basis. SOCKSv5 also supports the transfer of UDP data as a stream, avoiding the need to treat each packet of UDP data as an independent message. SOCKSv5 also allows protocol filtering, which offers enhanced access control on a protocol-specific basis. For example, a network administrator can add a SMTP (Simple Mail Transfer Protocol) filter command to prevent hackers from extracting from a mail message information such as a mail alias. Reference implementations exist for most UNIX platforms, as well as Windows NT. The cross-platform nature of SOCKS offers portability to Macintosh and other operating systems and browsers. According to Network World Magazine, September 27, 1999, "the latest version of SOCKSv5 offers network managers an easier way to run videoconferencing and video and audio streaming through firewalls, which has been difficult and time-consuming. Socksv5 does this by providing a single and powerful method of authenticating users and managing security policies for all Internet applications, including multimedia." SOCKSv5 also interoperates on top of IPv4, IPsec, PPTP, L2TP and other lower-level protocols.

SOF Start Of File

Soft Copy 1. A copy of a file or program which resides on magnetic medium, such as a floppy disk, or any form that is not a hard copy — which is paper.

2. Old legacy systems term reapplied to distributed computing in which reports are created on-screen from data residing within different applications.

Soft Decision See SISO.

Soft Ferrite Ferrite that is magnetized only while exposed to a magnetic field. Used to make cores for inductors, transformers, and other electronic components. See Barium Ferrite, Ferrite and Hard Ferrite.

Soft Font A font,usually provided by a font vendor, that must be installed on your computer and sent to the printer before text formatted in that font can be printed. Also known as downloadable font.

Soft Handoff 1. A cellular radio term. A soft handoff is a handoff between cell sites that involves first making the connection with the new cell site before breaking the connection with the previous cell site. A hard handoff, or "break and make" handoff, is not noticeable in a voice conversation, but has disastrous impact on a data communication. See also Hard Handoff.

2. A satellite term. The process of transferring a circuit from one beam or satellite to another without interruption of the call.

Soft Input-Soft Output See SISO.

Soft Key There are three types of keys on a telephone: hard, programmable and soft. HARD keys are those which do one thing and one thing only, e.g. the touchtone buttons 1, 2, 3, * and # etc. PROGRAMMABLE keys are those which you can program to do or produce a bunch of tones. Those tones might be "dial mother." They might be "transfer the

ly standard anymore.) The most
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characters above 127 to repre-
uch os those to draw boxes. But
ndard 7-bit ASCII. The ITU (now
bet 5.
nounced ebb'-si-dick). It's large-
rs (but not their PCs, which use
ing scheme, thus allowing up to
: 2 x 2 = 256. EBCDIC codes let-
nt way than ASCII. For ASCII files
), those ASCII files must be trans-
is available. See also ASCII Editor,
e Code and Unicode.
"DOS" or "non-document mode"
E] codes, which are used by word
c, underlining, and super/subscript
c paragraph reformat, pagination,
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de their text so they can tell printers

ages, such as EDLIN (for batch files),
SCII and printer codes, it could not be
; these "high level" codes differently
"vanilla" text...nothing fancy about it.
127 and below ASCII characters that
editor, also called an ASCII editor. An

nsfer of a word-processed file directly
scanned from a hard copy print-out.
e out much cleaner at the other end,
ge.
's leased line (also called private line)
ar services. It is available in N x 56/64
OP-POP service (between long distance
line.
nt. A module or portion of a protocol in
interconnection) protocol stack. Several
ocol, e.g., the X.400 P1 protocol which
ment), and the RTSE (Reliable Transfer

the tandem or the dial tone office and

mpression algorithm that is said to offer
annel. It can be used in bridges, routers,
aid at one point that it was the exclusive

technique used on ISDN circuits to com-
e to the other CPE. It is the opposite of
uently at the T-1 level. ASI assigns spaces
0 mV) of marks to zeroes. See also AMI.

3.Application Software Interface. An ISDN term. See Application Software Interface.
4.Adapter Support Interface. The driver specification developed by IBM for networking over IEEE 802.5 Token-Rings.

Asia-Pacific Telecommunity APT. A telecommunications organization for the Asia Pacific region.

ASIC Application-Specific Integrated Circuit. A silicon chip that is custom-designed for a particular purpose, at least that's the pure definition. In actuality, the term is misleading because many ASICs are designed to perform multiple, generalized tasks. From the manufacturer's point of view, a microprocessor is an ASIC, though they can and are used for widely disparate purposes in the field. An ASIC requires large production volumes to be economical; long design cycles and high-priced design tools (and designers) make them expensive to create, but inexpensive to produce in high-volumes. Manufacturers use ASICs to consolidate many chips into a single package, thereby reducing system board size and power consumption. Many video boards and modems use ASICs. ASICs span programmable array logic (PAL) devices, electrically programmable logic devices (EPLDs), field programmable logic devices (FPGAs), gate arrays, standard cell-based devices, and full custom, designed-from-scratch ICs. See also ASSP, FPGA, and SOC.

ASIC Chip Application Specific Integrated Circuit Chip. A fancy name for microprocessor chips which do specific tasks. For example, an ASIC chip might be responsible for a graphics display. See ASIC

ASL Adaptive Speed Leveling. A US Robotics term for adjusting the transmission speed of a modem up or down, depending on the conditions on the line. US Robotics says it can adjust speed in 2 or 3 seconds after detecting changed line conditions. It requires like modems an either end of the transmission.

ASMTP See Authenticated SMTP.

ASN 1. Abstract Syntax Notation One. LAN "grammar," with rules and symbols, that is used to describe and define protocols and programming languages. ASN.1 is the OSI standard language to describe data types. The Abstract Syntax Notation is a formal language defined by ITU X.208 and ISO 8824. Under both CMIP and SNMP, ASN.1 defines the syntax and format of communication between managed devices and management applications. See CMIP, SNMP. For a fuller definition, see Abstract Syntax Notation One.

ASOC Technology This definition from Bookham Technology: ASOC technology is the fabrication of integrated optical components from a base material of silicon. Silicon has excellent optical properties including a low optical loss at 1310nm and 1550nm — the wavelength bands at which to transmit telecommunication signals. Silicon is the world's best known manufacturing material and benefits from the mature manufacturing processes of the microelectronic industry to significantly reduce the complexity of design and manufacture. Manufacturing ASOC devices fundamentally involves the construction of low-loss, single-mode waveguides onto silicon-on-insulator wafers. Library elements, such as couplers and modulators, and hybridized active elements, such as lasers and photodiodes, are combined to provide devices with a wide range of functionality. Consequently compact and versatile integrated optical components can be produced in high volume and at low cost. The flexible nature of ASOC technology means it can also be utilized to provide application specific, high functionality, high value devices including Arrayed Waveguide Gratings (AWG) and Variable Optical Attenuators (VOA).

ASP 1. A Northern Telecom term for Attached Support Processor.
2.Adjunct Service Point. An intelligent-network feature that resides at the intelligent peripheral equipment and responds to service logic interpreter requests for service processing. See also AIN.
3.Administrable Service Provider. A SCSA term.
4.Abstract Service Primitive. An ATM term. An implementation-independent description of an interaction between a service-user and a service-provider at a particular service boundary, as defined by Open Systems Interconnection (OSI).
5.Application Service Provider. See Application Service Provider.
6.Active Server Page. A dynamic HTML scheme designed by Microsoft that is a combination of HTML and VBScript (Visual Basic Script). Active Server Pages, or ASP for short, generate HTML on your Web server and send it to your browser. Perl for Win32 and PerlScript are required on your server but they are not required on the clients. See also JHTML.

Aspect Ratio The ratio of width to height of a computer display or TV screen. The aspect ratio of NTSC and PAL TV is four units of width to every three units of height. This is expressed as 4 x 3 aspect ratio. A 35 mm frame measures 12 x 24 mm, which means it has two units of width to one unit of height. It is different in size from a TV screen. This is why the side parts of movies are chopped off on TV. For VGA and Indeo video technology, the aspect ratio is 4:3 yielding today's standard PC screen sizes in pixels of 640 x 480 and 1024 x 768.

ASPI Advanced SCSI Programming Interface set. In other words, software primitives and data structures which allow software using the ASPI interface to be SCSI host adapter-independent. SCSI stands for Small Computer System Interface. (Pronounced Scuzzie.) ASPI is software that acts as a liaison between SCSI device drivers (the software that drives the SCSI devices) and the interface card (also known as the host adapter). Whenever a new device is added to a computer system, a software program called a "driver" must tell the computer how to talk to the new device. Instead of forcing vendors to write drivers for every host adapter, ASPI lets them write a driver to ASPI standards, supposedly guaranteeing that the device the driver controls will work with all ASPI-compatible host adapters. The idea behind ASPI is to create a "black box" software interface - one which allows programmers to create software without having to know anything about the details of the SCSI interface hardware used in your computer. With ASPI, it's possible to write programs that can be used with any SCSI-based device used on a computer system that supports ASPI. While things are not always 100% perfect in all cases, ASPI greatly reduces potential compatibility problems for you, the user.
How does ASPI work? Essentially, there are two parts to an ASPI implementation. First, there's the ASPI "manager" which is a device driver supplied by the hardware manufacturer, and the ASPI software application. It's important to note that without an ASPI manager, ASPI compatibility is not possible. It's the manager that creates the standard ASPI-compatibility layer between the SCSI host adapter hardware and the ASPI-compatibility application. The manager is very hardware-specific, and is almost always supplied by the manufacturer of your SCSI host adapter.

ASQ Automated Status Query.

ASR 1. Automatic Speech Recognition. See Interactive Voice Response.
2.Automatic Send Receive. A teletype or telex machine manufactured by the old Teletype Corporation. Such a hard-copy terminal, if left on and loaded with paper, will receive incoming messages and print them, even when nobody is present. The machine also can be commanded remotely to send the full contents of its paper tape reader. Teletype Corporation's ASR-33 was a very popular minicomputer terminal in the 1970s. They now are considered to be obsolete.
3.Access Service Request. This is a request that a telephone company gives to another telephone company for any of many kinds of interconnectivity or data sharing needs. These requests can be between local carriers or long distance carriers and can originate with either an incumbent or an alternative company. See Access Service Request for more detail.
4.Authorized Sales Representative. Many phone companies have programs which allow interconnect or other resellers companies to resell their services — from simple local lines to T-1 lines. The phone companies often pay these companies a small commission for their sales efforts.
5.Answer Receive Ratio. A measurement of the effectiveness of a telecommunications service offering. ASR is the relationship between the number of line seizures and the number of answered (i.e., completed) calls. Did you ever get dial tone, and then a "fast busy" because the destination device is unavailable? That is not good for ASR. Did you ever get dial tone, and then an answered call because the destination device is available? That is good for ASR.
6.Average Service Rate = Percentage of calls placed that actually complete to terminating end. For instance you might hear a technician say the ASR for India is currently 15%. ASR is a term used frequently in the international arena. For instance the ASR would be much higher for calls from the USA to the United Kingdom than third world countries such as India, Zaire, Vietnam etc.

Assembler A program which translates an assembly programming language into the code of 1s and 0s used by computers. See also Assembly code and Assembly language.

Assembler code A programming language that is a close approximation of the binary machine code. Difficult to write and different for each processor.

Assembly Pertaining to the translation of a program from symbolic language into machine code. See Assembly Language.

Assembly Language A computer language for writing software. It is a language which is converted by programs called compilers or interpreters into machine language programs which consist of only 1s and 0s and which a computer can understand. Even though an assembly language consists of recognizable mnemonics and meaningful words, it's not easy to program in. It is referred to as a "low-level language". Assembly language programs run faster than high-level language programs, such as Basic, COBOL or FORTRAN, which are much easier to learn and program in. Choosing a programming language is a

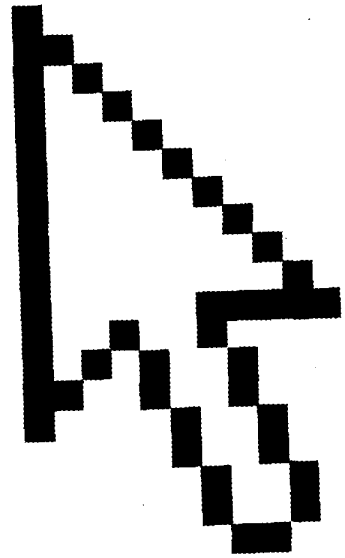
A

EXHIBIT 14

Microsoft

Microsoft® Computer Dictionary

Fifth Edition



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no application or transport semantics, which makes it highly modular and extensible.

SOC *n.* Acronym for system on a chip. A chip integrating computer, microprocessors, and all necessary support components in a single unit. SOC technology is used in firewalls, gateways, specialized servers, and interactive devices like Web pads and vending machines.

social engineering *n.* The practice of penetrating system security by tricking individuals into divulging passwords and information about network vulnerabilities. Often done by calling the individual on phone and pretending to be another employee of company with a computer-related question.

Society for Information Management *n.* A professional society based in Chicago for information systems executives, formerly the Society for Management Information Systems. *Acronym:* SIM.

Society for Management Information Systems *n. See* Society for Information Management.

socket *n.* **1.** An identifier for a particular service on a particular node on a network. The socket consists of a node address and a port number, which identifies the service. For example, port 80 on an Internet node indicates a Web server. *See also* port number, sockets API. **2.** The receptacle part of a connector, which receives a plug. *See also* female connector. **3.** A receptacle on a PC motherboard into which a microprocessor is plugged. A socket-mounted microprocessor, such as the Pentium, connects to the motherboard through numerous pins on the underside. Newer Intel microprocessors, such as the Pentium II and later, plug into the motherboard through an edge connector along the side of the chip. *See also* socket 4, socket 5, socket 7, socket 8. *Compare* Slot 1, Slot 2.

socket 4 *n.* A 5-volt mounting socket on a PC motherboard designed to hold a Pentium microprocessor operating at 60 MHz or 66 MHz. Socket 4 includes openings for 273 pins. *See also* Pentium, socket (definition 3). *Compare* Slot 1, Slot 2, socket 5, socket 7, socket 8.

socket 5 *n.* A 3.3-volt mounting socket on a PC motherboard designed to hold a Pentium microprocessor operating at the following speeds: 75, 90, 100, 120, 133, 150, 166, 180, and 200 MHz. Socket 5 includes openings for 320 pins. It has been superceded by socket 7, socket 8, slot 1, and slot 2. *See also* Pentium, socket (definition 3). *Compare* Slot 1, Slot 2, socket 4, socket 7, socket 8.

socket 7 *n.* A mounting socket on a PC motherboard designed to hold a microprocessor operating at the following speeds: 150, 166, 180, 200, 210, and 233 MHz. Socket 7 includes openings for 321 pins and operates at two voltages, 2.5 volts at the core and 3.3 volts input/output. It is used with the Pentium MMX chip and competitive microprocessor chips from other manufacturers, such as AMD and Cyrix. *See also* MMX, Pentium, socket (definition 3). *Compare* Slot 1, Slot 2, socket 4, socket 5, socket 8.

socket 8 *n.* A 2.5-volt mounting socket on a PC motherboard designed to hold a Pentium Pro microprocessor. Socket 8 has openings for 387 pins. *See also* Pentium, socket (definition 3). *Compare* Slot 1, Slot 2, socket 4, socket 5, socket 7.

sockets API *n.* An application programming interface implemented to create and use sockets in client/server networking. The most common sockets API is the University of California at Berkeley UNIX/BSD implementation (Berkeley Sockets API), which is the basis for Winsock. *See also* socket (definition 1).

soc. newsgroups *n.* Usenet newsgroups that are part of the soc. hierarchy and have the prefix soc. These newsgroups are devoted to discussions of current events and social issues. Soc. newsgroups are one of the seven original Usenet newsgroup hierarchies. The other six are comp., misc., news., rec., sci., and talk. *See also* newsgroup, traditional newsgroup hierarchy, Usenet.

soft *adj.* **1.** In computing, temporary or changeable. For example, a soft error is a problem from which the system can recover, and a soft patch is a temporary program fix that holds only while the program is running. *Compare* hard (definition 1). **2.** In electronics, characterized by magnetic materials that do not retain their magnetism when a magnetic field is removed. *Compare* hard (definition 2).

soft boot *n. See* warm boot.

soft copy *n.* The temporary images presented on a computer display screen. *Compare* hard copy.

soft error *n.* An error from which a program or operating system is able to recover. *Compare* hard error.

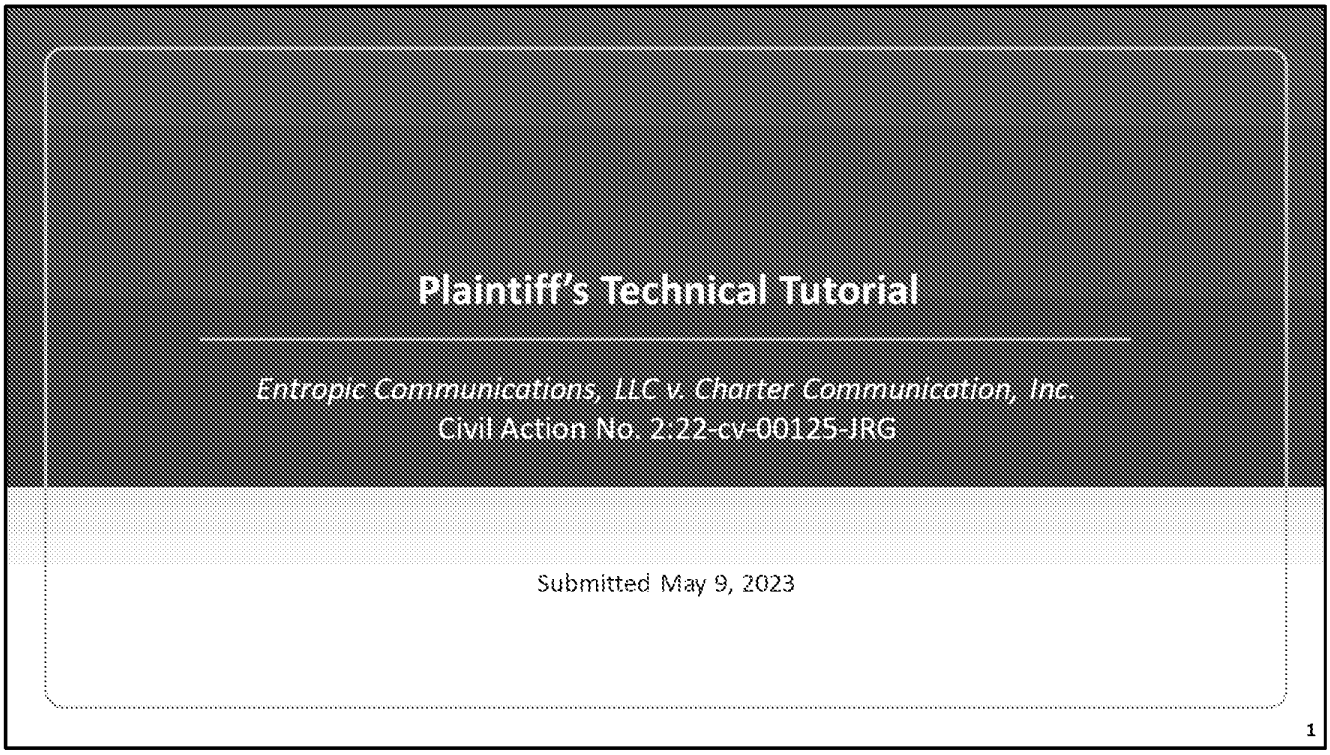
soft font *n. See* downloadable font.

soft hyphen *n. See* hyphen.

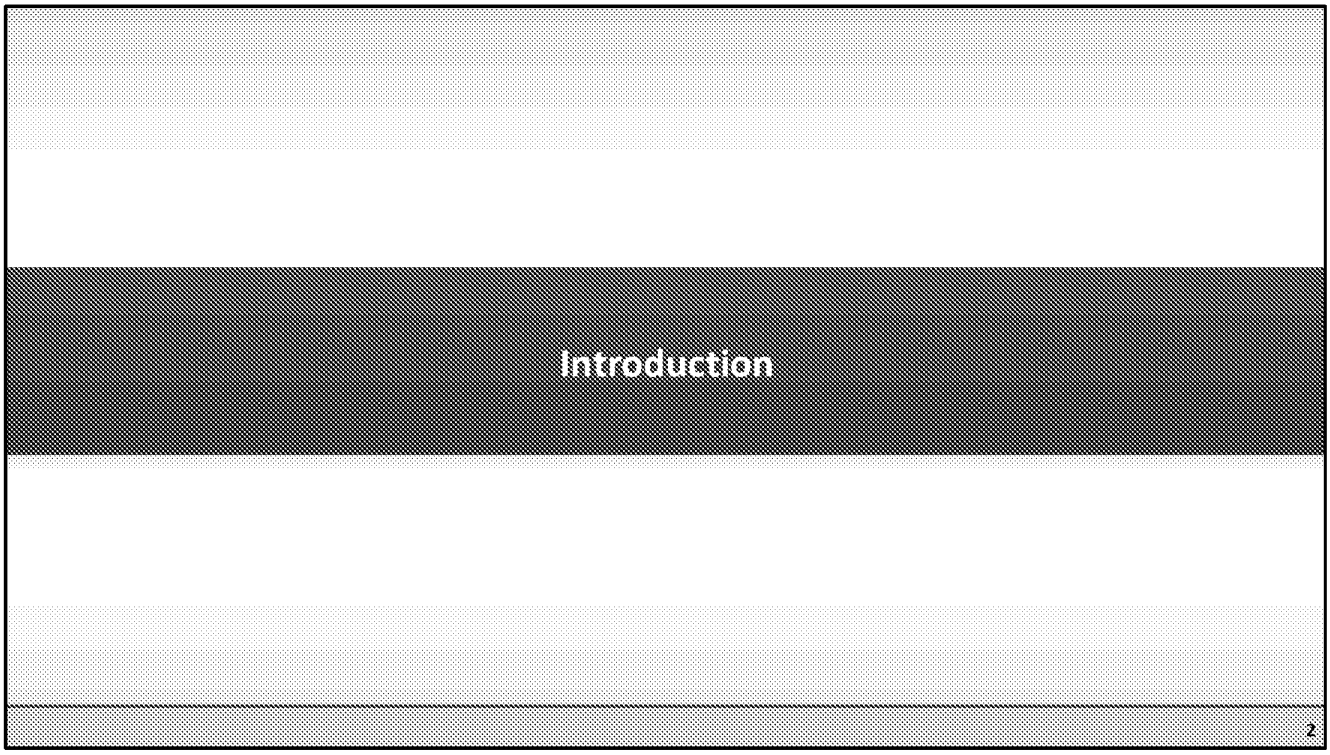
soft link *n. See* symbolic link.

softmodem *n. See* software-based modem.

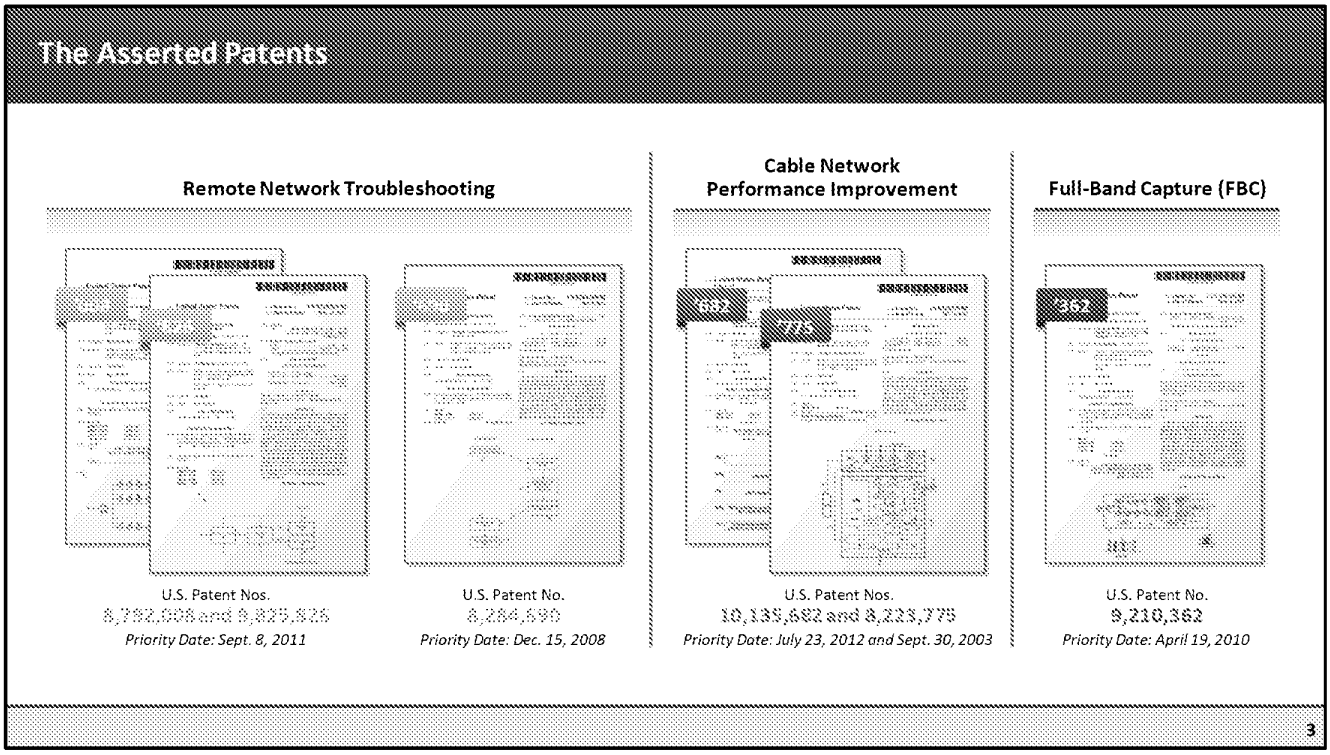
EXHIBIT 15



This is a technology tutorial by Plaintiff and Patent Owner, Entropic Communications LLC in the matter of *Entropic v. Charter Communications, Inc.* in Civil Action No. 2:22-cv-00125-JRG. This case involves six asserted patents that relate to systems and techniques for providing cable television and internet services and improving these services. Plaintiff thanks the Court for the opportunity to present this technical tutorial and hopes it will provide context for the asserted patents and the disputed claim terms.



We begin with an overview of the six Entropic patents asserted in this case and the three categories of technology they fall into. We then provide a general technology overview of cable systems, with a particular focus on where the asserted patents are implemented therein. Lastly, we provide a detailed analysis of the three categories of technology as they relate to the disputed claim terms.



The asserted patents fall into three categories of technology:

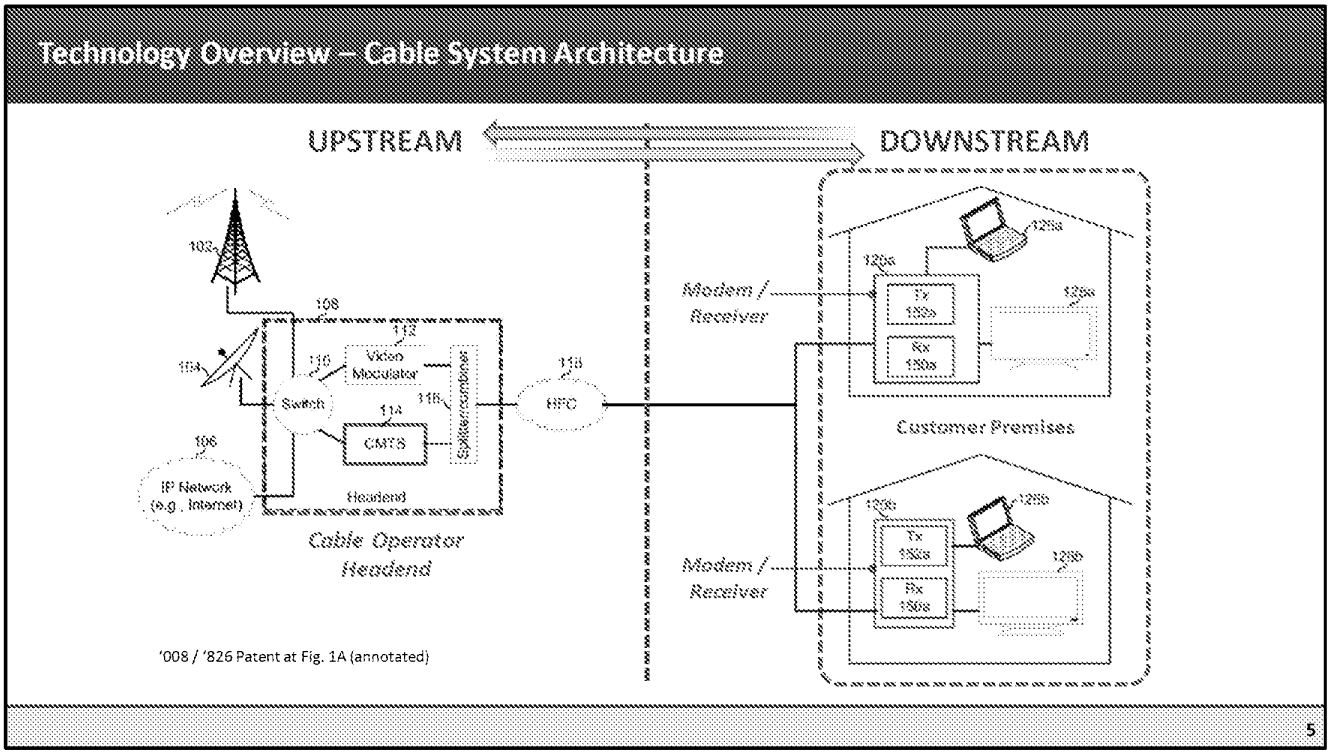
Remote Network Troubleshooting, which includes the '008, '826, and '690 Patents. We address the '008 and '826 Patents together in places because the '826 Patent is a continuation of the '008 Patent, so these patents share a specification.

Cable Network Performance Improvement, which includes the '682 and '775 Patents; and

Full-Band Capture (FBC) (also known as Full-Spectrum Capture), which includes the '362 Patent.



We now provide a general technology overview of cable systems and architecture, beginning with a high-level overview and moving to the various components and how they relate to the disputed claim terms.



Illustrated here is an overview of a cable system architecture. This Figure is from the '008 Patent and is helpful in identifying where the technology of the asserted patents are implemented within the cable system.

Two terms that are helpful to describe the specific locations in the cable system are "Upstream v. Downstream". In the context of transmitting signals, a signal is sent Downstream when it is sent away from the cable operator equipment or facilities to the customer premises. An example of a downstream bound signal is a television signal containing programing a customer wants to view on their television. A signal is transmitted Upstream when a signal is sent towards the cable operator equipment or facilities from a customer premises. An example of an upstream bound signal is a network management message regarding signal quality sent from equipment within the customer premises to the cable operator's equipment or facility.

The first component we will discuss is the "cable operator headend." This is a facility that receives an incoming signal—for example, from an antenna, satellite, or IP network—and then prepares the signal for transmission to the customer premises. Headend facilities are typically operated by the cable operator.

The next component we will discuss is the CMTS or Cable Modem Termination System. While the CMTS is typically located at the headend facility as shown, it can also be located near the customer premises. You may also hear the term CCAP, which is a Converged Cable Access Platform. A CCAP allows cable operators to use a single platform for offering traditional video and IP-based broadband services to the

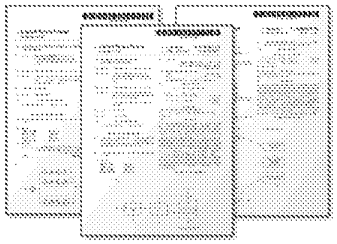
customer. For the purposes of this case and these technologies, a CMTS and a CCAP are very similar, and we will use the term CMTS throughout to refer to hardware and software the cable operators use to provide their services to their customers.

The next component we will discuss is the Hybrid Fiber Coaxial Network, or the HFC network, that connects the cable operator headend and/or CMTS to the customer premises. A HFC network includes a fiber optic network and a coaxial network, such as the networks used by the vast majority of cable operators in the United States. The fiber optic network is typically used to connect the various cable operator headends and other hardware used by the cable operator to provide their services, while the coaxial network is used for "last mile" delivery from the fiber optic network to the customer premises.

The final component is the customer premises. Various devices, often referred to as Customer Premises Equipment (sometimes referred to as CPE), are located at the customer premises. CPE can refer to a variety of devices such as cable modems, set top boxes, gateways, personal computers, televisions, and the like. We explore these on the following slides.

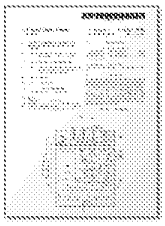
Technology Overview – Cable Operator Deployment on Customer Premises

Remote Network Troubleshooting



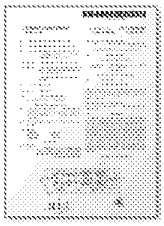
'008, '826, and '690 Patents

Cable Network Performance Improvement

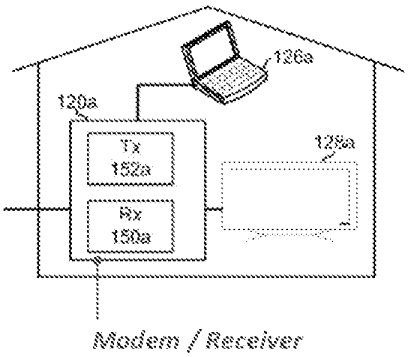


'775 Patent

Full-Band Capture (FBC)



'362 Patent



'008 / '826 Patent at Fig. 1A (excerpt)

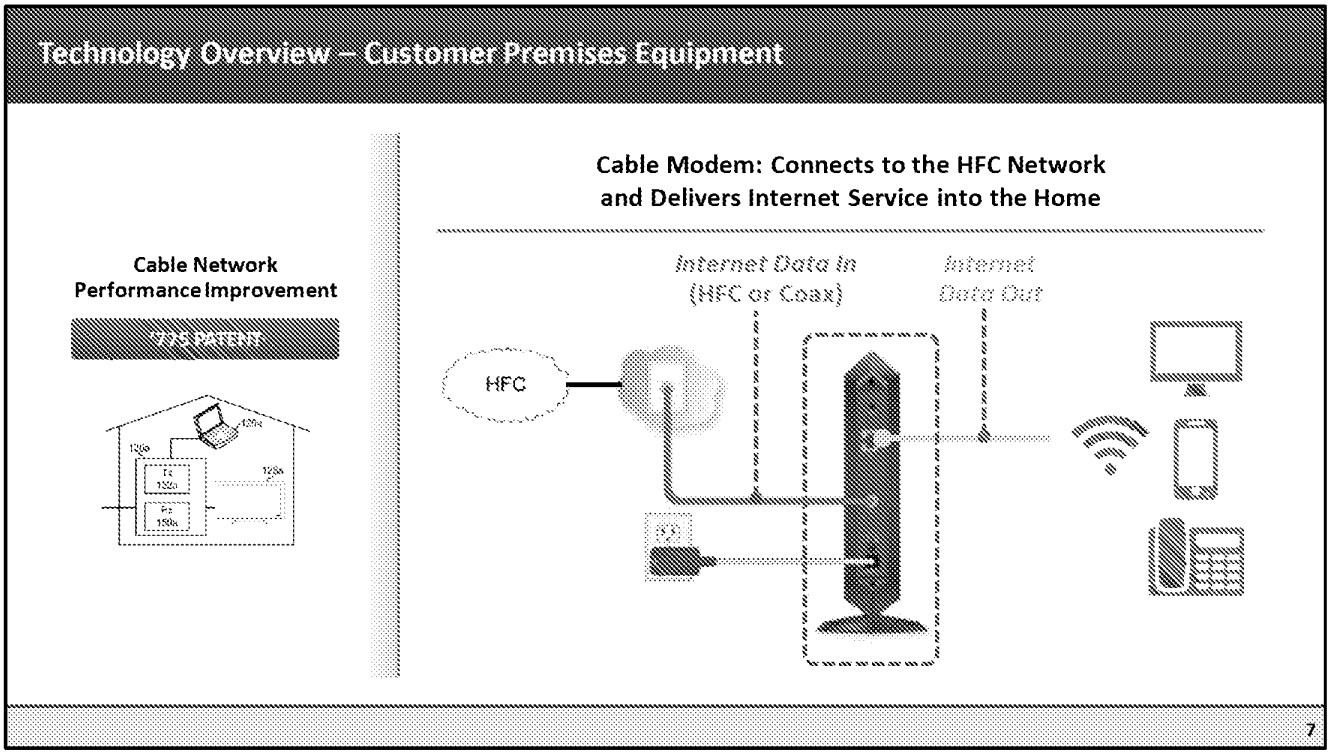
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All three categories of technology involve Customer Premises Equipment in some capacity.

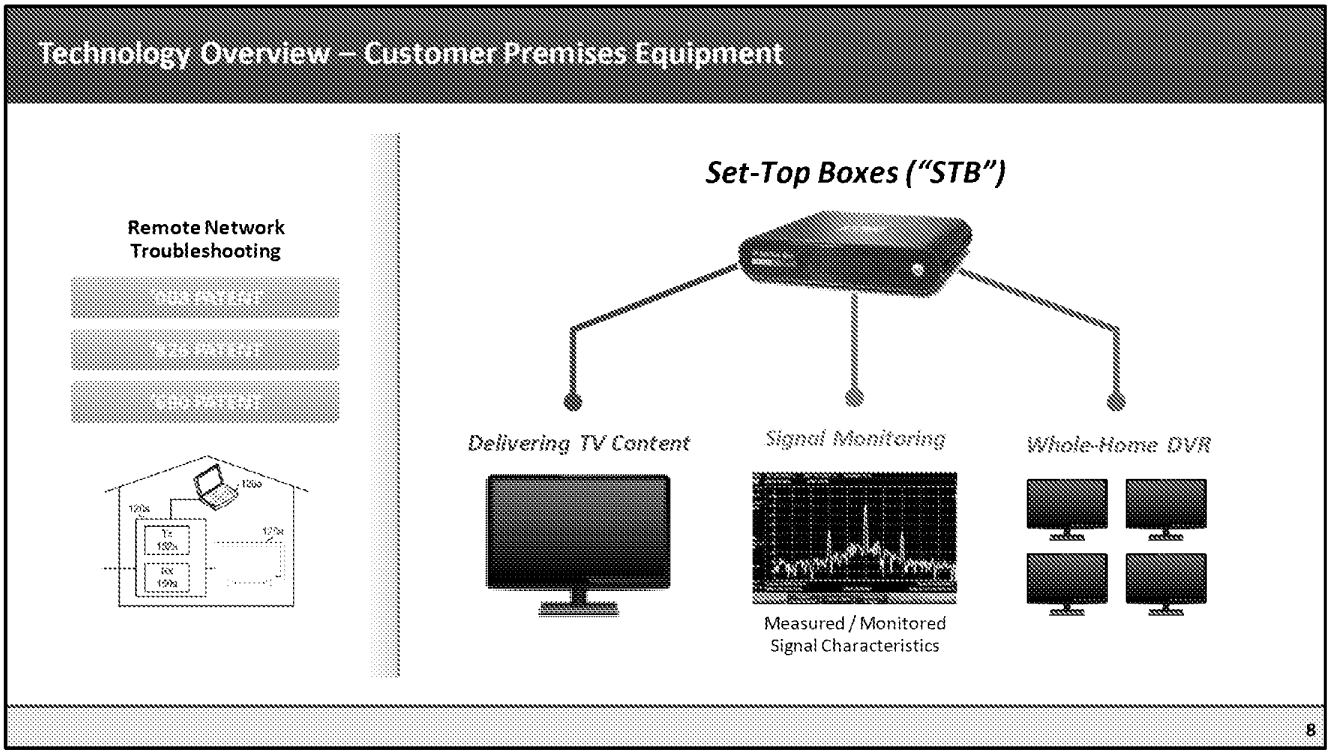
The **Remote Network Troubleshooting Patents** (the '008, '826, and '690 Patents) are directed to monitoring the signal received at the customer premises and reporting certain information back upstream to the cable operator.

The **Cable Network Performance Improvement Patents** include the '775 Patent, which is directed to an improved design for the cable gateway device.

Lastly, the **Full-Band Capture Patent** (the '362 Patent) is directed to a wideband receiver system.



One specific piece of Customer Premises Equipment is a cable modem. A cable modem (sometimes referred to as a CM) connects to the HFC network via a coaxial connection and delivers internet service into the customer premises. The customer can connect various devices, such as computers, mobile devices, Voice over Internet Protocol (VoIP) Phones, game consoles, and the like to the cable modem using Ethernet cable or a wireless connection. Cable modems are often connected to routers in order to distribute the internet service to these devices.



An additional piece of customer premises equipment is the Set Top Box, or STB for short. A Set Top Box is sometimes called a receiver or a gateway. A Set Top Box receives and decodes a television signal and delivers TV content by selecting the desired channels and outputting the content for viewing or recording. Some Set Top Boxes provide whole-home DVR services which allows a customer to watch and record different TV programs on various devices within their premises.

A Set Top Box can perform a variety of signal monitoring and reporting functions that will be discussed in more detail shortly.

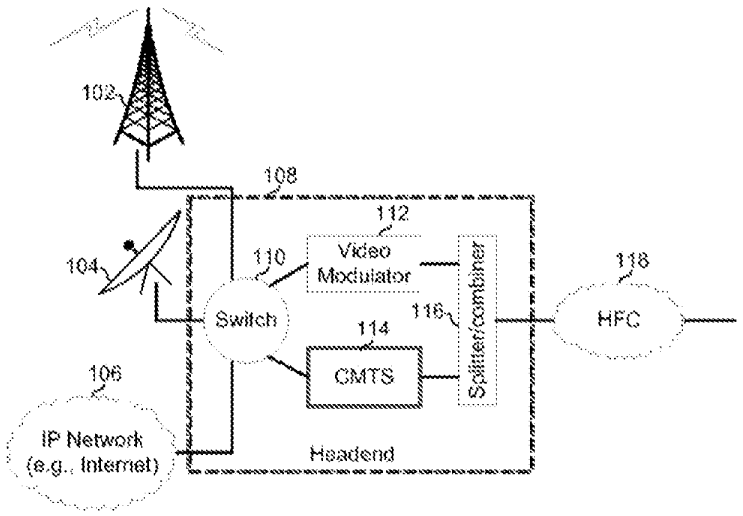
Technology Overview – Cable Modem Termination System (CMTS)

Cable Network Performance Improvement

'682 PATENT

Remote Network Troubleshooting

'690 PATENT



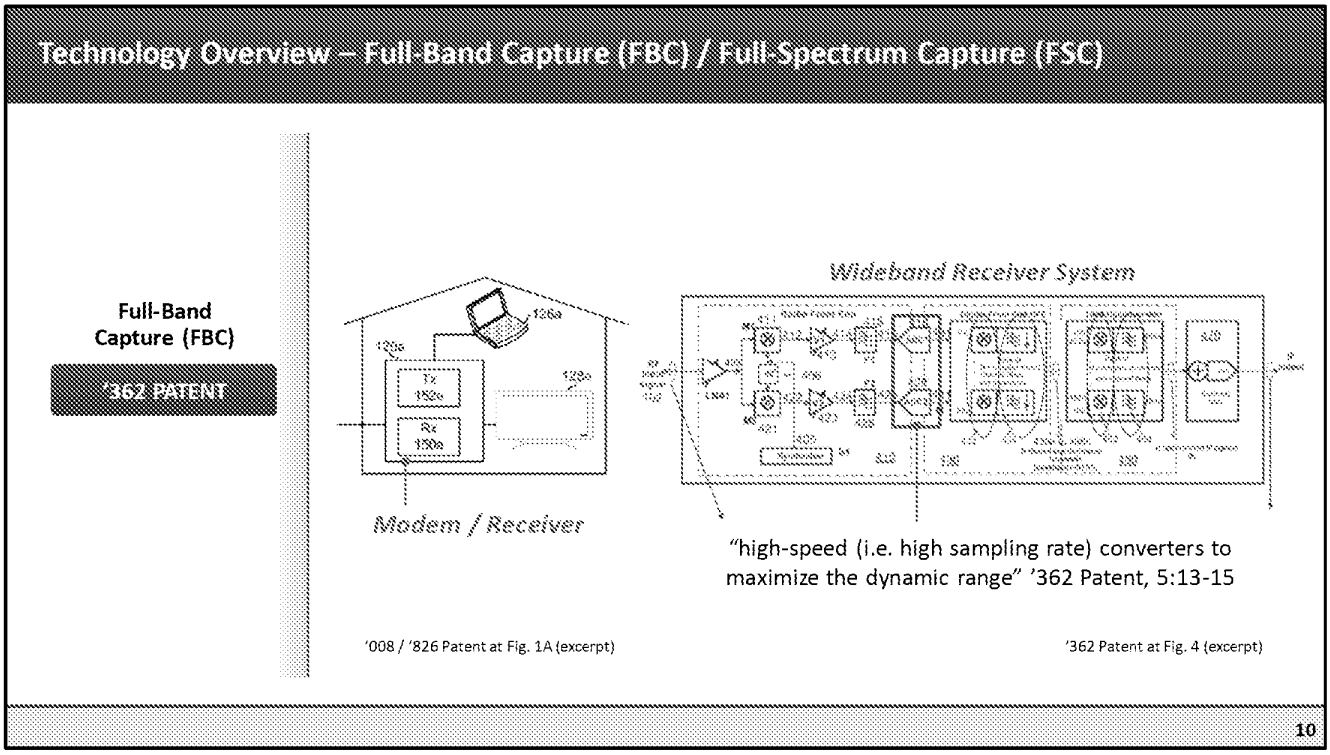
'008 / '826 Patent at Fig. 1A (excerpt)

9

As previously mentioned, a CMTS is hardware and/or software that the cable operators use to provide their services to their customers. The CMTS can transmit data to and receive data from the cable modems via the HFC network. In addition, the CMTS is responsible for managing the cable modems and measuring performance of the HFC network. One way that a CMTS can manage cable modems is by organizing them into logical groups, such as service groups.

The '682 Patent involves the use of SNR metrics, or signal-to-noise ratio metrics, to organize cable modems into service groups for a CMTS.

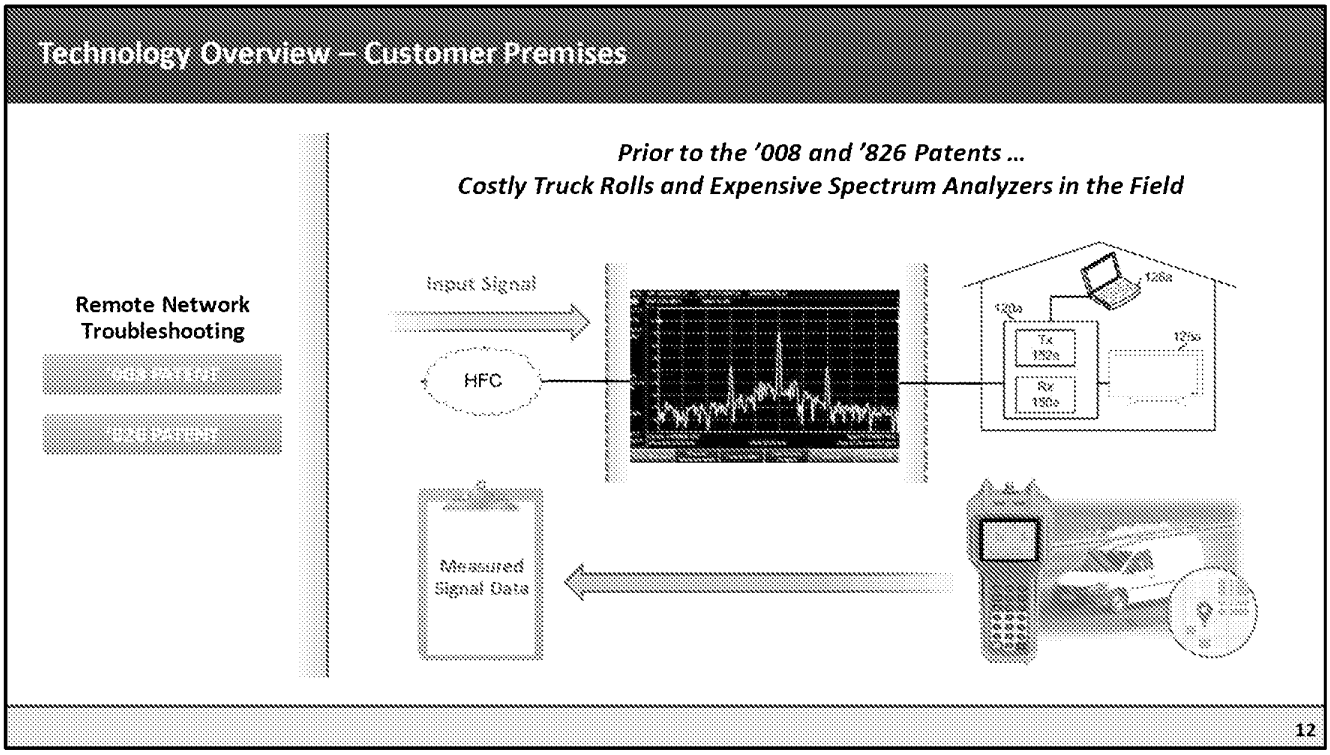
The '690 Patent involves probing customer premises equipment and reporting information back upstream to the CMTS. This enables remote diagnosis of service issues.



The last category of technology is called Full Band Capture or Full Spectrum Capture. Full Band Capture enables a customer's gateway or receiver device to capture the entire bandwidth of a received signal. The '362 Patent is directed to the use of wideband analog-to-digital converters (ADCs) to convert the received signal from analog to digital. The digital signal is processed to recover content, such as tuning specific television channels.



Next, we'll look at the '008 and '826 Patents. As mentioned before, the '826 Patent is a continuation of the '008 Patent. Therefore, we'll discuss these patents together for convenience. These two patents fall within the Remote Network Troubleshooting category of technology. These patents relate to monitoring and reporting signal characteristics of a received signal. But before we discuss the patents themselves, let's talk about the problem they were designed to solve.

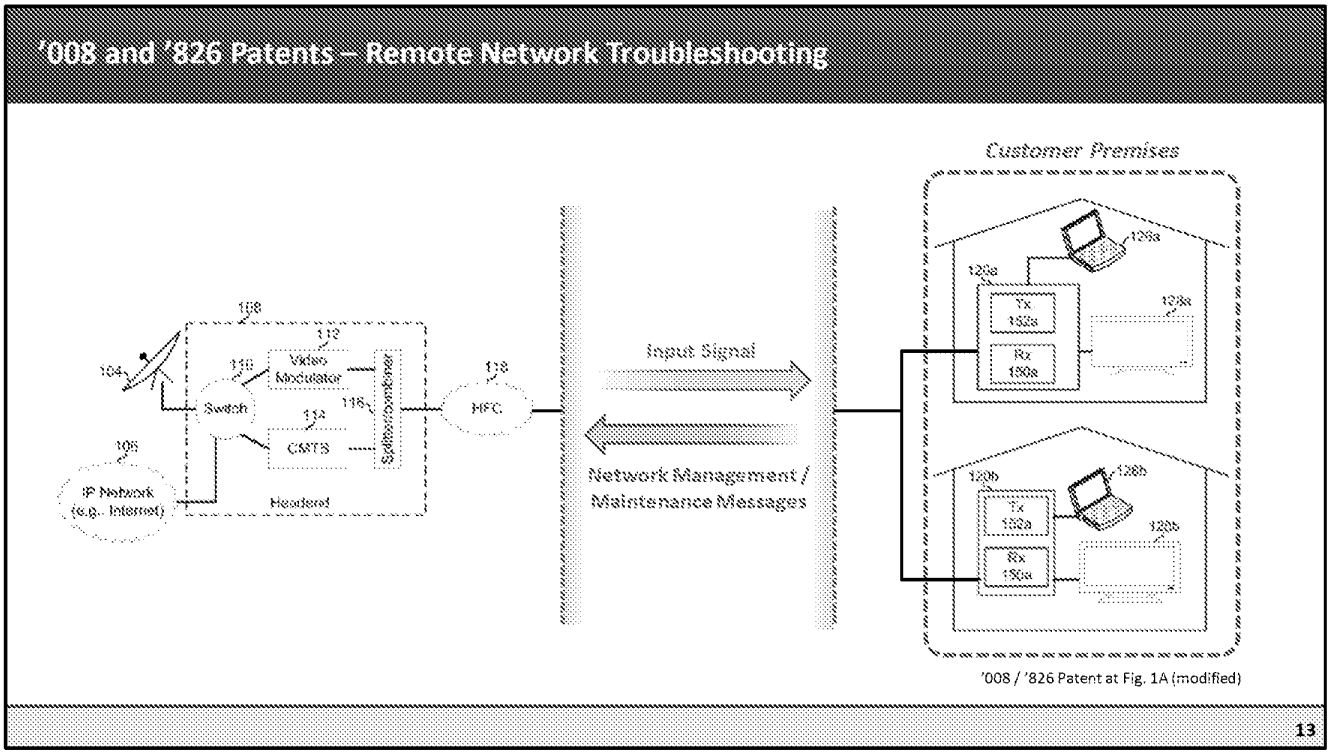


We've all experienced issues with our TV or internet service. At one time, the solution was for your cable operator to send a technician out to your home or business with diagnostic equipment. Signal analyzers are one example of diagnostic equipment that tap into the signal being sent to a customer premises and provides a read out of various signal quality metrics. These signal analyzers can be expensive, on top of the cost of sending a technician out in the field.

The '008 and '826 Patents address this problem by enabling devices located in the customer's premises to remotely monitor the service at the customer premises and report information back to the cable operator. This eliminates the need for an in-person house call.

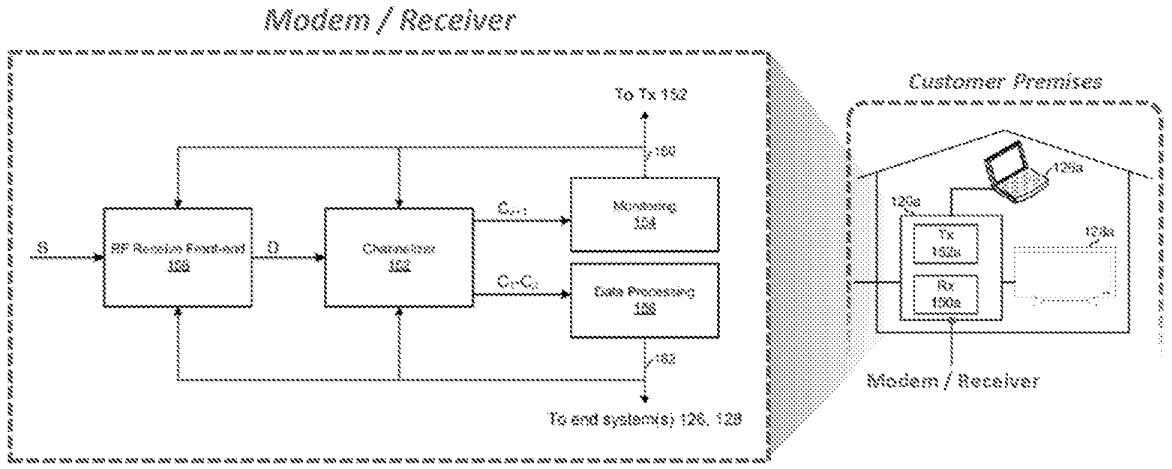
The ability to remotely monitor signal characteristics and report those characteristics back to a facility operated by a cable service provider drastically reduces costs while also providing invaluable insight for the cable service provider.

Data is money and, using the technology embodied in the '008 and '826 Patents, cable service providers have a remarkable amount of data regarding their products, their network, and their customers at their disposal.



The bidirectional nature of communications between customer premises equipment and the equipment operated by the cable service provider is illustrated here. The input signal travels downstream to Customer Premises Equipment devices, such as a cable modem or set top box, located at the customer premises. The Customer Premises Equipment devices monitor the incoming signal and report information back upstream to the cable operator. These reports can be called network management or network maintenance messages.

'008 and '826 Patents – Remote Network Troubleshooting



'008 / '826 Patent at Fig. 1B

'008 / '826 Patent at Fig. 1A (modified)

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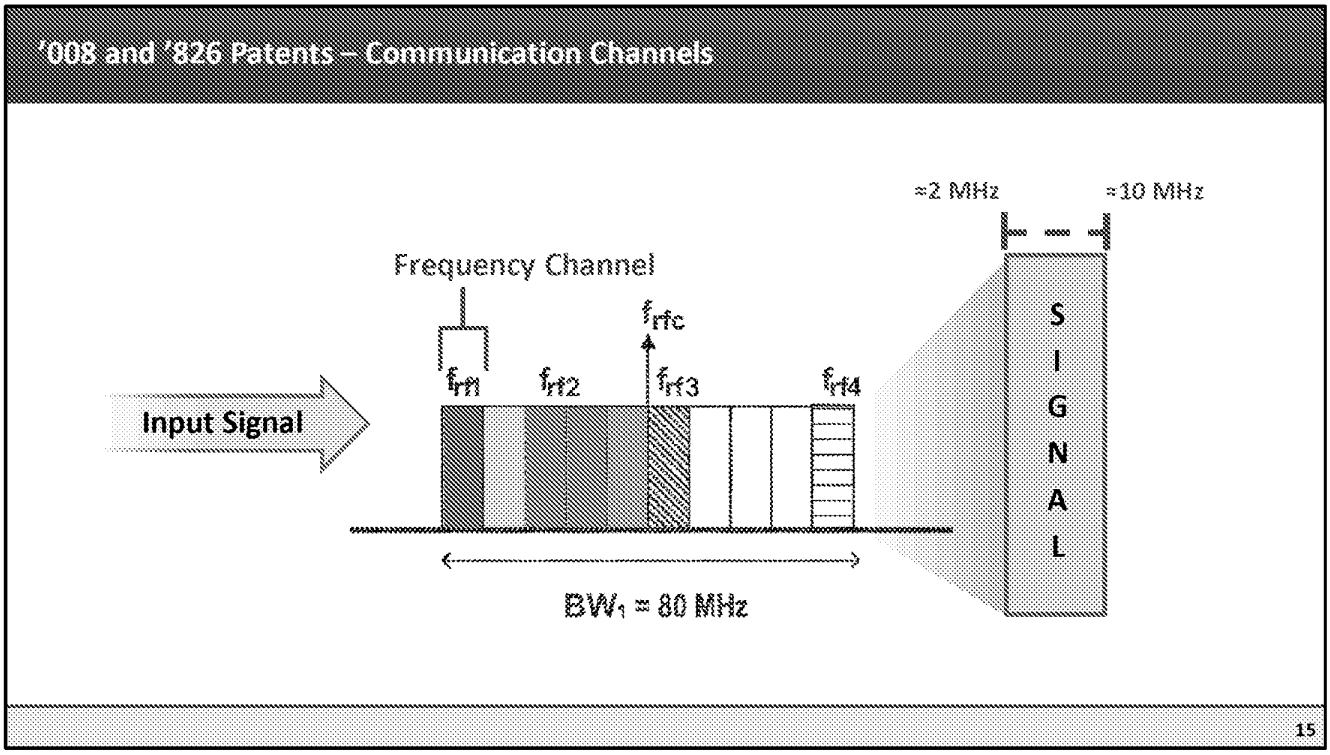
A receiver circuit, located in Customer Premises Equipment, can include several subcomponents or modules, including an RF Front End (158); a Channelizer (152); a Monitoring Module (154); and a Data Processing Module (156).

The RF Front End receives an analog input signal (labeled "S") spanning an entire spectrum. The RF Front end digitizes the input signal and outputs a digitized signal (labeled "D").

The Channelizer selects a first portion and a second portion of the digitized signal D and concurrently outputs the selected portions to the Monitoring Module and Data Processing Module. The concurrent output means that signal monitoring can occur without interrupting the customer's television service.

The Monitoring Module analyzes the portion of the signal provided by the Channelizer to determine properties (e.g. characteristics) of the signal. Network management messages describing the measured characteristics can be sent back to the source of the received signal, i.e. the cable operator.

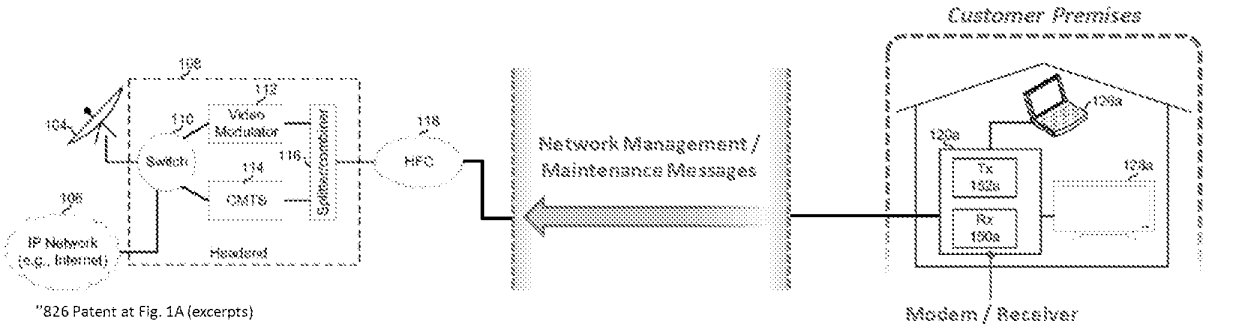
The Data Processing Module processes the signal provided by the Channelizer and recovers content stored on the signal. For example, the content can include television programming and recovering this content allows the customer to watch desired television channels.



A communication channel includes one or more frequencies that carries data. An input RF signal can include one or more channels that are located at portions of a radio frequency spectrum. A communication channel has a bandwidth, which is both a measure of the distance between the highest and lowest frequencies of the communication channel and a measure of how much data can be transferred via the communication channel. The bandwidth of a particular channel can vary, for example, the illustrated channel has a bandwidth of approximately 8 MHz.

While the word "channel" may be used in the TV space to refer to a TV Channel, such as ESPN, HGTV, etc., that is not how channel is used in the asserted patents when referring to communication channels.

'826 Patents – Remote Network Troubleshooting



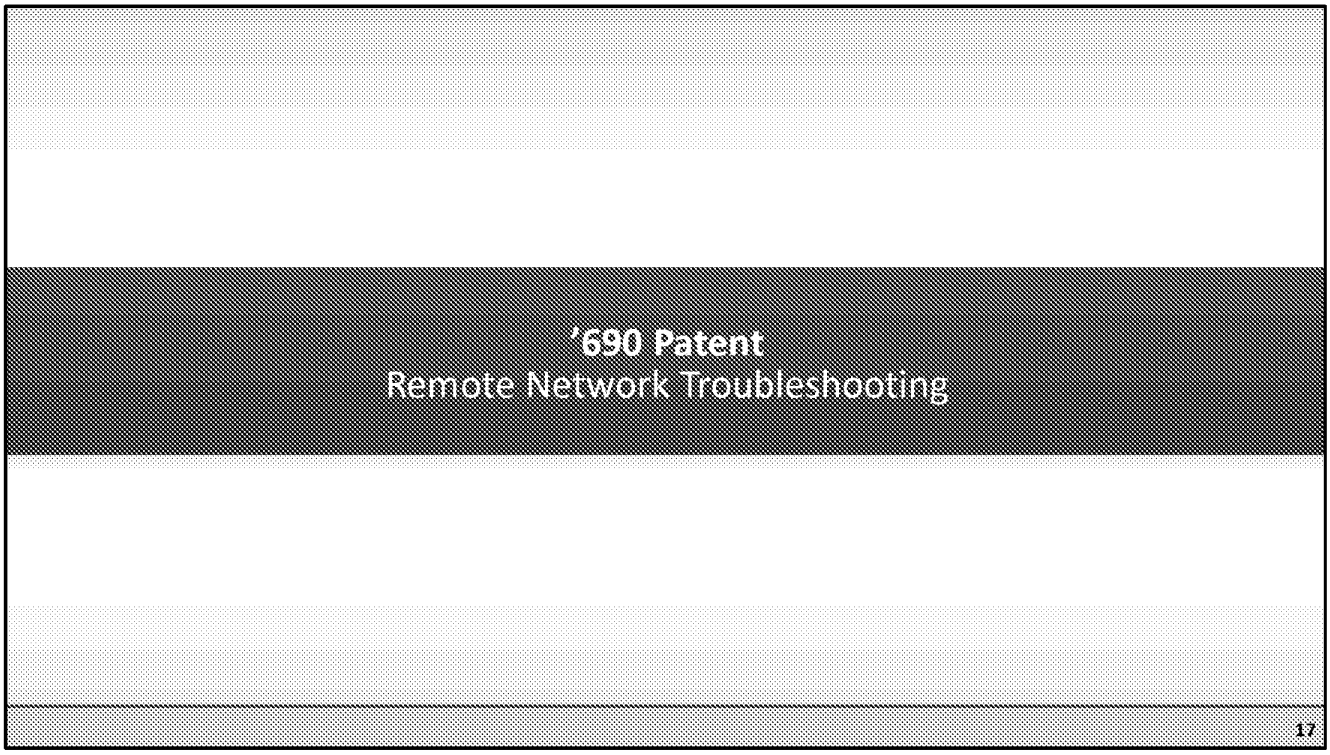
"826 Patent at Fig. 1A (excerpts)

Measured/Monitored Characteristics:

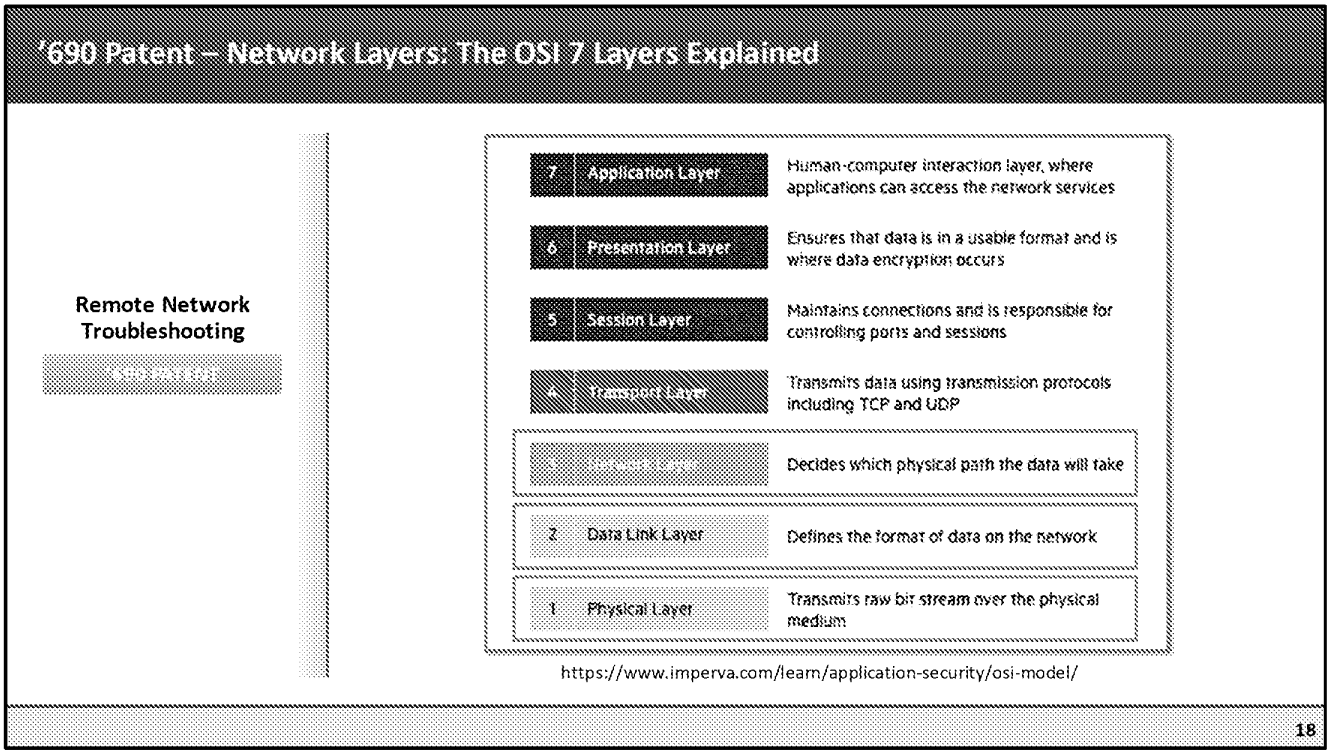
- Signal power level vs. frequency
- Phase shift vs. frequency
- Type and/or amount of modulation
- Interference levels
- Signal to noise ratio (SNR)

16

As previously discussed, the Monitoring Module of the receiver generates data describing characteristics of the received signal. Examples of signal characteristics that can be monitored and reported by the gateway include the Signal power level vs. frequency, the Phase shift vs. frequency, the Type and/or amount of modulation, Interference levels, and Signal to noise ratio (known as SNR). However, any of a variety of characteristics can be included.



The '690 Patent falls within the Remote Network Troubleshooting category of technology. Specifically, the '690 Patent is directed to diagnosing problems with customer services by using probes within a network. But first, let us explore a conceptual model of a computer network.



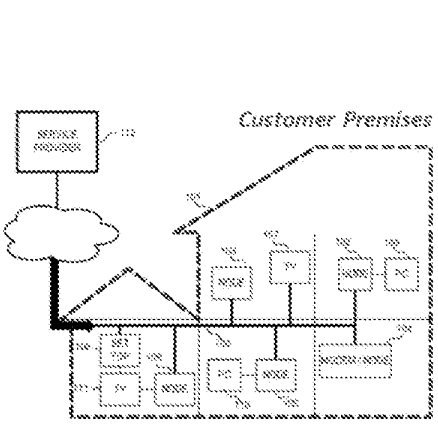
The Open Systems Interconnection (or OSI) Model of network layers utilized in the context of the '690 Patent, is illustrated on this slide. The OSI Model is commonly used in the industry to understand the various technologies and techniques used to transmit data from one device to another.

In the OSI model, the lowest layer is the Physical Layer ((P-H-Y, also pronounced "fie"), while the next layer up is the Data Link Layer. The Data Link Layer includes a Medium (or Media) Access Controller (which is referred to as MAC), which interfaces with the Physical Layer and the Network Layer to facilitate the conversion of physical communication signals (sent via the physical layer) to digital data that is processed in the Network Layer and above.

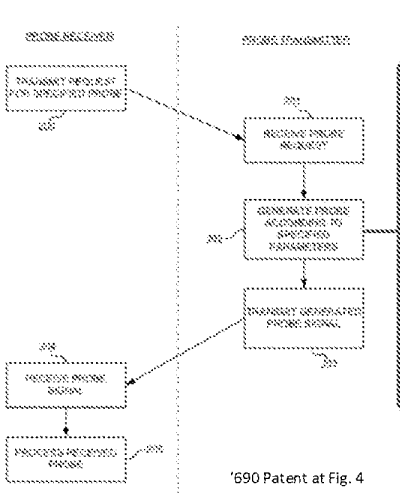
In general, the Data Link Layer provides functionality including addressing management of source and destination addresses and error detection.

A MAC address is a unique identifier assigned to every device that connects to a network. Devices in the network use these addresses for a variety of purposes, including identifying specific devices in the network and managing routing tables and other data structures.

'690 Patent – Remote Network Troubleshooting Using Probes and "a plurality of parameters"



'690 Patent at Fig. 1



'690 Patent at Fig. 4

Example Parameters:

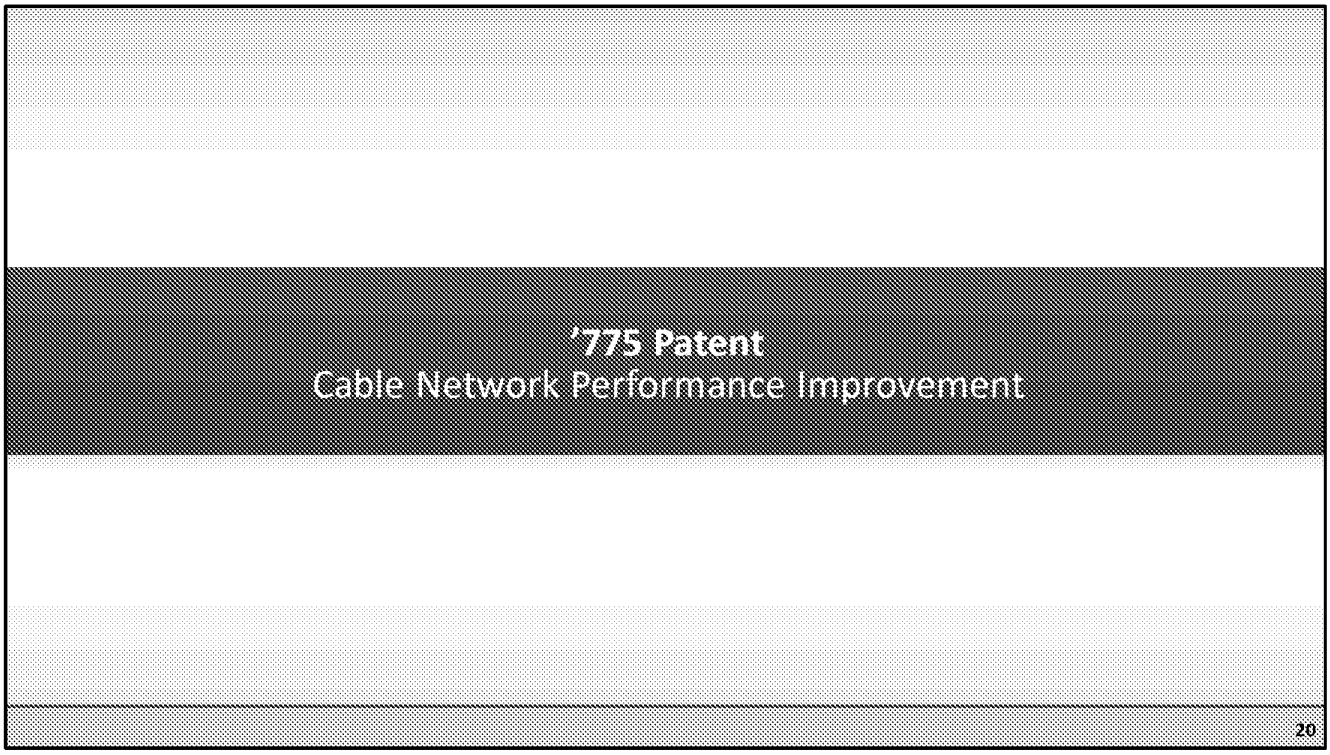
- The modulation profile for the probe
- The payload content of the probe
- The number of times to transmit the probe
- The preamble type for the probe
- The cyclic-prefix length for the payload of the probe
- The transmit power for the probe

19

The '690 Patent describes the use of probes to characterize the communication channel over which data is transmitted within a customer premises network. These probes are generated in response to a request from another node.

The slide illustrates an example embodiment.

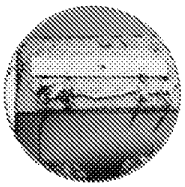
- The left side of the slide shows a customer premises network, which includes numerous network devices, or "nodes."
- These nodes are programmed to generate a probe in response to a request.
- The request may be created by the device expecting to receive the probe, and the request may specify parameters to be used in creating the probe.
- A list of example parameters is featured on the right side of the slide.



The '775 Patent falls within the Cable Network Performance Improvement category of technology and is directed towards a novel architecture for cable modems.

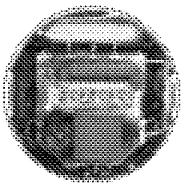
'775 Patent - Timeline

1958



First integrated circuit (IC) invented

1974



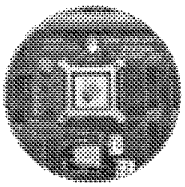
Earliest Systems-on-Chips (SoC's) used in LCD watches

1984



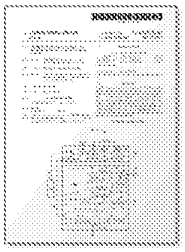
Open Systems Interconnection (OSI) model adopted as an international standard

1985



Acorn Computers develops first Advanced RISC Machine (ARM) processor

2003



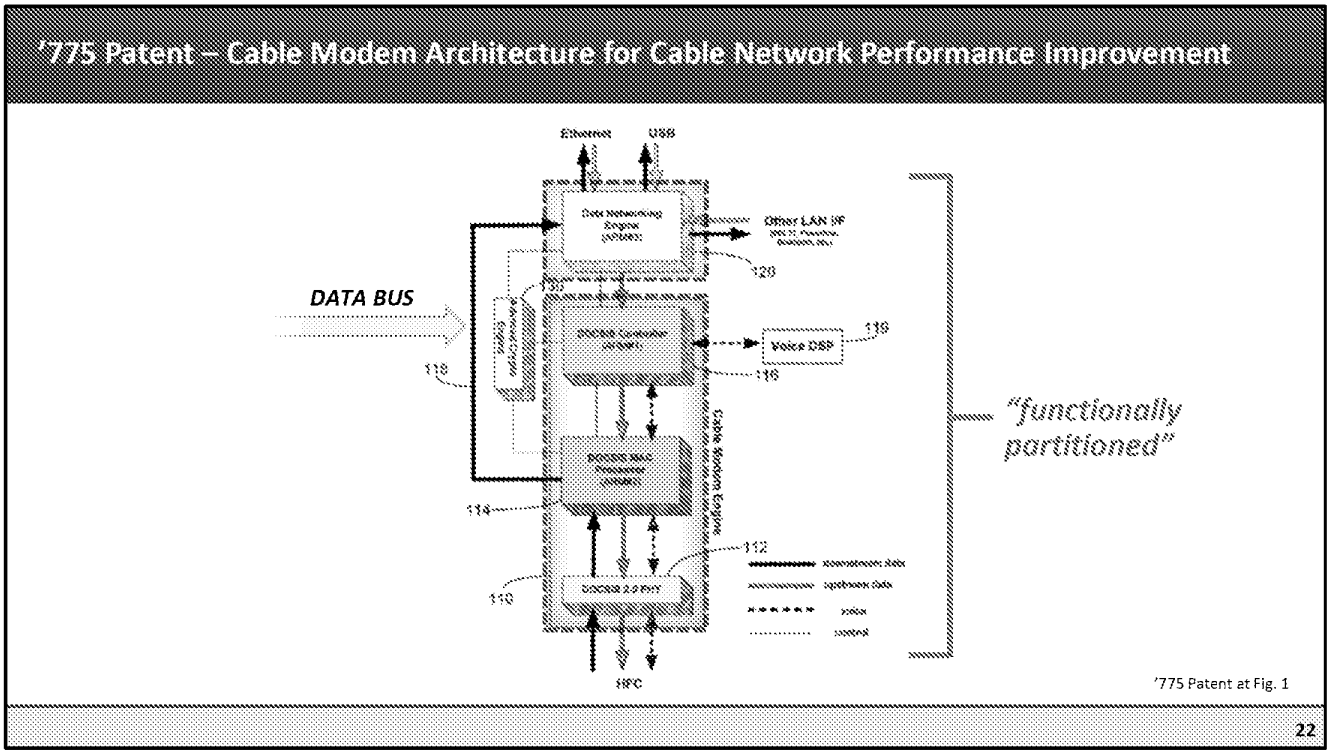
'775 Patent is filed

21

This slide provides background information on the development of computer processor technology. As shown on this timeline, the first integrated circuits were introduced as early as 1958. By the mid-'70s, systems-on-chip, or S-O-C's, were beginning to see use in commercial products.

The mid-'80s saw the introduction of the OSI model. That same decade also saw the introduction of the first ARM processors. ARM is a widely used family of computer architectures based on a reduced instruction set computer (RISC) instruction set.

By the time the '775 Patent was filed in 2003, all of these developments were well known in the art and had been for nearly 20 years.



This slide illustrates a block diagram of a cable modem architecture according to the '775 Patent, which shows the relationship among the functionalities in the disclosed cable modem.

This exemplary cable modem includes three major subsystems:

- a Data networking engine or DNE (illustrated at the top of the slide within the blue dashed box);
- a Cable modem engine or CME (illustrated by the red dashed box in the middle of the slide); and
- an Advanced crypto engine or ACE (illustrated to the left of the cable modem engine, and shown without any color.)

The cable modem engine itself contains multiple components, including:

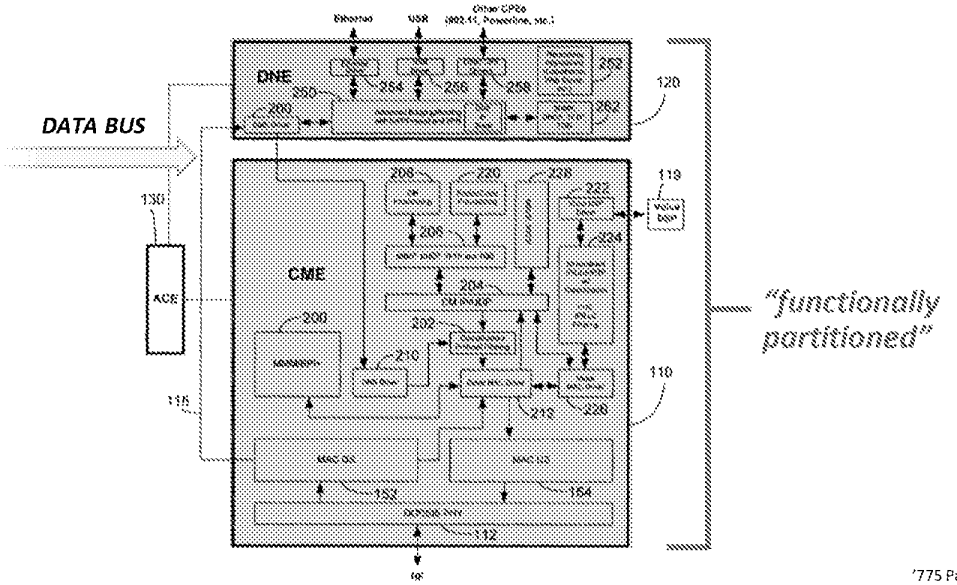
- a DOCSIS Controller (shaded in green),
- a DOCSIS MAC Processor (shaded in orange) and
- a DOCSIS Physical Layer (shaded in yellow).

The cable modem engine and data networking engine, shown in red and blue respectively, are functionally partitioned, meaning each engine is responsible for particular functions. The cable modem engine interfaces with the cable operator's network to transport data. The networking engine interfaces with an on-premises LAN,

such as WiFi or Ethernet to distribute data received from the cable modem engine.

A communication path or "data bus" allows for information to be passed from the cable modem engine to the data networking engine.

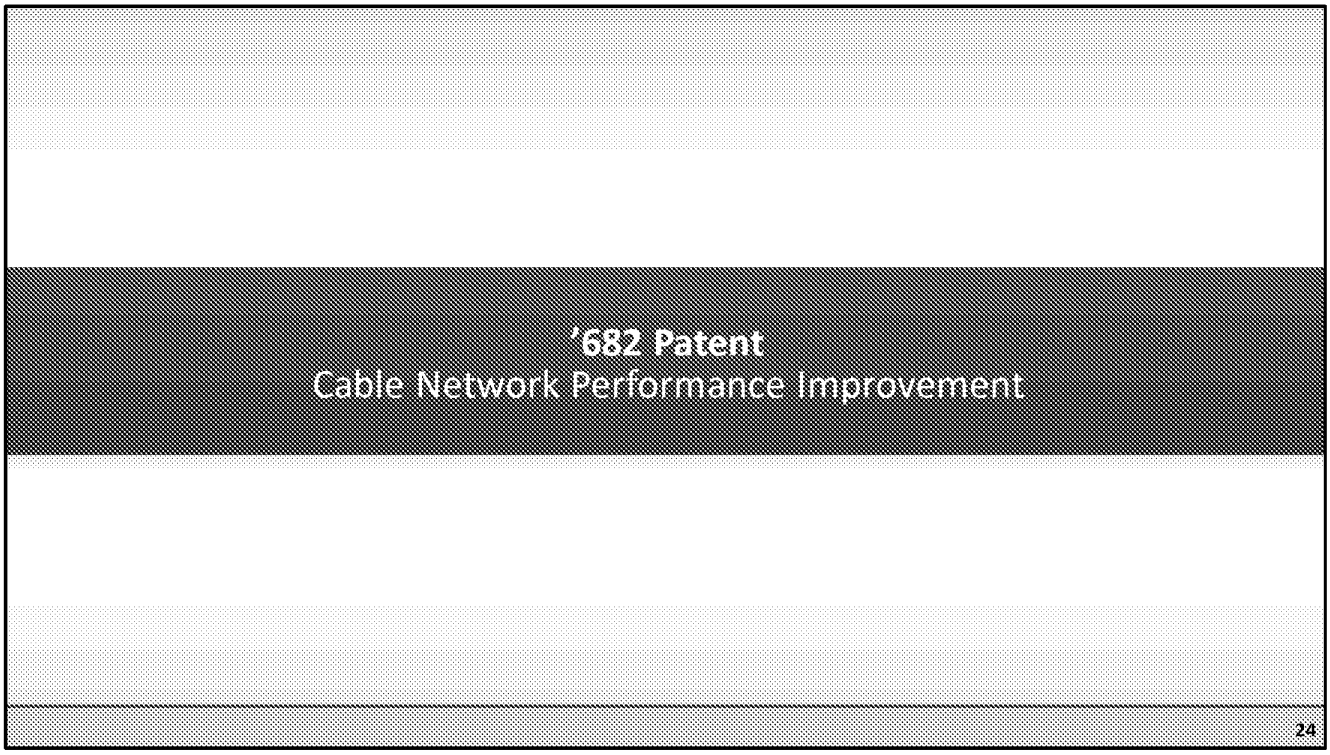
'775 Patent – Cable Network Performance Improvement



'775 Patent at Fig. 2

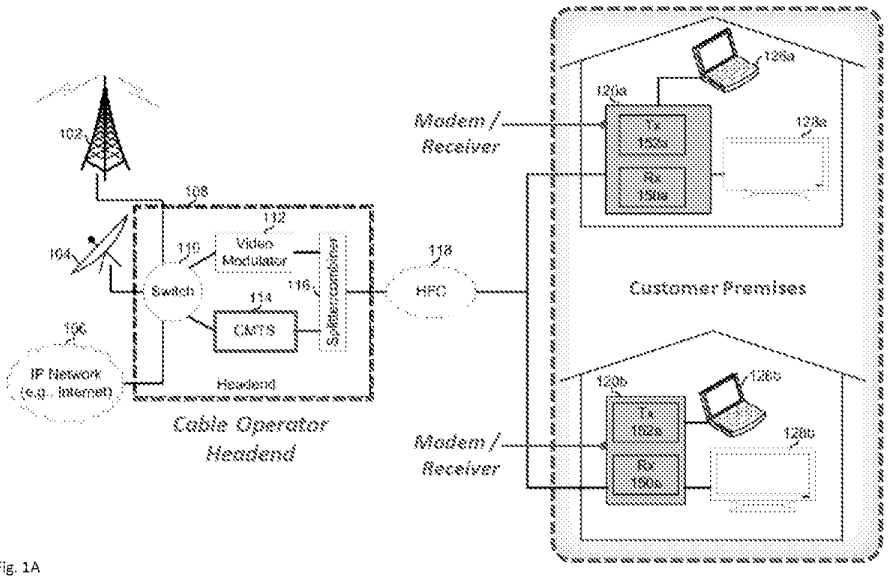
23

This slide provides an additional illustration, using Figure 2 in the '775 Patent. This image shows the exemplary cable modem architecture which includes a cable modem engine and data networking engine (again, shaded red and blue respectively). The data bus is once again illustrated by communication path 118.



The '682 Patent is also within the Cable Network Performance Improvement category of technology. The '682 Patent relates to how a CMTS manages its communication with the various individual cable modems it serves.

'682 Patent – Cable Network Performance Improvement



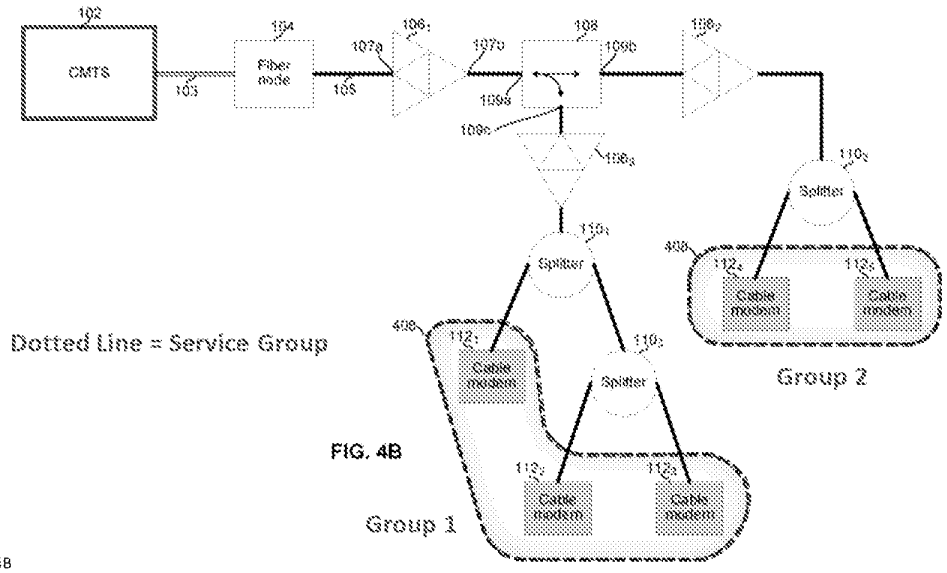
'008 / '826 Patent at Fig. 1A

25

The '682 Patent relates to specific communications between cable modems (blue) located within a customer premises and CMTS equipment located within the cable operator headend and operated by a cable service provider (highlighted in yellow). A single CMTS generally serves numerous cable modems.

Specifically, the '682 Patent is directed to methods and systems for a CMTS to determine a plurality of Signal-to-Noise Ratio (SNR) -related metrics for a plurality of cable modems and assign cable modems (also referred to as CMs) into service groups based on the SNR-related metrics.

'682 Patent – Cable Network Performance Improvement



'682 Patent at Fig. 4B

26

Illustrated here with reference to Fig. 4B of the '682 Patent is a network with a specific grouping of cable modems.

Specifically, various cable modems (highlighted in blue) may be assigned to service groups by the CMTS (highlighted in yellow).

The cable modems in this slide are assigned into service groups based on network topology, or their location in the HFC network.

For example, Service Group 1 (labeled as 406 in the figure) has three cable modems that are all similarly situated in the topology of the HFC network and branch off, directly or indirectly, from Splitter 1101. Similarly, Service Group 2 (labeled as 408 in the figure) has two cable modems that are also all similarly situated in the topology of the HFC network and both branch off of another splitter, splitter 1102, which is located elsewhere in the HFC network. In practice, there may be dozens of service groups and tens or hundreds of cable modems in a service group.

The CMTS can adjust physical layer communication parameters that affect performance and throughput to the cable modems. Rather than the CMTS making adjustments for each individual cable modem, the CMTS can adjust physical layer communication parameters for an entire service group. By controlling groups of cable modems rather than individual modems, the processing demands of the CMTS are greatly reduced. This provides a number of advantages, such as allowing more cable modems to be operated by a single CMTS.

'682 Patent – Cable Network Performance Improvement

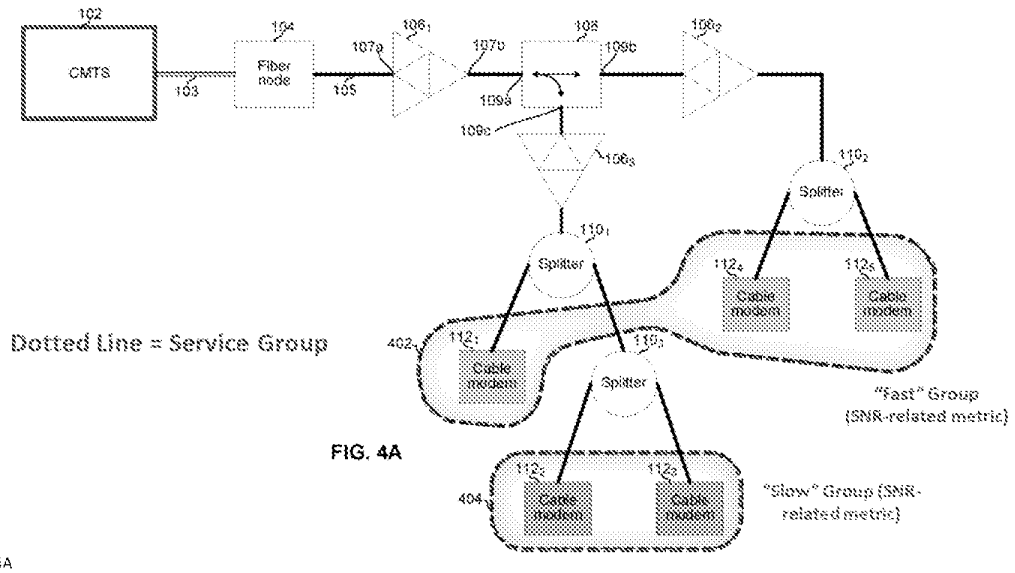


FIG. 4A

'682 Patent at Fig. 4A

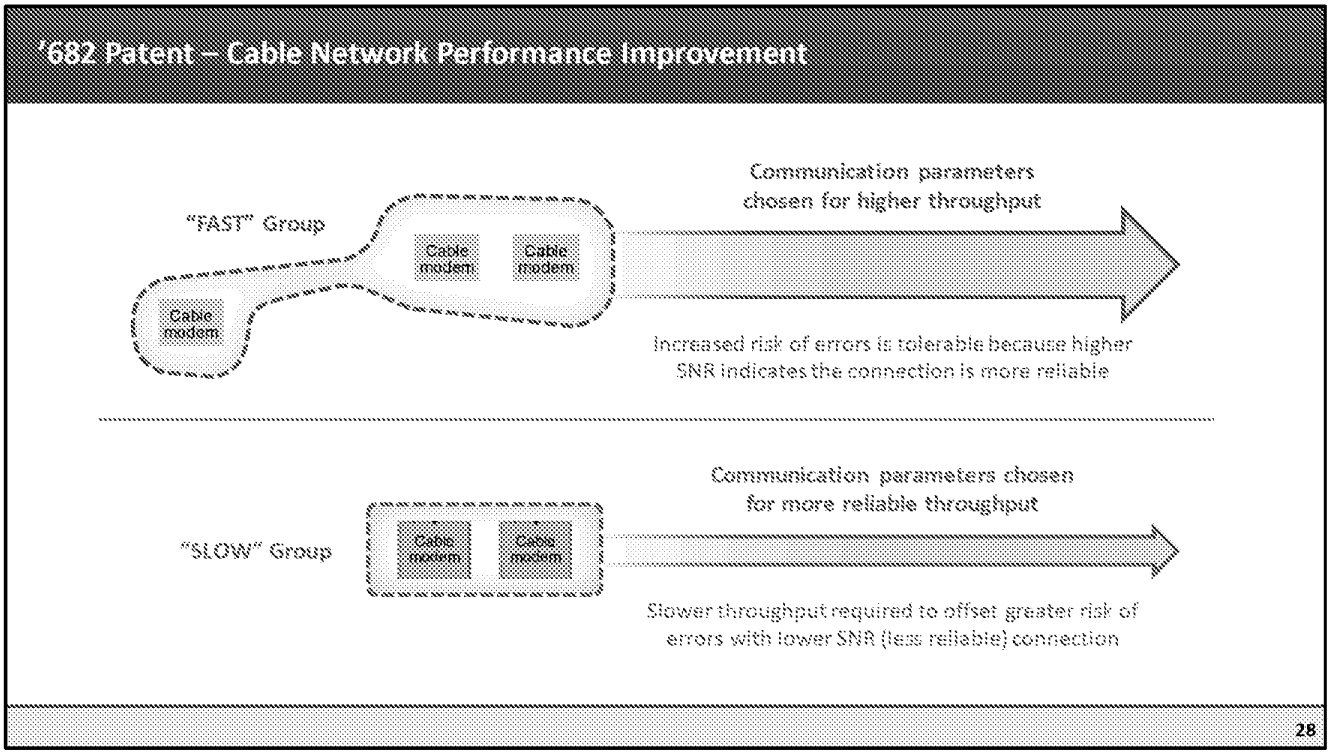
27

Digital communications is a tradeoff between speed and reliability. Faster communications require more reliable communication channels. The speed of communications conducted via a communication channel can be controlled by communication parameters, such as a modulation profile. By varying the communication parameters, a balance between speed and reliability of communications can be achieved. With a higher-speed set of parameters you get better throughput, but you trade off by having a lower tolerance for errors.

For example, cable modems communicating with the CMTS via communication channels having a relatively low SNR (i.e, a noisier communication channel) need to use more robust communication parameters to ensure that their communications are successful. Cable modems that have a relatively high SNR can use communication parameters that allow for higher speeds given the more reliable communication channel.

This slide illustrates the same network as the previous slide with an alternative grouping of cable modems. Specifically, cable modems may be assigned to service groups based on the quality of the cable modem's connection. This quality can be evaluated by, for example, evaluating a signal-to-noise ratio (SNR)-related metric.

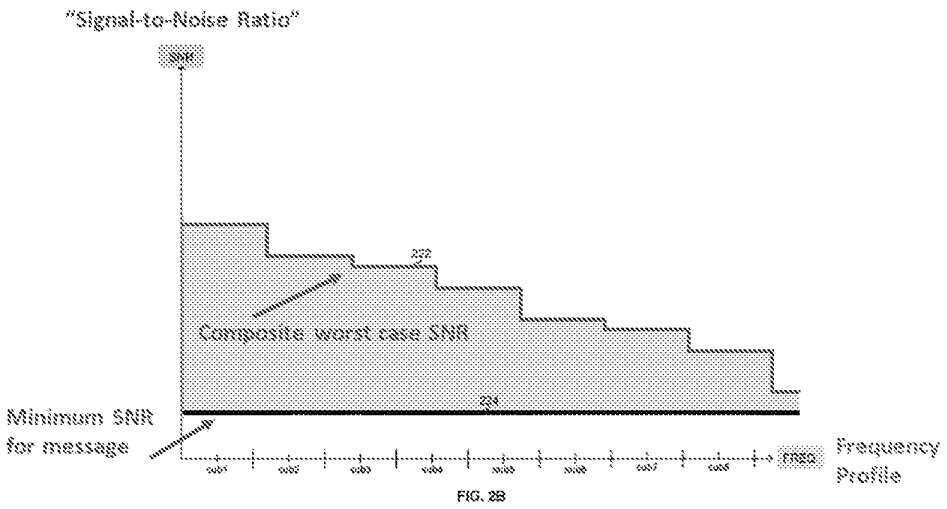
In this way, the CMTS may group cable modems with similar performance together. For example, this slide shows the cable modems grouped into a "slow" group, where the cable modems in the group have relatively low SNRs, and a "fast" group, where the cable modems in the group have relatively high SNRs.



Assigning cable modems using connection quality allows the operator to better match the communication parameters used with the cable modems. Communication with the group of cable modems with high SNR can utilize different parameters than the low SNR group. The "fast group" parameters would allow more throughput and thus higher speeds, but would require a higher SNR for reliable transmission than the low group has available. The slow group parameters would be set differently, to guarantee reliable communication at the cost of throughput.

This allows an operator to avoid the "lowest common denominator" problem. By more precisely organizing cable modems into service groups based on the quality of the communication channel between the cable modems and the CMTS, the CMTS is not forced to use the slower, suboptimal communication parameters with cable modems that can handle higher speeds. By dividing the cable modems into groups based on SNR metrics, and then using communication parameters matched to the SNR, overall throughput is boosted and cable operators can make more efficient usage of their network resources.

'682 Patent – "a composite SNR-related metric ... a worst-case SNR profile"



'682 Patent at Fig. 2B (annotated)

29

This slide illustrates an example of the composite worst-case signal-to-noise ratio, or "SNR," profiles relevant to the '682 Patent. The CMTS determines a worst-case SNR profile across the various frequencies. When the CMTS does this for all cable modems of a particular service group, this is called a "composite" worst case SNR profile.

In this slide, the horizontal axis represents frequency with marks for 8 different subcarriers along the spectrum of frequencies that service groups, and by extension cable modems, may transmit. The vertical axis represents SNR.

The composite worst-case SNR profile is represented by the stair stepped line 222. The flat line 224 is an example of a minimum SNR at which a particular message can be transmitted between the CMTS and the cable modem with acceptable chances of successful receipt.

As we move right along the horizontal axis (which is frequency) the headroom between the two lines get narrower. Accordingly, there is significantly more available headroom for the service groups of cable modems at subcarrier 1 than subcarrier 8, for example; but by using a composite SNR profile, the message can be received at all subcarriers along the spectrum of frequencies.

'682 Patent – "a composite SNR-related metric ... a worst-case SNR profile"

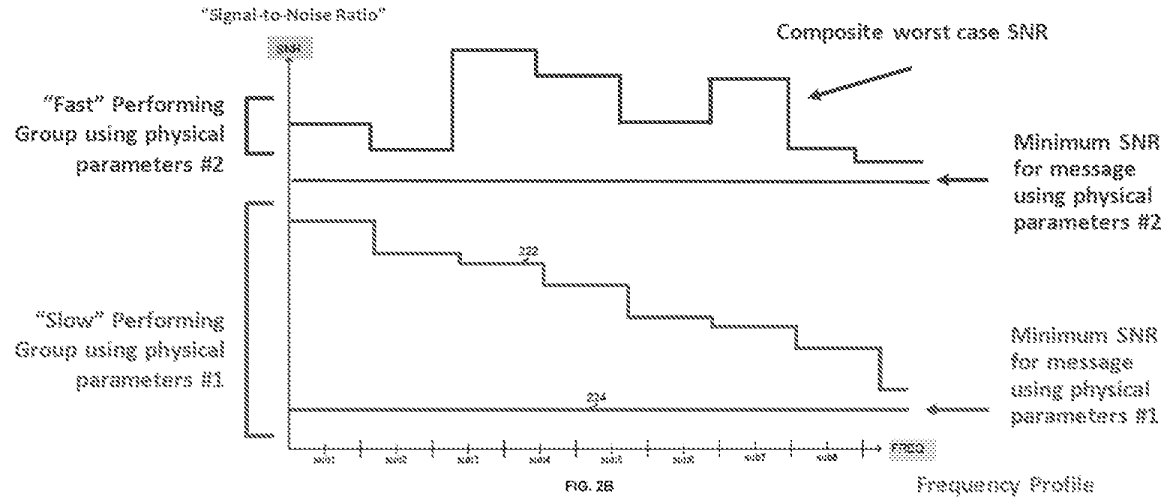


FIG. 2B

'682 Patent at Fig. 2B (annotated)

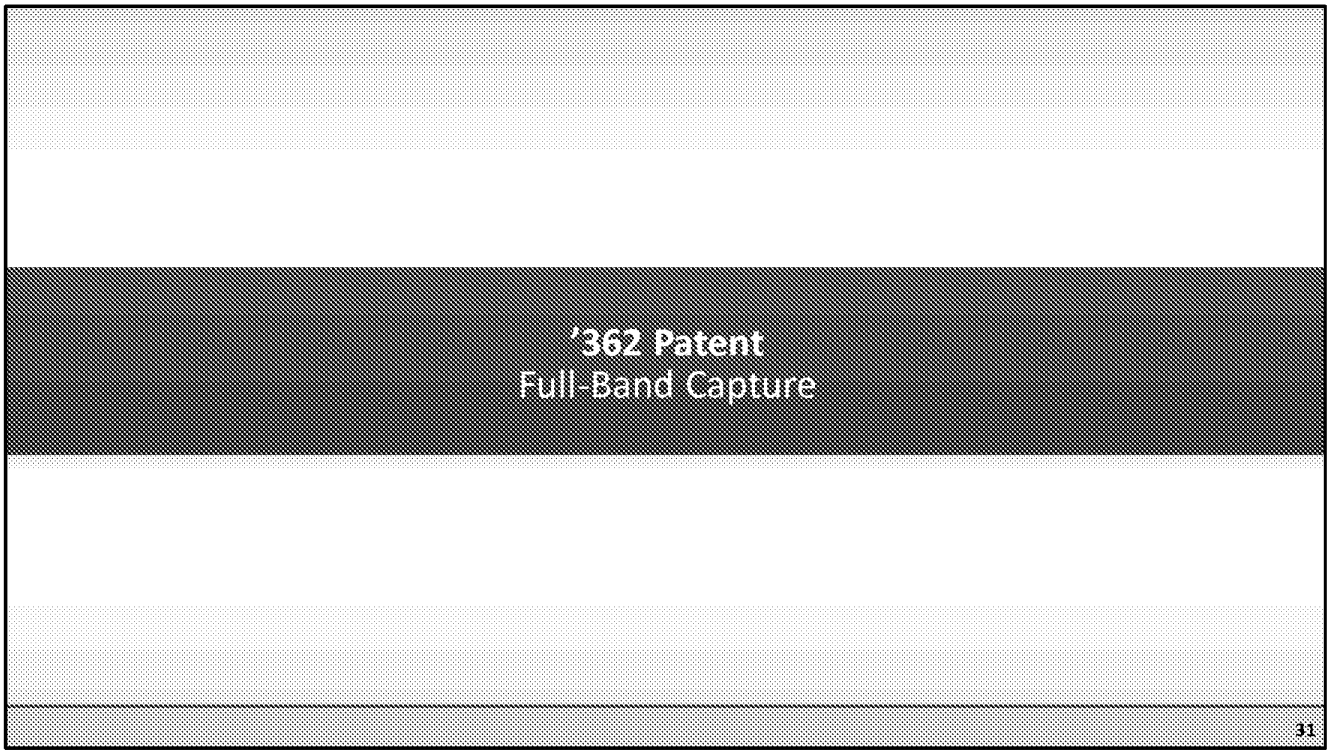
30

This slide illustrates an example of a composite worst-case SNR profile disclosed in the '682 Patent represented as the line 222, which is in the stair-stepped red line. Also shown, in blue, is an example of the composite worst-case SNR profile for a group of CM's with higher SNR.

Note that because a composite worst case SNR is much higher for the "High" service group, the CMTS may set the communication parameters to provide higher throughput, but with less tolerance for errors. Thus the line representing the minimum SNR needed is much higher, shown as the flat blue line. This, however, is an advantage because although more SNR is needed using such parameters, the "High" service group has plenty to spare.

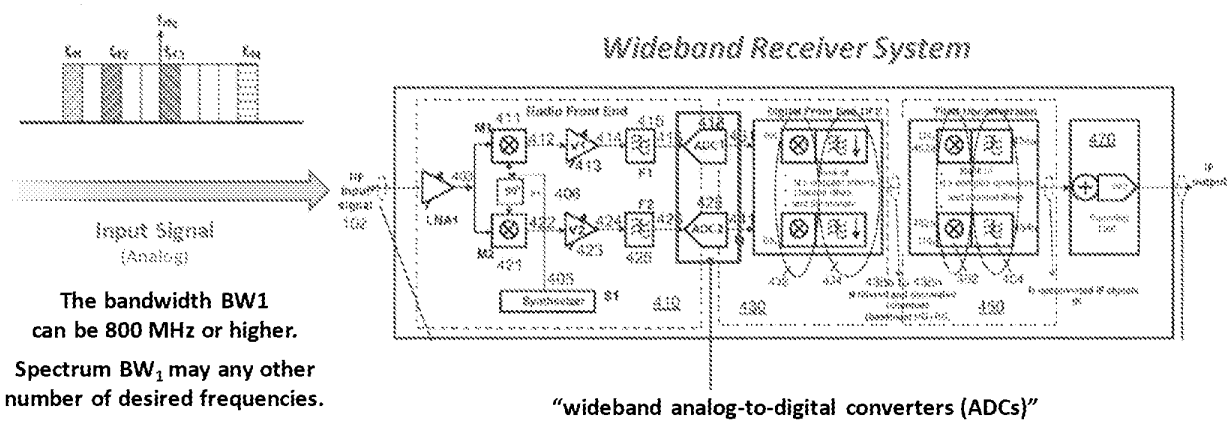
Meanwhile, the cable modems with comparatively low performance would be in the service group utilizing a different composite worst-case SNR profile, shown as the red line 222, and would use physical layer parameters tailored to their performance.

Grouping the cable modems in this way and utilizing different composite worst-case SNR profiles leads to more available throughput for the customers in both the low performing and high performing groups while avoiding the "lowest common denominator" problem previously discussed.



As previously mentioned, the '362 Patent is directed to Full-Band Capture and provides for a wideband gateway or receiver device.

'362 Patent – Full-Band Capture



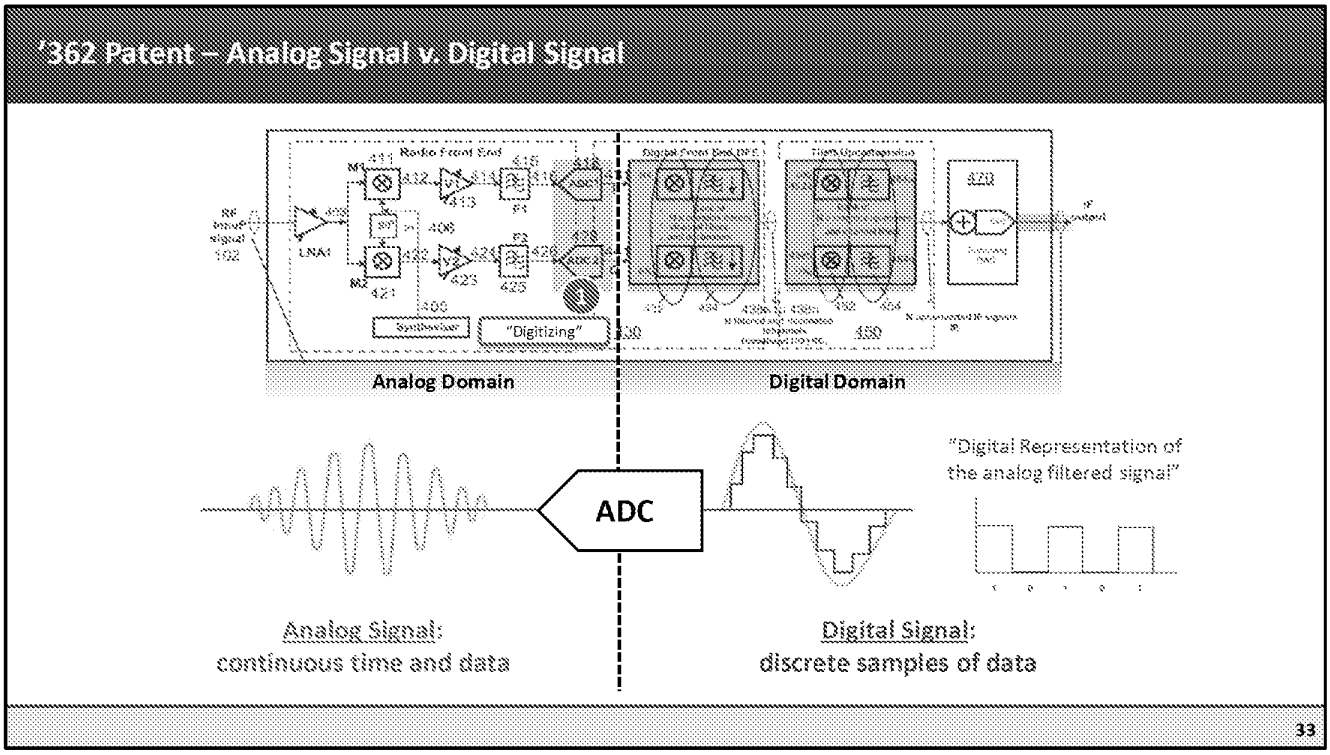
'362 Patent at Fig. 4 (excerpt)

32

The Full-Band Capture process is illustrated here. On the left side of the screen, an analog input signal is received by the wideband receiver system.

The input signal (depicted by the green arrow) can have a bandwidth of 800 megahertz or higher and may contain any number of channels (illustrated by the vertical grey rectangles).

Highlighted in yellow are two wideband analog to digital converters ("ADCs"). In the context of the '362 Patent, a wideband ADC is capable of digitizing the entirety of the input signal - that is, capturing the full band of the input signal, hence full band capture.

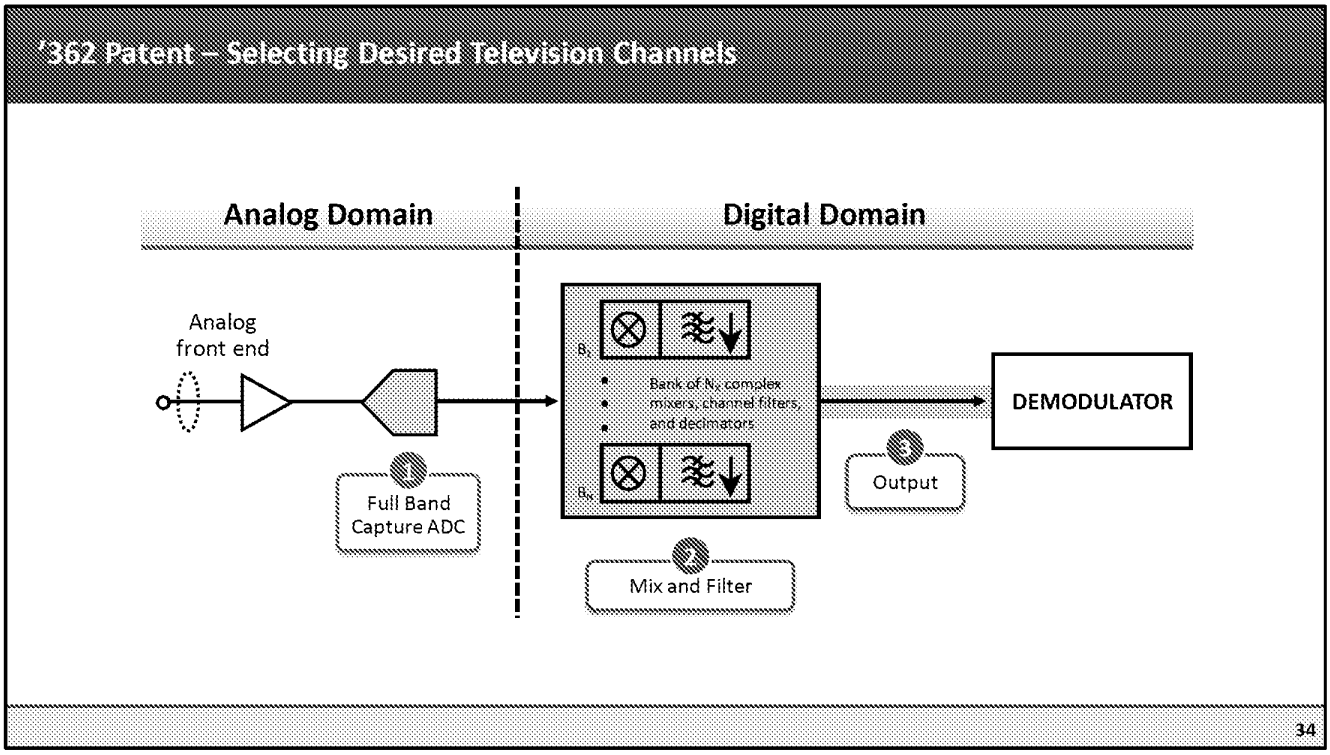


Additional details concerning the difference between analog signals and digital signals are helpful to understand the ADC's role in the receiver system.

The input signal is an analog signal. An analog signal is a continuous signal that is configured to carry data conveying information. For example, in the context of television, the analog signal carries individual television channels.

As discussed on the previous slide, the ADC or analog-to-digital converter converts the analog signal to a digital signal.

A digital signal represents data as a sequence of discrete values. A digital signal can be produced from an analog signal by an ADC that samples the analog signal at different times and quantizes each sample into a finite set of levels. This converts the continuous analog signal into a set of discrete digital samples, and by sampling the analog signal at a high enough rate, the corresponding digital signal effectively represents the original analog signal. The digital signal can be processed in the digital domain, shown in blue.



Zooming in on the wideband receiver system, this slide provides a more detailed breakdown of the steps involved in Full Band Capture. We've already discussed how the receiver takes an incoming analog signal and digitizes it into a digital signal. It is therefore helpful to think of the receiver as having an analog domain, which operates on analog signals, and a digital domain that operates on digital signals. The ADCs form the dividing line between these domains. The "digitizing" step occurs at the ADC's, which are shown highlighted in red.

Next, we discuss "selecting" a plurality of desired television channels. Digital channel selection is accomplished using digital mixing and filtering techniques. Specifically, the digitized signal is provided to one or more digital mixers, which select the desired channel(s), and the filters remove any unwanted portions of the digital signal.

This results in the selection of desired channels, which can be output for further processing. For example, the selected channels can be output to a demodulator (sometimes called a tuner) which can process the channels to recover content contained in the channels. In the context of television systems, the recovered content can be television channels.



This concludes Entropic Communication's technical tutorial. Entropic again thanks the Court for the opportunity to present this technical tutorial and welcomes any follow up questions.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D	9980

94518 7590 09/02/2011

DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303

EXAMINER	
WINDER, PATRICE L	
ART UNIT	PAPER NUMBER
2452	

MAIL DATE	DELIVERY MODE
09/02/2011	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/675,566	LI ET AL.	
	Examiner	Art Unit	
	PATRICE WINDER	2452	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 June 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-16* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-16* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on June 7, 2010 has been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-2, 4-6, 10, 11, are rejected under 35 U.S.C. 103(a) as being unpatentable over Schain et al., US 6,944,706 B2 (hereafter referred to Schain).

Regarding claim 1, Schain taught a cable modem system (column 4, lines 12-21) comprising:

a data networking engine implemented in a first circuit that includes at least one processor (processing element), the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data

networking engine to perform home networking functions including interfacing with customer provided equipment (column 4, lines 22-28);

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit (column 10, lines 28-34), the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media (column 4, lines 28-43; column 8, lines 35-48), and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine (column 10, lines 28-34); and

a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine (column 9, lines 26-28). Schain does not specifically teach separate processing elements but suggests embodiments where the engines would be implemented in the separate processing elements (column 10, lines 10-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made that incorporating separate processing elements would have been equivalent embodiment.

Regarding dependent claim 2, Schain taught all DOCSIS functions are localized in the cable modem engine (column 8, lines 49-51).

Regarding dependent claim 4, Schain taught a cable modem system further comprising an advanced crypto engine configured to perform all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem engine (column 12, lines 55-64).

Regarding dependent claim 5, Schain taught a cable modem engine includes: a DOCSIS PHY layer; a DOCSIS MAC processor; and a DOCSIS controller, and wherein the at least one processor of the data networking engine is a RISC processor (column 13, lines 26-36).

Regarding dependent claim 6, Schain taught DOCSIS PHY layer includes a hardware transmitter and receiver (column 7, lines 47-51).

Regarding dependent claim 10, Schain taught the data networking engine is configured to perform all data networking processing including advanced multi-port bridging routing with NAT/firewall and VPN, and home networking applications (column 11, lines 59-67; column 12, lines10).

Regarding dependent claim 11, Schain does not specifically teach the data networking engine comprises the entire embedded portal services functionality of the CableHome specification. “Official notice” is taken embedded portal services functionality CableHome specification is well known in the art. It would have been obvious to one of ordinary skill in the art at the time the invention was made that incorporating the CableHome specification in Schain’s data networking engine would

have improved effectiveness. The motivation would have been to provide new services in a standardized manner.

Claims 3, 8, 9, 12-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schain as applied to claims 2, 5 above, and further in view of Winters et al., US 2006/0080650 A1 (hereafter referred to as Winters).

Regarding dependent claim 3, Schain does not specifically teach VoIP functionality is embedded in the cable modem engine. However, Winters taught VoIP functionality is embedded in the cable modem engine (paragraphs 5-6). It would have been obvious to one of ordinary skill in the at the time the invention was made that incorporating Winter's VoIP functionality in Schain's cable modem would have extended functionality. The motivation would have to expand Schain's functionality to include voice telephony and provide capabilities for other cable modem services.

Regarding dependent claim 8, Schain does not specifically teach all VoIP functionality is implemented in the DOCSIS controller. However, Winters taught VoIP functionality is implemented in the DOCSIS controller of a cable modem (paragraphs 5-6). It would have been obvious to one of ordinary skill in the at the time the invention was made that incorporating Winter's VoIP functionality in Schain's cable modem would have extended functionality. The motivation would have to expand functionality to include voice telephony and provide capabilities for other cable modem services.

Regarding dependent claim 9, Winters taught the VoIP functionality is in conformance with the PacketCable specification (paragraphs 5-6).

Regarding dependent claim 12, Schain taught the cable modem engine includes: the DOCSIS PHY layer includes a transmitter and receiver (column 7, lines 47-51); the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications (column 12, lines 25-38); and the DOCSIS controller is configured to implement other functionality (column 10, lines 54-62); and wherein the data networking engine includes a processing element configured to implement a majority of data networking processing and home networking applications decoupled from the implementation of the MAC functions and the other functionality of the cable modem engine (column 8, lines 35-48). Schain does not specifically teach the other functionality is VoIP functionality. However, Winters taught VoIP functionality is implemented in the DOCSIS controller of a cable modem (paragraphs 5-6). It would have been obvious to one of ordinary skill in the at the time the invention was made that incorporating Winter's VoIP functionality in Schain's cable modem would have extended functionality. The motivation would have to expand functionality to include voice telephony and provide capabilities for other cable modem services.

Regarding dependent claim 13, Winters taught the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, wherein the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality provided by the data networking engine is completely

decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine (paragraphs 5-6).

Regarding dependent claim 14, Schain does not the DOCSIS MAC processor is an RISC processor, and wherein the DOCSIS controller is an RISC processor (column 13, lines 26-36). Schain does not specifically teach ARM940-based or ARM9TDMI-based. However, both models are from a well know processor family. It would have been obvious to one of ordinary skill in the art at the time the invention was made that incorporating ARM 940-based processors in Schain's RISC processors would have been an acceptable selection. The motivation would have been because ARM 940 based processors have similar advantages.

Regarding claim 15, Schain taught a method for providing a flexible and partitioned cable modem gateway comprising:

providing data and home networking functionality in a data networking engine (column 4, lines 22-28);

providing DOCSIS and other functionality in a cable modem engine (column 4, lines 28-43; column 8, lines 35-48); and

partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and other functionality (column 10, lines 6-15). Schain does not specifically teach the other functionality is VoIP functionality in accordance with the PacketCable specification. However, Winters taught VoIP functionality is implemented in the DOCSIS controller of a cable modem in accordance with PacketCable specification (paragraphs 5-6). It would

have been obvious to one of ordinary skill in the at the time the invention was made that incorporating Winter's VoIP functionality in Schain's cable modem would have extended functionality. The motivation would have to expand functionality to include voice telephony and provide capabilities for other cable modem services.

Regarding dependent claim 16, Schain taught the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver (column 11, lines 9-15). Schain does not specifically teach the data networking engine comprises the entire embedded portal services functionality of the CableHome specification. "Official notice" is taken embedded portal services functionality CableHome specification is well known in the art. It would have been obvious to one of ordinary skill in the art at the time the invention was made that incorporating the CableHome specification in Schain's data networking engine would have improved effectiveness. The motivation would have been to provide new services in a standardized manner.

Schain does not specifically teach the other functionality is VoIP functionality in accordance with the PacketCable specification. However, Winters taught VoIP functionality is implemented in the DOCSIS controller of a cable modem in accordance with PacketCable specification (paragraphs 5-6). It would have been obvious to one of ordinary skill in the at the time the invention was made that incorporating Winter's VoIP functionality in Schain's cable modem would have extended functionality. The

motivation would have to expand functionality to include voice telephony and provide capabilities for other cable modem services.

In combination Schain-Winter the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine (column 10, lines 6-15).

Allowable Subject Matter

Claim 7 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: the DOCSIS MAC processor is configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to PATRICE WINDER whose telephone number is (571)272-3935. The examiner can normally be reached on Monday-Friday, 12:00 pm - 8:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thu V. Nguyen can be reached on 571-272-6967. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Patrice L Winder/
Primary Examiner, Art Unit 2452

August 29, 2011

Notice of References Cited	Application/Control No. 10/675,566	Applicant(s)/Patent Under Reexamination LI ET AL.	
	Examiner PATRICE WINDER	Art Unit 2452	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,944,706 B2	09-2005	Schain et al.	709/250
*	B	US-2006/0080650 A1	04-2006	Winters et al.	717/168
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10675566	LI ET AL.
	Examiner	Art Unit
	Patrice Winder	2452

SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
US Patents and PG Publications (using EAST) - see attached search history	8-9-2011	plw
US Patents and PG Publications (using EAST) - see attached search history	8-25-2011	plw

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	("20010039600").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/08/25 20:57
L2	773	broadband adj2 gateway	US-PGPUB; USPAT	OR	ON	2011/08/25 21:04
L3	43907	cable adj2 modem	US-PGPUB; USPAT	OR	ON	2011/08/25 21:04
L4	245	l2 same2 l3	US-PGPUB; USPAT	OR	ON	2011/08/25 21:04
L5	131	l4 and docsis	US-PGPUB; USPAT	OR	ON	2011/08/25 21:05
L6	17	l5 and (cablelab or packetcable or cablehome)	US-PGPUB; USPAT	OR	ON	2011/08/25 21:06
L7	2791	residential adj2 gateway	US-PGPUB; USPAT	OR	ON	2011/08/25 21:08
L8	536	l3 same2 l7	US-PGPUB; USPAT	OR	ON	2011/08/25 21:08
L9	207	l8 and docsis	US-PGPUB; USPAT	OR	ON	2011/08/25 21:09
L10	50	l9 and (cablelab or packetcable or cablehome)	US-PGPUB; USPAT	OR	ON	2011/08/25 21:09
L11	32	l10 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/25 21:10
L12	85	l5 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/25 21:17
L13	3171	l3 same2 hub	US-PGPUB; USPAT	OR	ON	2011/08/25 21:23
L14	2121	l3 same hub	US-PGPUB; USPAT	OR	ON	2011/08/25 21:23
L15	637	l14 and docsis	US-PGPUB; USPAT	OR	ON	2011/08/25 21:23
L16	436	l15 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/25 21:23
L17	1665	hub near8 (home adj2 network or data adj2 network)	US-PGPUB; USPAT	OR	ON	2011/08/25 21:24
L18	96	l3 same2 l17	US-PGPUB; USPAT	OR	ON	2011/08/25 21:24
L19	67	l18 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/25 21:24

L20	103172	nat or newtork adj2 translat $3	US-PGPUB; USPAT	OR	ON	2011/08/25 21:31
L21	0	internal adj2 address near8 external adj2 address	US-PGPUB; USPAT	OR	ON	2011/08/25 21:32
L22	5212	(configur$3 or configuration or provision$3) near8 (vpn or virtual adj2 (private or network))	US-PGPUB; USPAT	OR	ON	2011/08/25 21:32
L23	3179	internal adj2 address with external adj2 address	US-PGPUB; USPAT	OR	ON	2011/08/25 21:33
L24	599	l3 same2 (l20 or l22 or l23)	US-PGPUB; USPAT	OR	ON	2011/08/25 21:33
L25	350	l3 same (l20 or l22 or l23)	US-PGPUB; USPAT	OR	ON	2011/08/25 21:33
L26	202	l25 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/25 21:33
L27	34	l26 and docsis	US-PGPUB; USPAT	OR	ON	2011/08/25 21:34
L28	18	(US-20030106067-$ or US-20100074267-$).did. or (US-7149474-$ or US-7046796-$ or US-6775273-$ or US-7460546-$ or US-6944706-$ or US-6889321-$ or US-6728239-$ or US-7334252-$ or US-6888850-$ or US-6588016-$ or US-7620055-$ or US-7590144-$ or US-7092397-$ or US-6697864-$ or US-6693878-$ or US-6577642-$).did.	US-PGPUB; USPAT	OR	ON	2011/08/25 21:52

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	43598	cable adj2 modem	US-PGPUB; USPAT	OR	ON	2011/08/09 21:00
L2	48097	co$1process$3 or bypass$3 near8 process$3	US-PGPUB; USPAT	OR	ON	2011/08/09 21:01
L3	182810	vpn or virtual adj2 private or nat or network adj2 translat $3 or firewall	US-PGPUB; USPAT	OR	ON	2011/08/09 21:01
L4	282	l2 same l3	US-PGPUB; USPAT	OR	ON	2011/08/09 21:02
L5	12	l1 and l4	US-PGPUB; USPAT	OR	ON	2011/08/09 21:02
L6	4	l5 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/09 21:02
L7	143	l1 same2 l2	US-PGPUB; USPAT	OR	ON	2011/08/09 21:03
L8	2	l7 and docis	US-PGPUB; USPAT	OR	ON	2011/08/09 21:03
L9	2	l8 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/09 21:03
L10	297101	(multiple or plural$3) near8 (processor or engine)	US-PGPUB; USPAT	OR	ON	2011/08/09 21:05
L11	1177	l1 same2 l10	US-PGPUB; USPAT	OR	ON	2011/08/09 21:06
L12	28560	l10 same (independent or separate or distinct)	US-PGPUB; USPAT	OR	ON	2011/08/09 21:06
L13	49	l1 same2 l12	US-PGPUB; USPAT	OR	ON	2011/08/09 21:07
L14	35	l13 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/09 21:07

L15	1	docis same engine	US-PGPUB; USPAT	OR	ON	2011/08/09 21:10
L16	200	docsis same engine	US-PGPUB; USPAT	OR	ON	2011/08/09 21:11
L17	182	l1 and l16	US-PGPUB; USPAT	OR	ON	2011/08/09 21:11
L18	133	l17 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/09 21:11
L19	19	l3 and l18	US-PGPUB; USPAT	OR	ON	2011/08/09 21:11
L20	3583	gateway same cable adj2 modem	US-PGPUB; USPAT	OR	ON	2011/08/09 21:15
L21	867	l3 same2 l20	US-PGPUB; USPAT	OR	ON	2011/08/09 21:15
L22	571	l3 same l20	US-PGPUB; USPAT	OR	ON	2011/08/09 21:15
L23	1	l22 same (co$1process$3 or engine)	US-PGPUB; USPAT	OR	ON	2011/08/09 21:16
L24	17	l22 same2 (co$1process$3 or engine)	US-PGPUB; USPAT	OR	ON	2011/08/09 21:16
L25	14	l24 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/09 21:16
L26	11165	l3 near8 gateway	US-PGPUB; USPAT	OR	ON	2011/08/09 21:17
L27	793	l20 and l26	US-PGPUB; USPAT	OR	ON	2011/08/09 21:17
L28	129	l27 and partition$3	US-PGPUB; USPAT	OR	ON	2011/08/09 21:17
L29	49	l28 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2011/08/09 21:18
L30	1	(US-6944706-$).did.	USPAT	OR	ON	2011/08/09 21:22

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EAST Search History

EAST Search History (Prior Art)

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L1	0	li-gordon$-.in.	US-PGPUB; USPAT	OR	ON	2011/08/09 20:35
L2	9	li-gordon$.in.	US-PGPUB; USPAT	OR	ON	2011/08/09 20:35
L3	11	hebron-yoav$.in.	US-PGPUB; USPAT	OR	ON	2011/08/09 20:35
L4	17	l2 or l3	US-PGPUB; USPAT	OR	ON	2011/08/09 20:35
L5	3074	cable adj2 modem	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:38
L6	127992	nat or network adj2 address adj2 translat$3 or firewall or vpn or virtual adj2 private adj2 network $3	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:42
L7	1944	l6 with (engine or process $3)	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:42
L8	8	l5 and l7	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:42
L9	0	l8 and @pd<"20030930"	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:43
L10	6189	(independent or decoupl $3 or distinct or different) near2 engine	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:43
L11	2	l5 and l10	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:43
L12	0	l11 and @pd<"20030930"	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:43
L13	49	l5 and engine	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:44
L14	9	l13 and @pd<"20030930"	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:44
L15	4	l6 same co$1processor	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:46
L16	1	l15 and @pd<"20030930"	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:46
L17	0	l5 and co$1processor	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:46
L18	58	l5 and l6	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:47

L19	8	l18 and @pd<"20030930"	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:47
L20	270	functional near4 partition $3	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:49
L21	0	l5 and l20	FPRS; EPO; JPO; DERWENT	OR	ON	2011/08/09 20:50

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10675566	LI ET AL.
	Examiner	**Art Unit**
	Patrice Winder	2452

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/16/2009	08/24/2009	01/30/2010	08/29/2011					
	1	✓	÷	✓	✓					
	2	✓	÷	✓	✓					
	3	✓	÷	✓	✓					
	4	✓	÷	✓	✓					
	5	✓	÷	✓	✓					
	6	✓	÷	✓	✓					
	7	✓	÷	✓	✓					
	8	✓	÷	✓	✓					
	9	✓	÷	✓	✓					
	10	✓	÷	✓	✓					
	11	✓	÷	✓	✓					
	12	✓	÷	✓	✓					
	13	✓	÷	✓	✓					
	14	✓	÷	✓	✓					
	15	✓	÷	✓	✓					
	16		÷	✓	✓					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appln. No.	:	10/675,566	Conf. No.:	9980
First Named Inventor	:	Gordon Y. Li		
Filed	:	September 30, 2003		
Art Unit	:	2452		
Examiner	:	Winder, Patrice L.		
Docket No.	:	348162-982350		

Title: Architecture For A Flexible And High-Performance Gateway Cable Modem

AMENDMENT AND RESPONSE TO OFFICE ACTION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Madam:

In response to the Office action mailed September 2, 2011, please enter the amendments set forth below and consider the following remarks.

Amendments to the Claims are reflected in the listing of claims that begins on page 2 of this paper.

Remarks begin on page 9 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (**Canceled**)

2. (**Currently Amended**) A cable modem system as claimed in claim [[1]] 7, wherein all DOCSIS functions are localized in the cable modem engine.

3. (**Original**) A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. (**Currently Amended**) A cable modem system as claimed in claim [[1]] 7, and further comprising an advanced crypto engine configured to perform all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem engine.

5. (**Canceled**)

6. (**Currently Amended**) A cable modem system as claimed in claim [[5]] 7, wherein the DOCSIS PHY layer includes a hardware transmitter and receiver.

7. (**Currently Amended**) A cable modem system comprising: ~~as claimed in claim 5,~~

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to

perform home networking functions including interfacing with customer provided equipment, wherein the at least one processor is a RISC processor;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine including a DOCSIS PHY layer, a DOCSIS controller, and a DOCSIS controller and programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and

a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine;

wherein the DOCSIS MAC processor is configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. (**Currently Amended**) A cable modem system as claimed in claim [[5]] 7, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. (**Original**) A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. (**Currently Amended**) A cable modem system as claimed in claim [[5]] 7, wherein the data networking engine is configured to perform all data networking processing

including advanced multi-port bridging routing with NAT/firewall and VPN, and home networking applications.

11. (**Original**) A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. (**Currently Amended**) A cable modem system as claimed in claim [[5]] 7, wherein with regard to the cable modem engine ~~includes~~:

the DOCSIS PHY layer includes a transmitter and receiver;

the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications; and

the DOCSIS controller is configured to implement VoIP functionality; and wherein the data networking engine includes a RISC processor configured to implement a majority of data networking processing and home networking applications decoupled from the implementation of the MAC functions and the VoIP functionality of the cable modem engine.

13. (**Currently Amended**) A cable modem ~~architecture~~ system as claimed in claim 12, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, wherein the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. (**Currently Amended**) A cable modem ~~architecture~~ system as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. (**Currently Amended**) A method of ~~for~~ cable modem operation as claimed in claim 17, further comprising:

providing a flexible and partitioned cable modem gateway comprising:

providing data and home networking functionality in the data networking engine;

providing DOCSIS and VoIP functionality in the cable modem engine; and

partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

16. (**Currently Amended**) A cable modem system as claimed in claim [[5]] 7, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

17. (**New**) A method of cable modem operation comprising:

executing, via at least one processor of a first circuit that implements a data networking engine, first software that causes the data networking engine to perform home networking functions including interfacing with customer provided equipment, wherein the at least one processor is a RISC processor;

executing, via one or more processors of a second circuit that implements a cable modem engine programmed with second software, the second software to cause the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem

functions including interfacing with cable media, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, wherein the second circuit is separate from the first circuit, and wherein the cable modem engine includes a DOCSIS PHY layer, a DOCSIS controller and a DOCSIS controller;

connecting, via a data bus, the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine;

processing, via the DOCSIS MAC processor, downstream PDU packets and forwarding the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

18. (**New**) A method as claimed in claim 17, further comprising:

providing VoIP functionality in accordance with the PacketCable specification in the DOCSIS controller; and

providing the embedded portal services functionality of the CableHome specification in the data networking engine;

wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

19. (**New**) A method as claimed in claim 17, further comprising:

providing the embedded portal services functionality of the CableHome specification in the data networking engine; and

providing VoIP functionality in accordance with the PacketCable specification in the DOCSIS controller;

wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver; and

wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

20. (**New**) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a DOCSIS controller and a DOCSIS MAC processor, the DOCSIS MAC processor configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput; and

a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

21. (**New**) A cable modem system as claimed in claim 20, wherein all DOCSIS functions are localized in the cable modem engine.

22. (**New**) The cable modem system as claimed in claim 20 wherein the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications.

REMARKS

In reply to the non-final Office Action mailed September 2, 2011, please enter the amendments set forth above and consider the following remarks. By this response, Applicants cancel claims 1 and 5 without prejudice or disclaimer, amend claims 2, 4, 6-8, 10, 12-15, and 16, and present new claims 17-22. No new matter has been added. After entry of this paper, claims 2-4 and 6-22 will be pending in this application.

In the Office action, the Examiner (i) rejected claims 1-2, 4-6, 10 and 11 under 35 U.S.C. 103(a), as being anticipated by Schain et al. (US 6,944,706 B2); (ii) rejected claims 3, 8, 9, 12-16 under 35 U.S.C. 103(a) as being unpatentable over Schain et al. as applied to claims 2, 5 above, and further in view of Winters et al. (US 2006/0080650 A1). With regard to the rejections, Applicants respectfully traverse, submitting that the standing rejections are unsupportable/moot/overcome as against the claims presented for at least the reasons set forth below. Reconsideration is respectfully requested.

Claim Rejections Under 35 USC § 103 (a)

Claims 1-2, 4-6, 10 and 11 stand rejected under 35 U.S.C. 103(a), as being anticipated by Schain et al. (US 6,944,706 B2).

Claims 3, 8, 9, 12-16 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Schain et al. as applied to claims 2, 5 above, and further in view of Winters et al. (US 2006/0080650 A1).

Applicants respectfully traverse these rejections.

As an initial matter, Applicants have canceled claims 1 and 5 without prejudice or disclaimer, and respectfully submit the rejections against these claims are moot..

Further and without acquiescence, in the interests, e.g., of advancing the prosecution of this case, avoiding additional costs, etc., Applicants have canceled the rejected claims, or amended the claims to depend from a claim indicated as allowable by the Examiner. Accordingly, Applicants submits that the rejections are moot or now unsupported in view of the amended claims, and respectfully request that they be withdrawn.

Specifically, the Examiner indicates on page 9 of the Office Action that claim 7 is allowable if rewritten in independent form. Claim 7 has been rewritten in independent

form, and claims 2-4, 6, 8-14, and 16 depend directly or indirectly on claim 7. Independent claim 15 has been amended to depend on new claim 17 which recites subject matter indicated as allowable by the Examiner (*see, e.g.,* Office Action, pg. 9).

New Claims

Claims 17-22 are new claims presented in place of the claims canceled by Applicant without prejudice or disclaimer. New claims 17-22 are either copies of existing claims (with different dependencies or additional language) or are new claims reciting features indicated to be patentable. Further, all of these claims either depend on allowable claims or recite subject matter consistent with existing allowable claims. Accordingly, Applicants respectfully submit that these new claims present no new matter, and are allowable for at least the same reasons as their related claims.

Closing Remarks

In view of the above, it is respectfully submitted that the claims are now in condition for formal allowance, and early and favorable action to that end is respectfully requested.

The Examiner is encouraged to call Applicants' attorney at the number below if doing so will in any way advance the prosecution of this application.

The Commissioner is hereby petitioned to grant any extensions of time required to enter this paper as well as authorized to charge any fees which may be required, or credit in the overpayment, to Deposit Account No. 07-1896 referencing Attorney Docket No. 348162-982350.

Respectfully submitted,

DLA PIPER US LLP

Dated: March 2, 2012

By: /Andy Schwaab/
Andrew B. Schwaab
Reg. No. 38,611
Attorneys for Applicant

DLA PIPER US LLP
2000 University Avenue
East Palo Alto, CA 94303
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Electronic Patent Application Fee Transmittal

Application Number:	10675566
Filing Date:	30-Sep-2003
Title of Invention:	Architecture for a flexible and high-performance gateway cable modem
First Named Inventor/Applicant Name:	Gordon Y. Li
Filer:	Andrew B. Schwaab
Attorney Docket Number:	348162-982350

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 3 months with $0 paid	1253	1	1270	1270

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**1270**

Electronic Acknowledgement Receipt

EFS ID:	12217941
Application Number:	10675566
International Application Number:	
Confirmation Number:	9980
Title of Invention:	Architecture for a flexible and high-performance gateway cable modem
First Named Inventor/Applicant Name:	Gordon Y. Li
Customer Number:	94518
Filer:	Andrew B. Schwaab
Filer Authorized By:	
Attorney Docket Number:	348162-982350
Receipt Date:	02-MAR-2012
Filing Date:	30-SEP-2003
Time Stamp:	20:54:34
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1270
RAM confirmation Number	6509
Deposit Account	071896
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	Response_To_9-2-11_Office_Action_348162-982350.pdf	71995 32ccaae6e0fb9d36e7a8133d479cecffee989765	no	10
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30020 7615d5d1392763b8313f940579deaa5f4602b94b	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	102015		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 10/675,566	Filing Date 09/30/2003	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	03/02/2012	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0	X $ =		OR	X $60=	0
	Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $ =		OR	X $250=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/DIANA BATES/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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NOTICE OF ALLOWANCE AND FEE(S) DUE

94518 7590 03/19/2012

DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303

EXAMINER
WINDER, PATRICE L

ART UNIT	PAPER NUMBER
2452	

DATE MAILED: 03/19/2012

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	348162-982350	9980

TITLE OF INVENTION: ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	06/19/2012

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

94518 7590 03/19/2012
DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	348162-982350	9980

TITLE OF INVENTION: ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

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nonprovisional	NO	$1740	$300	$0	$2040	06/19/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
WINDER, PATRICE L	2452	370-401000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
❑ Issue Fee
❑ Publication Fee (No small entity discount permitted)
❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
❑ A check is enclosed.
❑ Payment by credit card. Form PTO-2038 is attached.
❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	348162-982350	9980

94518 7590 03/19/2012

DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303

EXAMINER	
WINDER, PATRICE L	
ART UNIT	PAPER NUMBER
2452	

DATE MAILED: 03/19/2012

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 1748 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 1748 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No.	Applicant(s)	
	10/675,566	LI ET AL.	
	Examiner	Art Unit	
	PATRICE WINDER	2452	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *3-2-2012*.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *2-4 and 6-22*.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/Patrice L Winder/
Primary Examiner, Art Unit 2452

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	4146	(broadband or residential) near2 gateway	US-PGPUB; USPAT	OR	ON	2012/03/10 16:47
L2	49219	cable near2 modem	US-PGPUB; USPAT	OR	ON	2012/03/10 16:47
L3	843	l1 same2 l2	US-PGPUB; USPAT	OR	ON	2012/03/10 16:48
L4	2	l3 and docis	US-PGPUB; USPAT	OR	ON	2012/03/10 16:48
L5	43	l3 and (cablelav or cablehome or packetcable)	US-PGPUB; USPAT	OR	ON	2012/03/10 16:49
L6	30	l5 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB; USPAT	OR	ON	2012/03/10 16:53
L7	8281	hub same ((home or data) near2 network)	US-PGPUB; USPAT	OR	ON	2012/03/10 16:57
L8	1	l2 and docis and l7	US-PGPUB; USPAT	OR	ON	2012/03/10 16:58
L9	2986	l2 and l7	US-PGPUB; USPAT	OR	ON	2012/03/10 16:58
L10	534	l2 same2 l7	US-PGPUB; USPAT	OR	ON	2012/03/10 16:58
L11	1994034	nat or network ad2 translat$3	US-PGPUB; USPAT	OR	ON	2012/03/10 16:58
L12	6049	(internal or private) near2 address with (external or public) near2 address	US-PGPUB; USPAT	OR	ON	2012/03/10 16:59
L13	534	l10 and (l11 or l12)	US-PGPUB; USPAT	OR	ON	2012/03/10 16:59
L14	112980	nat or network adj2 address adj2 translat$3	US-PGPUB; USPAT	OR	ON	2012/03/10 17:00
L15	50	l10 and (l12 or l14)	US-PGPUB; USPAT	OR	ON	2012/03/10 17:00
L16	28	l15 and (@ad<"20030930" or @rlad<"20030930")	US-PGPUB;	OR	ON	2012/03/10 17:00

			USPAT			
S1	1	("20040139233").PN.	US-PGPUB; USPAT	OR	OFF	2012/02/10 17:25

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L17	636	(broadband or residential).clm. near2 gateway.clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:22
L18	2826	cable.clm. near2 modem.clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:22
L19	0	l17 and l18 and docis.clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:23
L20	0	l17 and l18 and (cablelab or cablehome or packetcable).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:23
L21	924	hub.clm. and ((home or data).clm. near2 network.clm.)	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:24
L22	0	l17 and l18 and l21	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:24
L23	1679	(internal or private).clm. near2 address.clm. and (external or public).clm. near2 address.clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:25
L24	2332	nat.clm. or network.clm. adj2 address.clm. adj2 translat$3.clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:26
L25	2	l17 and l18 and (l23 or l24)	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:26
L26	30	l18 and l21	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:29
L27	0	l26 and docis.clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/03/10 17:30

3/10/2012 5:30:38 PM
C:\Users\pwinder\Documents\EAST\Workspaces\10675566_03102012_Allow.wsp

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10675566	LI ET AL.
	Examiner	**Art Unit**
	PATRICE WINDER	2452

ORIGINAL		INTERNATIONAL CLASSIFICATION									
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED				
370	401	H	0	4	L	12 / 46 (2006.0)					

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
709	249				

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1	14	17												
2	2	16	18												
3	3	17	19												
4	4	18	20												
	5	19	21												
5	6	20	22												
1	7														
6	8														
7	9														
8	10														
9	11														
10	12														
11	13														
12	14														
15	15														
13	16														

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/PATRICE WINDER/ Primary Examiner.Art Unit 2452	03/10/2012	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office — Part of Paper No. 20120310

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10675566	LI ET AL.
	Examiner	Art Unit
	Patrice Winder	2452

SEARCHED			
Class	Subclass	Date	Examiner
709	249	3-10-2012	plw

SEARCH NOTES		
Search Notes	Date	Examiner
US Patents and PG Publications (using EAST) - see attached search history	3-10-2012	plw

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
709	249	3-10-2012	plw
	PG PUB text search of CLAIMS (using EAST) - see attached search printout	3-10-2012	plw

UNITED STATES PATENT AND TRADEMARK OFFICE

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www.uspto.gov

BIB DATA SHEET

CONFIRMATION NO. 9980

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
10/675,566	09/30/2003 RULE	370	2452	348162-982350

APPLICANTS
Gordon Y. Li, San Diego, CA;
Yoav Hebron, San Diego, CA;

**** CONTINUING DATA ***************************

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****
12/23/2003

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☐ No Verified and Acknowledged /PATRICE L WINDER/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		CA	2	15	3

ADDRESS
DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303
UNITED STATES

TITLE
Architecture for a flexible and high-performance gateway cable modem

FILING FEE RECEIVED		
900	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

BIB (Rev. 05/07).

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10675566	LI ET AL.
	Examiner	**Art Unit**
	PATRICE WINDER	2452

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/16/2009	08/24/2009	01/30/2010	08/29/2011	03/10/2012				
	1	✓	÷	✓	✓	-				
2	2	✓	÷	✓	✓	=				
3	3	✓	÷	✓	✓	=				
4	4	✓	÷	✓	✓	=				
	5	✓	÷	✓	✓	-				
5	6	✓	÷	✓	✓	=				
1	7	✓	÷	✓	✓	=				
6	8	✓	÷	✓	✓	=				
7	9	✓	÷	✓	✓	=				
8	10	✓	÷	✓	✓	=				
9	11	✓	÷	✓	✓	=				
10	12	✓	÷	✓	✓	=				
11	13	✓	÷	✓	✓	=				
12	14	✓	÷	✓	✓	=				
15	15	✓	÷	✓	✓	=				
13	16		÷	✓	✓	=				
14	17					=				
16	18					=				
17	19					=				
18	20					=				
19	21					=				
20	22					=				

To: PATENTDOCKETINGUS-PALOALTO@DLAPIPER.COM,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
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Mar 19, 2012 05:22:40 AM

Dear PAIR Customer:

DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 94518 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

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Application	Document	Mailroom Date	Attorney Docket No.
10675566	NOA	03/19/2012	348162-982350

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

94518 7590 03/19/2012
~~DLA PIPER LLP (US)~~
~~2000 UNIVERSITY AVENUE~~
~~EAST PALO ALTO, CA 94303~~
Duane Morris LLP
Suite 2900
750 B Street
San Diego, CA 92101
USA

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Ruth Der (Depositor's name)
(Signature)
June 14, 2012 (Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	E5982-00282	9980

TITLE OF INVENTION: ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	06/19/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
WINDER, PATRICE L	2452	370-401000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☒ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 James Sze
2 Duane Morris LLP
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

ENTROPIC COMMUNICATIONS, INC.

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☒ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 041679 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
☒ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature /James Sze/ Date June 14, 2012

Typed or printed name James Sze Registration No. 43,943

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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Electronic Patent Application Fee Transmittal

Application Number:	10675566
Filing Date:	30-Sep-2003
Title of Invention:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM
First Named Inventor/Applicant Name:	Gordon Y. Li
Filer:	James Y.C. Sze
Attorney Docket Number:	348162-982350
Filed as Large Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl issue fee	1501	1	1740	1740
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2040**

Electronic Acknowledgement Receipt

EFS ID:	13013684
Application Number:	10675566
International Application Number:	
Confirmation Number:	9980
Title of Invention:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM
First Named Inventor/Applicant Name:	Gordon Y. Li
Customer Number:	94518
Filer:	James Y.C. Sze
Filer Authorized By:	
Attorney Docket Number:	348162-982350
Receipt Date:	14-JUN-2012
Filing Date:	30-SEP-2003
Time Stamp:	13:30:44
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$2040
RAM confirmation Number	25830
Deposit Account	041679
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	poachngcorradd.pdf	132523 a1992b9313964323250c08f98c8f8165d6cd608f	no	1
Warnings:					
Information:					
2	Assignee showing of ownership per 37 CFR 3.73(b).	statement373.pdf	191654 8710be6dd188231249c3924d24a9807564531fb5	no	2
Warnings:					
Information:					
3	Issue Fee Payment (PTO-85B)	partbfeestransmittal.pdf	155673 a6fd5686f73c5c3f085ae7170fba06735c24920f	no	1
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	32257 481a33c650a62eef485599c7fdcfa6492dd288cf	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	512107		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/81 (01-09)
Approved for use through 11/30/2011. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	10/675,566
Filing Date	September 30, 2003
First Named Inventor	Gordon Y. Li
Title	Architecture for a flexible and high-perfor
Art Unit	2452
Examiner Name	Patrice L. Winder
Attorney Docket Number	E5982-00282

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith: 77561

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant/Inventor.

OR

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) (Form PTO/SB/96) submitted herewith or filed on _____

SIGNATURE of Applicant or Assignee of Record

Signature		Date	6-7-12
Name	Bruce W. Greenhaus	Telephone	(858) 768-3679
Title and Company	Vice President, Entropic Communications, Inc.		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☐ *Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/96 (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: ENTROPIC COMMUNICATIONS, INC.

Application No./Patent No.: 10/675,566 Filed/Issue Date: September 30, 2003

Titled: ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

ENTROPIC COMMUNICATIONS, INC. , a Corporation
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.

states that it is:

1. [X] the assignee of the entire right, title, and interest in;

2. [ ] an assignee of less than the entire right, title, and interest in
(The extent (by percentage) of its ownership interest is _____ %); or

3. [ ] the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

A. [ ] An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy therefore is attached.

OR

B. [X] A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Gordon Y. Li and Yoav Hebron To: Conexant Systems, Inc.
The document was recorded in the United States Patent and Trademark Office at
Reel 015024, Frame 0251, or for which a copy thereof is attached.

2. From: Brooktree Broadband Holding, Inc. To: The Bank of NY Trust Co., N.A.
The document was recorded in the United States Patent and Trademark Office at
Reel 018573, Frame 0337, or for which a copy thereof is attached.

3. From: Conexant Systems, Inc. To: Bank of NY Trust Co., N.A.
The document was recorded in the United States Patent and Trademark Office at
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[ ] Additional documents in the chain of title are listed on a supplemental sheet(s).

[ ] As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature 6-7-12 Date

Bruce W. Greenhaus Vice President
Printed or Typed Name Title

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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SUPPLEMENTAL STATEMENT UNDER 37 CFR 3.73(b)

Application No. 10/675,566, filed September 30, 2003

1 B Continued:

4. From: Bank of NY Mellon Trust Co., N.A. (Formerly, Bank of New York Trust Company, N.A.)

   To: Conexant Systems, Inc.

   Recorded at Reel 021523, Frame 0790

5. From: Bank of NY Mellon Trust Co., N.A. (Formerly, Bank of New York Trust Company, N.A.)

   To: Conexant Systems, Inc.

   Recorded at Reel 021523, Frame 0804

6. From: Conexant Systems, Inc.

   To: NXP, B.V.

   Recorded at Reel 021523, frame 0523

7. From: NXP

   To: NXP Holding 1 B.V.

   Recorded at 023928, Frame 0489

8. From: NXP Holding 1 B.V. and Trident Microsystems (Europe) B.V.

   To: Trident Microsystems (Far East) Ltd.

   Recorded at 023928, Frame 0552

9. From: Trident Microsystems, Inc. and Trident Microsystems (Far East) Ltd.

   To: ENTROPIC COMMUNICATIONS, INC.

   Recorded at Reel 028153, frame 0440

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	E5982-00282

CONFIRMATION NO. 9980

77561
Duane Morris LLP (Entropic)
IP Department
30 South 17th Street
Philadelphia, PA 19103-4196

POA ACCEPTANCE LETTER

OC000000054936531

Date Mailed: 06/19/2012

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/14/2012.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/nhorne/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	348162-982350

CONFIRMATION NO. 9980

94518
DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
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POWER OF ATTORNEY NOTICE

OC000000054936455

Date Mailed: 06/19/2012

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/14/2012.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/nhorne/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	07/17/2012	8223775	E5982-00282	9980

77561 7590 06/27/2012

Duane Morris LLP (Entropic)
IP Department
30 South 17th Street
Philadelphia, PA 19103-4196

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 2220 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Gordon Y. Li, San Diego, CA;
Yoav Hebron, San Diego, CA;

IR103 (Rev. 10/09)

PTO/SB/80 (11-08)
Approved for use through 11/30/2011. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:

☑ Practitioners associated with the Customer Number: 23446

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:

☑ The address associated with Customer Number: 23446

OR

☐ Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address:

Entropic Communications, LLC.
2051 Palomar Airport Road, Suite 100
Carlsbad, CA 92011

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	6/5/15
Name	Adam Spice	Telephone	
Title	Chief Finanical Officer		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	23015034
Application Number:	10675566
International Application Number:	
Confirmation Number:	9980
Title of Invention:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM
First Named Inventor/Applicant Name:	Gordon Y. Li
Customer Number:	77561
Filer:	Christopher C. Winslade/Deb Wilson
Filer Authorized By:	Christopher C. Winslade
Attorney Docket Number:	E5982-00282
Receipt Date:	24-JUL-2015
Filing Date:	30-SEP-2003
Time Stamp:	12:52:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Assignee showing of ownership per 37 CFR 3.73	29566US01_373b_Statement_sb96.pdf	430293 eef2bb6ac2d760dc8698b5ba5763f3b4ed94df52	no	2

Warnings:

Information:

2	Assignee showing of ownership per 37 CFR 3.73	29566US01_SuppSheet.pdf	19282 77f94689dbe37f89ca72754543a8844550a528a7	no	1
Warnings:					
Information:					
3	Power of Attorney	Entropic_POA_PreAIA.pdf	340881 8107f4c6d5473b527f97e45769199b81a37aad1b	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	790456		

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

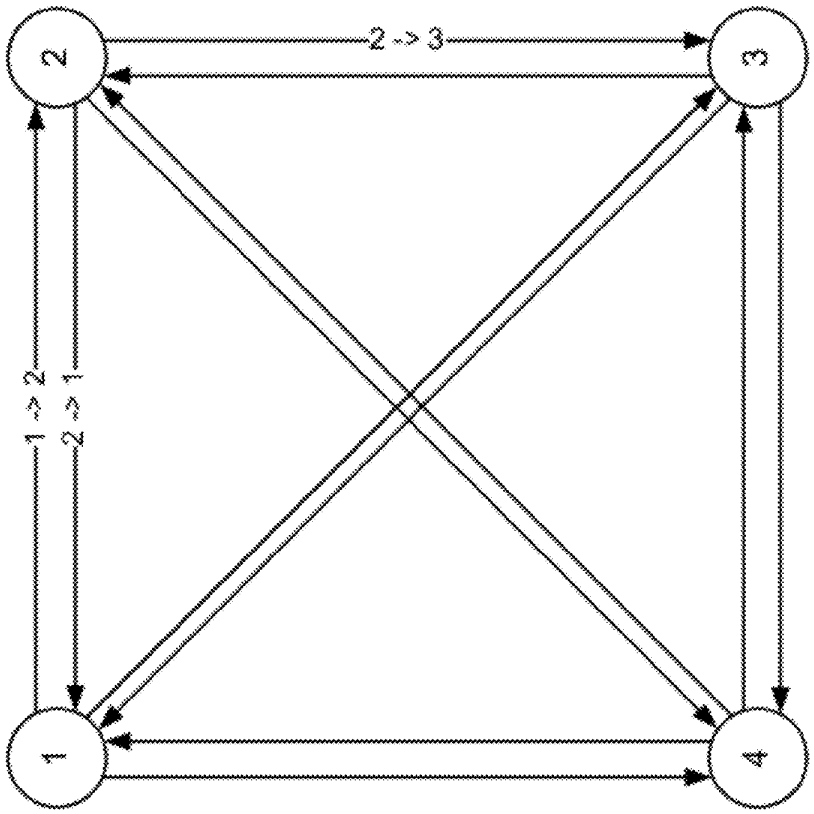


Fig. 2

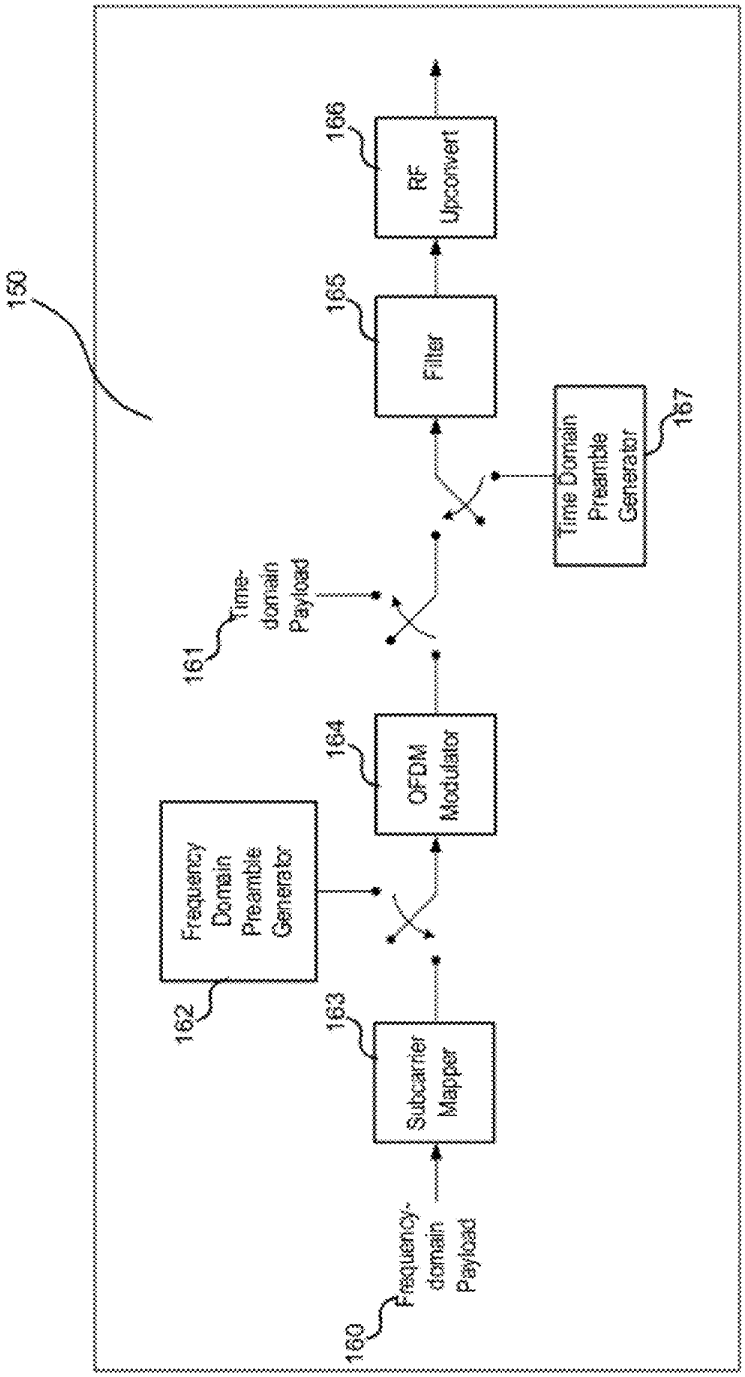

150
160
Frequency-domain Payload
163
Subcarrier Mapper
162
Frequency Domain Preamble Generator
164
OFDM Modulator
161
Time-domain Payload
167
Time Domain Preamble Generator
165
Filter
166
RF Upconvert

Fig. 3

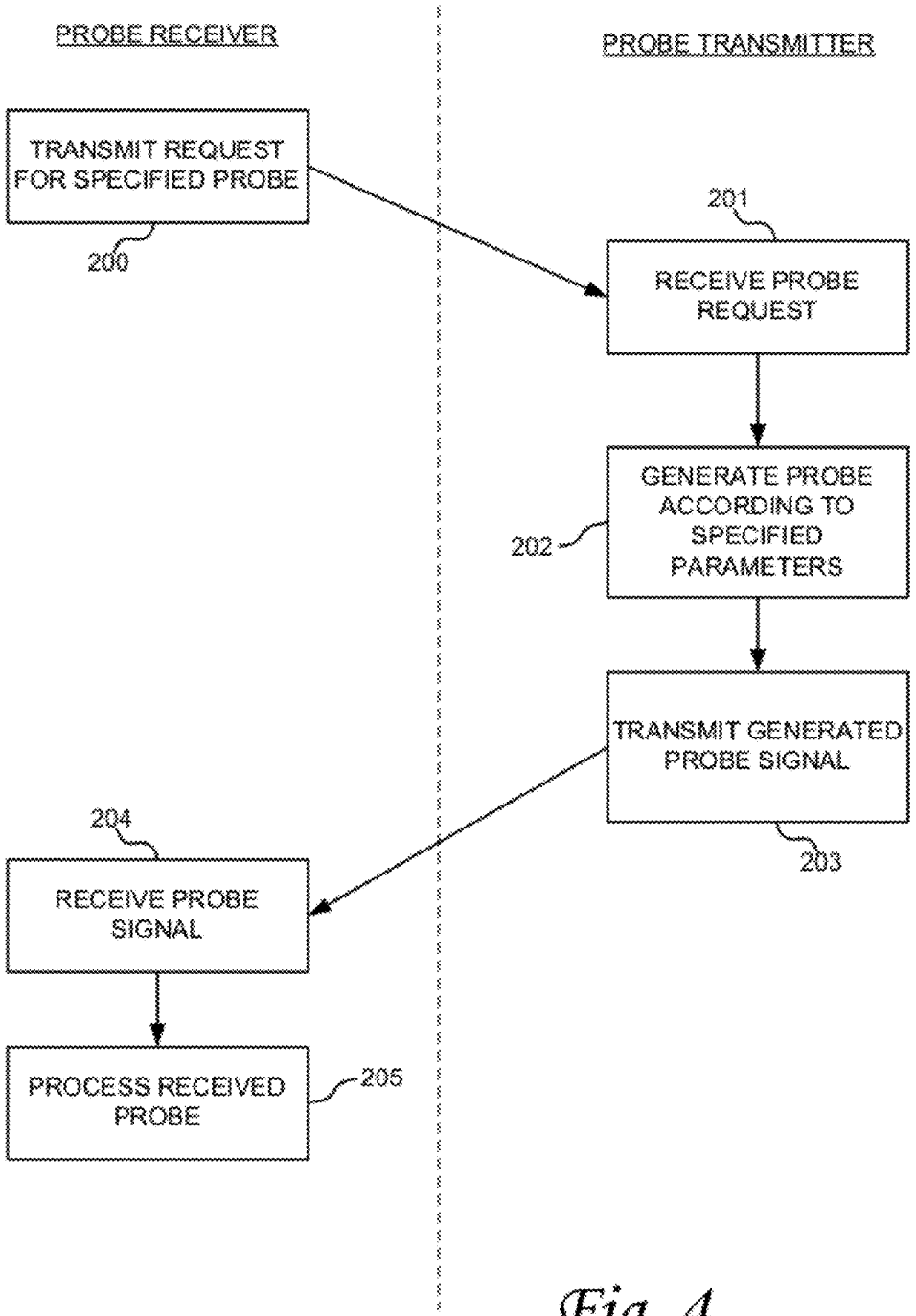

PROBE RECEIVER
PROBE TRANSMITTER
TRANSMIT REQUEST FOR SPECIFIED PROBE
200
201
RECEIVE PROBE REQUEST
GENERATE PROBE ACCORDING TO SPECIFIED PARAMETERS
202
TRANSMIT GENERATED PROBE SIGNAL
203
204
RECEIVE PROBE SIGNAL
PROCESS RECEIVED PROBE
205

Fig. 4

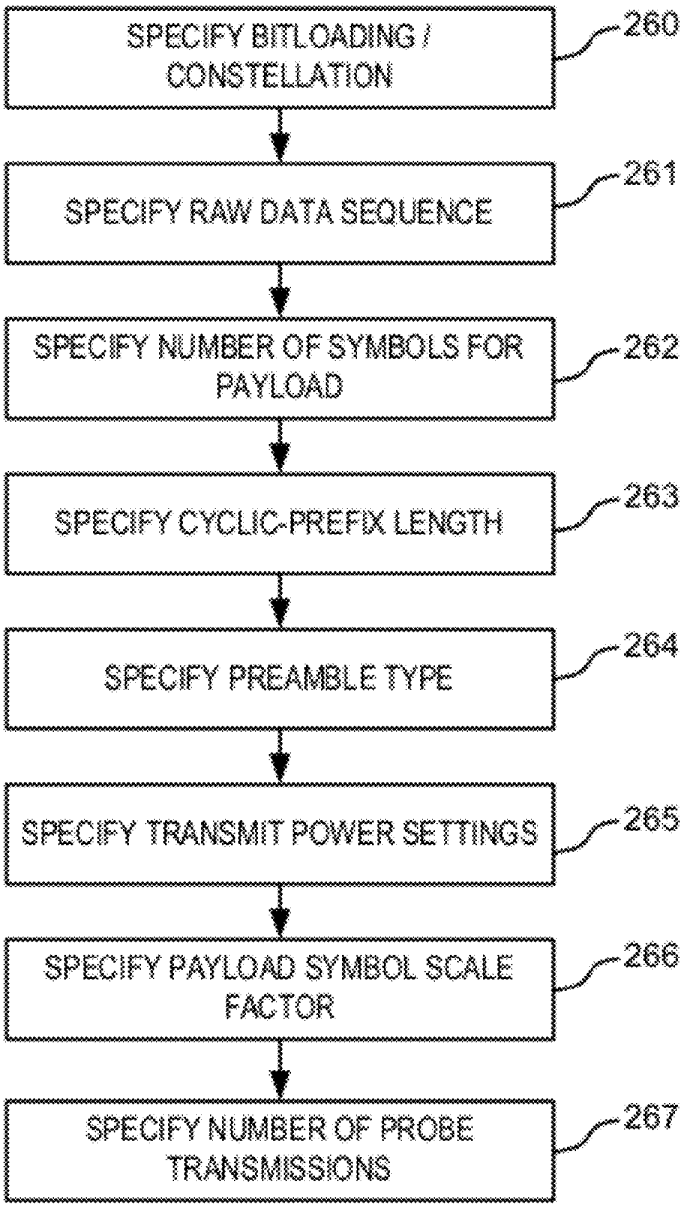

SPECIFY BITLOADING / CONSTELLATION
260
SPECIFY RAW DATA SEQUENCE
261
SPECIFY NUMBER OF SYMBOLS FOR PAYLOAD
262
SPECIFY CYCLIC-PREFIX LENGTH
263
SPECIFY PREAMBLE TYPE
264
SPECIFY TRANSMIT POWER SETTINGS
265
SPECIFY PAYLOAD SYMBOL SCALE FACTOR
266
SPECIFY NUMBER OF PROBE TRANSMISSIONS
267

Fig. 5

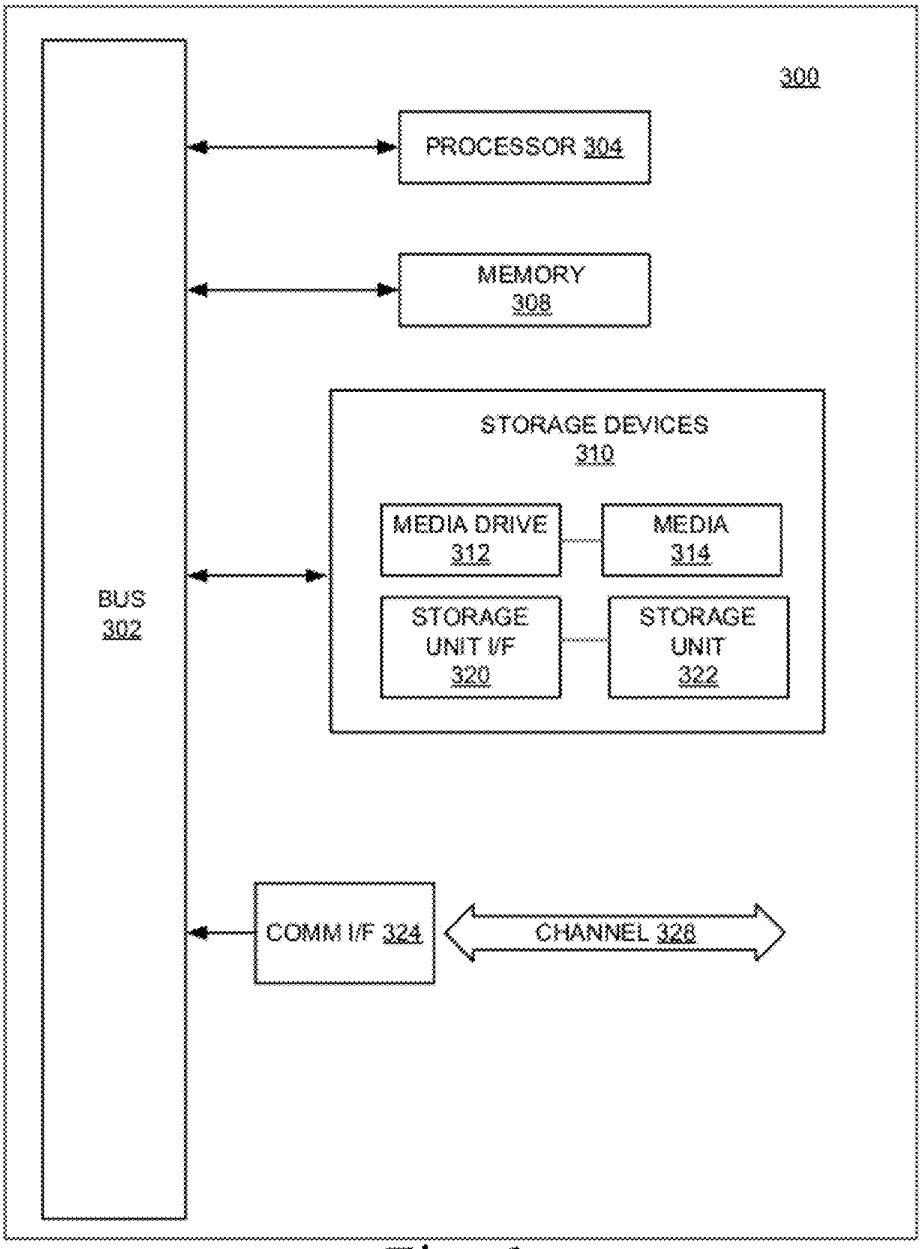

300
PROCESSOR 304
MEMORY 308
STORAGE DEVICES 310
MEDIA DRIVE 312
MEDIA 314
STORAGE UNIT I/F 320
STORAGE UNIT 322
BUS 302
COMM I/F 324
CHANNEL 326

Fig. 6

RECEIVER DETERMINED PROBE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Applications No. 61/122,687, filed Dec. 15, 2008, and No. 61/179,454, filed May 19, 2009, each of which is herein incorporated by reference.

TECHNICAL FIELD

The presently disclosed method and apparatus relates generally to communication networks, and more particularly, some embodiments relate to channel assessment probes.

DESCRIPTION OF THE RELATED ART

A home network may include multiple types of subscriber equipment configured to deliver subscriber services throughout the home. These subscriber services include delivering multimedia content, such as streaming audio and video, through the home network to subscriber equipment, where it is presented to a user. As the number of available subscriber services has increased and they become more popular, the number of devices being connected within each home network has also increased. The increase in the number of services and devices increases the complexity of coordinating communication between the network nodes as each node may experience different access conditions along its portion of the network.

This increase in complexity, further increases the likelihood that network problems may develop. When problems with subscriber services develop, subscriber service content providers are typically required to diagnosis the source of the network problem. Often, this requires sending a technician to the physical location of the home network to personally assess the network and diagnose the problem. Accordingly, as the number of homes with subscriber services incorporated into their home networks increases, so does the amount of resources a service provider must devote to technical support and network maintenance.

In many instances in which a network is established, it is helpful to characterize the communication channel over which data is to be sent between nodes of the network. It should be noted that for the purposes of this disclosure, a "channel" is the communication link between a first node of a network and a second node of a network in one particular direction. Therefore, there is a first channel from a first node **1** to a second node **2** and a second unique channel from the second node **2** to the first node **1**. In some instances, probes are sent between nodes of the network in order to allow a receiving node on the network to determine some of the characteristics of the channel between the receiving node and the transmitting node. These probes are typically well defined. Accordingly, the receiving node knows before reception what reference signal was transmitted. By comparing the reference probe with the actual received probe, the receiver can determine some of the characteristics of the channel between the transmitting and receiving node. However, requiring the transmitting node to send a predetermined probe reduces the amount flexibility of the characterization process. Nonetheless, this reduction in the flexibility must be suffered because it is critical to the process that the receiving node knows the precise form of the transmitted probe.

BRIEF SUMMARY

According to various embodiments of the disclosed method and apparatus, nodes on a network (also referred to as network devices) are programmed to generate a probe transmission in response to a request from the nodes that will be receiving the probe. The receiving node may generate a probe request that specifies a plurality of parameters to be used in such a "receiver determined" probe to generate a probe having the "form" specified by these parameters. Accordingly, the probe request specifies a plurality of parameters associated with the generation and transmission of a probe, including the content of a payload of the probe. In one embodiment, the parameters further include: the modulation profile for the probe; the payload content of the probe; the number of times to transmit the probe; the number of symbols for the payload of the probe; the preamble type for the probe; the cyclic-prefix length for the payload of the probe; the transmit power for the probe; and the transmit power scaling factor for the payload of the probe. Accordingly, the probe that is transmitted in response to the probe request will have a form dictated by the parameters specified in the probe request.

In various embodiments, these receiver determined probes may be used in a variety of applications. For example, the probes may be used to reach or discover hidden nodes; in networks employing orthogonal frequency division multiple access (OFDMA), the probes may be used for OFDMA subchannel assessment; or in networks accessible by content providers, the probes may be used for off-site network diagnosis.

An embodiment of the disclosed method comprises: a) receiving in a first node, a probe request specifying a plurality of parameters associated with the generation and transmission of a probe, including the content of a payload of the probe; and b) transmitting from the first node to a second node the probe having a form dictated by the parameters specified by the probe request.

In a further embodiment of the method and apparatus, at least one of the probe parameters indicates: a) a modulation profile for the probe; b) the payload content of the probe; c) the number of times to transmit the probe; d) the number of symbols for the payload of the probe; e) the preamble type for the probe; f) the cyclic-prefix length for the payload of the probe; g) the transmit power for the probe; and h) the transmit power scaling factor for the payload of the probe.

Other features and aspects of the disclosed method and apparatus will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the features in accordance with embodiments of the disclosed method and apparatus. The summary is not intended to limit the scope of the claimed invention, which is defined solely by the claims attached hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosed method and apparatus, in accordance with one or more various embodiments, is described in detail with reference to the following figures. The drawings are provided for purposes of illustration only and merely depict either typical embodiments or examples of particular embodiments. These drawings are provided to facilitate the reader's understanding of the disclosed method and apparatus and shall not be considered limiting of the breadth, scope, or applicability of the claimed invention. It should be noted that for clarity and ease of illustration these drawings are not necessarily made to scale.

FIG. **1** illustrates an example of one environment in which some embodiments of the disclosed method and apparatus may be implemented.

FIG. **2** illustrates an example of one embodiment of a network topology of the disclosed method and apparatus.

FIG. **3** illustrates a transmitter module that may be employed in some embodiments of the disclosed method and apparatus to generate PHY packets.

FIG. **4** illustrates a method of operation according to an embodiment of the disclosed method and apparatus.

FIG. **5** illustrates examples of parameters that may be modified or determined for generating a probe request according to an embodiment of the disclosed method and apparatus.

FIG. **6** illustrates an example computing module that may be used in implementing various features of embodiments of the disclosed method and apparatus.

The figures are not intended to be exhaustive or to limit the claimed invention to the precise form disclosed. It should be understood that the disclosed method and apparatus can be practiced with modification and alteration, and that the claimed invention should be limited only by the claims and the equivalents thereof.

DETAILED DESCRIPTION

Before describing the disclosed method and apparatus in detail, it is useful to describe an example of an environment in which the disclosed method and apparatus can be implemented. The network of FIG. **1** will be described for this purpose. A wired communications medium **100** is shown. In some embodiments, the wired communications medium might be a coaxial cable system, a power line system, a fiber optic cable system, an Ethernet cable system, or other similar communications medium. Alternatively, the communications medium might be a wireless transmission system. In the illustrated embodiment, the communications medium **100** is preinstalled coaxial cabling deployed within a residence **101**.

The network comprises a plurality of network nodes **102**, **103**, **104**, **105**, **106** in communication according to a communications protocol. For example, the communications protocol might comprise a networking standard, such as the Multimedia over Coax Alliance (MoCA) standard. In the illustrated embodiment, the communications protocol specifies a packet based communications system. In this embodiment, physical layer (PHY) packets comprise preambles and payloads. A PHY preamble is typically inserted at the beginning of each packet to assist receivers in detecting and acquiring the physical layer parameters to properly receive and decode the packet. The communications protocol may have a plurality of pre-defined PHY preambles to use with different types of network communications. For example, one type of preamble may be used when transmitting in a diversity mode (a communication mode in which little is known about the communication channel). Another type of preamble may be used when transmitting a media access plan (MAP) message. Another type of preamble may comprise a specified subset of subcarrier frequencies. Other types of packets may use other types of preambles.

A PHY payload is used to transmit the data content of the packet. In some cases, the PHY payload has a predetermined format. For example, in a MoCA network, network maintenance messages and MAP messages each have a format that is determined by the MoCA protocol. In other cases, the PHY payload may have undetermined format. For example, the PHY payload of a media streaming transmission might comprise an embedded Ethernet packet or a portion thereof.

In some embodiments, activity on the network is controlled by a network coordinator (NC) node. In one such embodiment, one of the nodes is selected to perform the functions of the NC based upon a process defined by the communications protocol. In networks employing an NC, the NC schedules network communications between network nodes using a MAP message. The MAP is sent as a packet. Such MAP packets are sent on a regular basis. MAPs are generated in response to reservation requests by the nodes of the network. The NC's MAP message may precisely schedule probe transmissions. The NC also performs admission procedures when a new node requests admission to the network.

Nodes described herein can be associated with a variety of devices. For example, in a system deployed in a residence **101**, a node may be a network communications module associated with one of the computers **109** or **110**. Such nodes allow the computers **109**, **110** to communicate on the communications medium **100**. Alternatively, a node may be a module associated with a television **111** to allow the television to receive and display media streamed from the internet, or from one or more other network nodes. A node might also be associated with a speaker or other media playing devices **103** that plays music. A node might also be associated with a module configured to interface with an internet or cable service provider **112**, for example to provide Internet access, digital video recording capabilities, media streaming functions, or network management services to the residence **101**.

In many embodiments, network probes are used to perform various channel assessment or network maintenance procedures. For example, in a wired network, network node mobility may be fairly low and new nodes joining the network may be a relatively rare occurrence. In contrast to highly dynamic networks, such as wireless networks, wired networks are more stable, i.e., the channel conditions do not change frequently. In stable networks probing can be used to profile the channel conditions without introducing unacceptable network overhead. However, even with more dynamic networks, network probes can be used to diagnose problems. For example, a probe can replicate a potential problem, reach or discover a distant or previously undetected node on the network, or assist with network admissions procedures.

In some embodiments, network communications use orthogonal frequency division multiplexing (OFDM). In OFDM, a communications channel comprises a plurality of orthogonal subcarrier frequencies. In one embodiment, transmissions are modulated onto these subcarriers using quadrature amplitude modulation (QAM), where symbols are modulated onto the subcarrier by modifying the amplitude of an in-phase and independently modifying the amplitude of a quadrature portion of the subcarrier transmission. Each OFDM symbol is formed from the collection of all of the QAM symbols modulated onto each of the used subcarriers in the same time slot. In some embodiments, each subcarrier is modulated with the same modulation scheme. For example, an OFDM symbol may comprise a plurality of subcarriers each modulated with 4-QAM. In another embodiment, transmissions on different subcarriers may utilize different QAM schemes. For example, a first subcarrier may be modulated using 2-QAM (otherwise known as binary phase shift keying (BPSK)), a second subcarrier may be modulated using 64-QAM, and so on. In yet another embodiment, different transmission types may utilize different types of OFDM symbols. For example, during network admissions processes, transmissions may utilize OFDM symbols where each subcarrier is modulated with 2-QAM, and once the network node has been admitted to the network, it may utilize an adaptable bitloading profile for its OFDM symbols.

In some embodiments, OFDMA may be employed to allow multiple nodes to have simultaneous access to the channel. In OFDMA, disjoint subsets of subcarriers, referred to as sub-

channels, are assigned to the nodes participating in the OFDMA communications. In some embodiments employing NCs, OFDMA is used for the communications between the non-NC nodes and the NC. In these embodiments, the NC may partition the channel into sub-channels and assign these sub-channels to the participating network nodes. In a particular embodiment, the sub-channels are configured such that the bitloading on each sub-channel is the same. In this embodiment, because different subcarriers may accommodate different modulation schemes, the sub-channels may not all have the same number of subcarriers. However, in other embodiments, different sub-channel bitloading and partitioning schemes may be employed.

FIG. **2** illustrates a full mesh topology between four example nodes. In some embodiments, network conditions may vary according to the particular channel, and even according to the direction of the channel. For example, network conditions for the channel from node **1** to node **2** can differ from the conditions for the channel from node **2** to node **1**. These can each be different from the conditions of the channel from node **2** to node **3**, and so on. Accordingly, different modulation schemes may be employed for each channel. In one embodiment, probes are used during a network profiling period to determine the modulation schemes to be used for the different links. For example, node **1** may transmit a probe request to each of nodes **2**, **3**, and **4** specifying a bitloading per subcarrier and a raw data sequence to be used in transmitting the probe. Each of nodes **2**, **3**, and **4** would then generate the probe with the requested bitloading and raw data sequence and transmit the probe to node **1**. By analyzing this return probe and repeating the process if necessary, node **1** can develop bitloading profiles for use on the subcarriers used to communicate with each of nodes **2**, **3**, and **4**.

In one embodiment employing OFDMA, a receiving node sends a probe request that indicates which sub-carriers are to be used to send a probe from a particular transmitting node and the bitloading profiles applied across those sub-carriers. For example, in one embodiment, node **1** may be an NC, and may receive reservation requests from nodes **2**, **3**, and **4** simultaneously using OFDMA. If node **1** were to establish a potential sub-channel with node **2**, node **1** can transmit a probe request specifying a bitloading profile in which the subcarriers that are not in the potential sub-channel are left untransmitted. Accordingly, the bitloading profile would indicate modulating only the subcarriers that are in the potential sub-channel. In this case, the probe generated by node **2** in response to the probe request from node **1** would emulate an OFDMA transmission from node **2** to node **1**. Node **1** could then use the information derived from the probe in its OFDMA sub-channel allocation procedure.

In another embodiment, node **1** could transmit one or more probe requests that request probes to be transmitted by some or all of the OFDMA participant nodes simultaneously on the subcarriers assigned to be used by each OFDMA participant node.

FIG. **3** illustrates a transmitter module **150** used within a node, such as the nodes **102**, **103**, **104**, **105**, **106** shown in FIG. **1**. The transmitter module **150** generates PHY packets in accordance with one embodiment of the disclosed method and apparatus. The module **150** has a frequency domain payload **160** and/or a time domain payload **161**. A subcarrier mapper **163** maps the payload **161** to a plurality of assigned subcarriers according to a predetermined bitloading profile for the channel (or sub-channel in the case of an OFDMA transmission). The transmitter module **150** uses a frequency domain preamble generator module **162** to insert a frequency domain PHY preamble before the frequency domain payload **160**. Accordingly, a preamble specified in the frequency domain may be "prepended" to the payload after the subcarrier mapper **163**. The combined signal is then modulated onto the OFDM symbol by a modulator module **164**. The modulated signal is then filtered and upconverted to the channel's predetermined radio frequencies by the filter **165** and an RF upconverter **166**.

When the transmitting module **150** is generating a time domain packet, the frequency domain modulation is not necessary. However, in one embodiment the frequency domain modulation is used even when generating a time domain packet. A time domain payload **161** having a time domain preamble generated by a time domain preamble generator module **167** is filtered and RF upconverted for transmission on the channel.

FIG. **4** illustrates a method of operation according to an embodiment of the disclosed method and apparatus. In block **200**, one or more nodes transmit a probe request specifying probe parameters to one or more nodes that will be transmitting the eventual probe(s) having a form that is dictated by the specified parameters. In one embodiment, the probe is transmitted by a single node and received by a single node (point-to-point) or received by several nodes (point-to-multipoint, such as multicast or broadcast). In another embodiment, the probe is simultaneously transmitted by multiple nodes and received by a single node (multipoint-to-point, such as OFDMA). In other OFMDA embodiments, multiple nodes might share the communications channel for multi-point to multi-point communications. In such a case, multiple nodes can transmit probe requests, and multiple nodes can receive probes, all simultaneously.

In block **201**, the probe transmitter or transmitters receive the probe request or requests. In one embodiment, the probe request specifies a plurality of parameters for the probe that will dictate the form of the probe to be transmitted. These parameters are discussed in more detail below with respect to FIG. **5**. In block **202**, the probe transmitter uses the specified probe parameters to generate a probe having a form that complies with the specified parameters. In block **203**, the probe transmitter transmits the generated probe to the probe requester at a specified time. Alternatively, the probe transmitter can transmit the probe to any other probe base upon one of the parameters of the probe request or based upon information that previously existed within the transmitting node. In some embodiments, the requested probe may exceed certain capabilities of the transmitter.

In one embodiment, the probe transmitter's RMS error (signal fidelity) requirements may be relaxed if the requested probe specifies a power output that exceeds the transmitting node's nominal total output power. As another example, the probe transmitter may have restrictions on how many time domain probes it is allowed to send, and will send a time domain probe only if the probe transmitter determines that the time domain probe will not negatively impact other network operations.

In block **204**, the requesting node receives the probe generated according to its earlier probe request. The received probe may then be used in further processing in block **205**. In one embodiment, the received probe may be used in channel analysis to determine a bitloading table, FEC and other communication parameters for OFDM or OFDMA signals for future transmissions from the probe transmitter. In another embodiment, post reception processing might comprise generating a report from the probe and transmitting this probe report to the requesting node or to a designated entity. For example, the probe report could contain bitloading, FEC and

other communication parameters to be used subsequently by the transmitting node when communicating to the receiving node. In another example, the probe report could be conveyed to an offsite network administrator for remote management purposes. For example, the parameters of the requested probe can be determined by an off-site network administrator, and conveyed to a probe requestor. The resulting probe, post-processing, and probe report can be used to assist in diagnosing a network problem possibly involving the probe requester or the probe transmitter. In one such case, a probe report is sent to the network administrator.

In other embodiments, the probe request might be transmitted by a different node than the probe receiver. For example, in FIG. **2**, node **2** might generate a probe request for node **3** to generate and transmit a specified probe to node **1**. In some embodiments, this is used to determine how communications between node **3** and node **1** could impact communications between node **2** and node **4**. This might occur, for example, in an OFDMA system in which a sub-channel between node **1** and node **3** and a second sub-channel between node **2** and node **3** are active at the same time. In another embodiment, an NC can generate a probe request for a probe to be transmitted between two other nodes with an instruction that a probe report be transmitted to the NC. This might be used by an off-site network manager that can communicate with only some of the network nodes, but suspects that communications between other network nodes may be causing a network problem.

FIG. **5** illustrates examples of parameters that may be modified or determined for generating a probe request according to an embodiment of the disclosed method and apparatus. A probe request may specify a bitloading profile or constellation profile to be used in the probe (block **260**). For example, in OFDM networks, the bitloading profile or constellation profile may specify which QAM constellations to use for which channel subcarriers. In some embodiments, the specified bitloading profile may specify a QAM constellation or QAM scheme to use for each subcarrier. In other embodiments, the bitloading profile specifies QAM schemes for only a subset of the available subcarriers and the probe generating node will not transmit the remaining subcarriers.

In various embodiments, the bitloading profile includes indications to leave certain subcarriers untransmitted. For example, in one embodiment, in which the network conforms to an industry standard established by MoCA, 100 MHz/512 versions of MoCA's Type II Frequency Domain Tone Probes can be accommodated without the need to specifically define the probes in the MoCA specification. This could be accomplished in part by generating a probe request for a probe having two modulated subcarriers, while specifying that the remaining subcarriers of the probe be untransmitted. As another example, an OFDMA transmission from a single node could be emulated by instructing the node to transmit a probe in which only subcarriers belonging to a certain sub-channel are transmitted, while leaving the remaining subcarriers untransmitted. Additionally, simultaneous OFDMA transmissions may occur in response to probe requests to multiple nodes. In one embodiment, each of the multiple probe requests is sent to one of a plurality of nodes. Each probe request specifies a bitloading profile specific to the particular probe-transmitting node, such that the simultaneously transmitted probes from the multiple nodes comprise an OFDMA transmission to the requesting node.

In accordance with the embodiment shown in FIG. **5**, in block **261**, the probe request specifies a raw data sequence for the probe (or for just the probe's payload). In some embodiments, a network communications protocol specifies that various techniques, such as data-scrambling, bin-scrambling, forward error correction, or encryption be used in network communications. In some such embodiments, these techniques are specified in the probe request. In alternative embodiments, these techniques are not used in the specified data sequence for simplicity.

In block **262**, a probe request specifies a number of symbols for the probe payload length. In one embodiment, the number of symbols and the raw data sequence will be determined such that the serialized bit stream corresponding to the raw data sequence fully occupies the requested number of symbols using the requested bitloading profile. Additionally, in embodiments using OFDM communications, or other embodiments with multi-path channel characteristics, a cyclic prefix length may be specified. In some embodiments, the cyclic prefix length may he the same for each symbol of the specified number of symbols. In other embodiments, the cyclic prefix length may be assigned in a symbol specific manner or may otherwise vary between symbols of the probe.

In block **264**, a probe request further specifies a preamble type to use in the probe. As discussed above, some networks operate according to protocols that specify a variety of available packet preambles. These packet preambles can be used for packet identification or can contain information useful in receiving and decoding the packet's payload. In some embodiments, different preambles may be utilized according to channel conditions, such as a long and robust preamble when the channel conditions are unknown, or a short and efficient preamble when the channel conditions are known to be good. In some embodiments using OFDMA transmissions, a preamble type may be used in which each simultaneous transmitter contributes a portion of the composite preamble corresponding to the particular subcarriers assigned to each participating transmitter. In some embodiments, nodes may be restricted from using certain preamble types. For example, in a network utilizing MAP packets, a MAP packet preamble may be specified, and nodes may be restricted from requesting that a probe utilize a MAP packet preamble. This can serve to reduce the likelihood that a probe might adversely affect the operation of other nodes not involved in the probing procedure. In other embodiments, the type of preamble available is not restricted, or the restriction can be overcome in certain circumstances. For example, diagnostic probe requests could be unrestricted in terms of the available preambles while network maintenance or assessment or channel assessment probe requests could be restricted in terms of their available preambles. Additionally, in some embodiments, only certain probe parameters can be requested under certain conditions. For example, in an OFDMA network, the network protocol may specify that a particular OFDMA preamble be used in all OFDMA transmissions. Therefore, if a probe request specifies an OFDMA probe, then the probe request will specify that the particular OFDMA preamble be used in the OFDMA probe. In another embodiment, the probe request also specifies that the same subcarriers remain untransmitted in the preamble as in the OFDMA packet payload. In another embodiment, the probe transmitting node may perform this operation automatically.

In the embodiment of FIG. **5**, block **265** indicates that a probe request specifies a transmit power setting for the probe. In some embodiments, the network protocol may establish a range of transmit power settings that are available for various transmissions. In a particular embodiment, a range of transmit power (attenuation) settings is between 0 and 30 dB for normal transmissions, and between −12 dB (corresponding to amplification) to 45 dB for OFDMA transmissions, or transmissions with an OFDMA specifying preamble. In some

embodiments, a node conforms to these predetermined settings in generating probe requests. In other embodiments, the different settings available for different transmission types may be exploited to generate particular probes. For example, a probe request could request an amplified non-OFDMA probe in order to reach or identify a distant or hidden node.

In block **266**, a probe request further specifies a power scaling factor for the payload relative to the preamble. In embodiments employing this scaling factor, probe payloads can be transmitted with different power characteristics than the probe preambles. In one particular embodiment, the scale factor varies from 0 to 17 dB of amplification in the payload relative to the preamble. This might be used in a variety of different requested probes. For example, 100 MHz/512-subcarrier versions of MoCA's Type II Frequency Domain Tone Probes can be emulated, in part, by applying an appropriate payload scale factor. For example, a probe request may specify a payload that modulates only a single subcarrier with the maximum available payload scaling factor (amplification) in order to reach or identify a distant or hidden node. In another example, a payload scale factor may be requested which produces a probe transmission which exceeds the transmitting node's nominal total output power, in order to reach or identify a distant or hidden node. Alternatively, the probe request may specify an OFDMA emulating probe in which the payload is modulated on a set of subcarriers that comprises a potential sub-channel for OFDMA communications. The scaling factor can be determined such that the payload is transmitted at the power level of a normal OFDMA sub-channel, even though the preamble does not specify that the communication is an OFDMA sub-channel. In one embodiment, such probes might be used to assess a channel and thus allow an NC to pre-determine which OFDMA sub-channels should be used if a node leaves or joins the network. For example, an NC could establish four potential sub-channels for a network having three current nodes. This would avoid overhead if a fourth node were to join the network. In some embodiments, packet power restrictions may impact what scaling factors are available in terms of the specified transmit power setting. In a particular embodiment, the payload symbol scaling factor minus the transmit power (attenuation) setting is restricted to less than or equal to 12 dB.

In block **267**, a probe request specifies the number of times the generated probe should be transmitted. For example, a probe request may specify that the generated probe be repeated to allow improved channel assessment or to diagnosis a particular network issue. In one embodiment, the amount of delay between repetitions is specified. In further embodiments, the probe request may specify that certain probe parameters vary in subsequent transmissions. For example, the probe request may specify that the transmitter transmit three subsequent probes with equivalent parameters except for an increasing power transmit setting. In some embodiments, this is used to avoid repetitious probe requests.

In some alternative embodiments, the probe requests specify time-domain probes. For example, a probe request may specify a time domain probe to generate a square wave or other easily analyzed signal for channel estimate purposes. In some embodiments, factors similar to those employed in the embodiments described with respect to FIG. **5** may be employed in a time domain probe request, except that the bitloading profile and raw data bit-sequence are replaced with a time series for the transmitted probe. In some embodiments, the allowed time domain sequences are restricted, for example to prevent a mal-formed packet from disrupting other network communications. In other embodiments, probe transmitters are programmed to evaluate a received time-domain probe request to determine if the corresponding time-domain probe would disrupt the network.

In various embodiments, allowing a probe receiving node to specify the parameters for a probe from the probe transmitting node allows various features to be implemented. Furthermore, in some embodiments, networks implementing these embodiments may simplify their shared communications standards. For example, a network standard may forgo specifying particular assessment probes and allow a receiving node to determine its own assessment probe. In one embodiment, the receiving node may utilize this ability to specify the characteristics of an error vector measurement (EVM) probe or echo profile probe (EPP). Furthermore, this may simplify the shared communications standard by allowing proprietary aspects of the probe signal processing to be confined to particular receivers. Allowing the receiving node to specify the characteristics of the probe also supports future extensibility (e.g., new probe signals could be supported by older transmitters). In addition to allowing a network to improve its functioning, this may also allow legacy nodes to better interoperate with nodes operating according to future standards. For example, if an improved EVM probe type were developed for a future network, nodes implementing this embodiment will be capable of transmitting the improved probe, even if they themselves are not able to process these probes and are restricted to using a legacy EVM probe. Additionally, some nodes may be capable of downloading or receiving new probe types from outside entities. In networks implementing an embodiment of the disclosed method and apparatus, these new probes may be uploaded to the capable nodes, which can then request the updated probes to be transmitted from nodes that would not otherwise have the upgraded capabilities.

As used herein, the term module might describe a given unit of functionality that can be performed in accordance with one or more embodiments of the disclosed method and apparatus. As used herein, a module might be implemented utilizing any form of hardware, software, or a combination thereof. For example, one or more processors, controllers, ASICs, PLAs, PALs, CPLDs, FPGAs, logical components, software routines or other mechanisms might be implemented to make up a module. In implementation, the various modules described herein might be implemented as discrete modules or the functions and features described can be shared in part or in total among one or more modules. In other words, as would be apparent to one of ordinary skill in the art after reading this description, the various features and functionality described herein may be implemented in any given application and can be implemented in one or more separate or shared modules in various combinations and permutations. Even though various features or elements of functionality may be individually described or claimed as separate modules, one of ordinary skill in the art will understand that these features and functionality can be shared among one or more common software and hardware elements, and such description shall not require or imply that separate hardware or software components are used to implement such features or functionality.

Where components or modules of the disclosed method and apparatus are implemented in whole or in part using software, in one embodiment, these software elements can be implemented to operate with a computing or processing module capable of carrying out the functionality described with respect thereto. One such example computing module is shown in FIG. **6**. Various embodiments are described in terms of this example-computing module **300**. After reading this description, it will become apparent to a person skilled in the relevant art how to implement the disclosed method and apparatus using other computing modules or architectures.

Referring now to FIG. **6**, computing module **300** may represent, for example, computing or processing capabilities found within desktop, laptop and notebook computers; handheld computing devices (PDA's, smart phones, cell phones, palmtops, etc.); mainframes, supercomputers, workstations or servers; or any other type of special-purpose or general-purpose computing devices as may be desirable or appropriate for a given application or environment. Computing module **300** might also represent computing capabilities embedded within or otherwise available to a given device. For example, a computing module **300** might be found in electronic devices such as, for example, digital cameras, navigation systems, cellular telephones, portable computing devices, modems, routers, wireless access points (WAPs), terminals and other electronic devices that might include some form of processing capability.

Computing module **300** might include, for example, one or more processors, controllers, control modules, or other processing devices, such as a processor **304**. Processor **304** might be implemented using a general-purpose or special-purpose processing engine such as, for example, a microprocessor, controller, or other control logic. In the illustrated example, processor **304** is connected to a bus **302**, although any communication medium can be used to facilitate interaction with other components of computing module **300** or to communicate externally.

Computing module **300** might also include one or more memory modules, simply referred to herein as main memory **308**. For example, preferably random access memory (RAM) or other dynamic memory, might be used for storing information and instructions to be executed by processor **304**. Main memory **308** might also be used for storing temporary variables or other intermediate information during execution of instructions to be executed by processor **304**. Computing module **300** might likewise include a read only memory ("ROM") or other static storage device coupled to bus **302** for storing static information and instructions for processor **304**.

The computing module **300** might also include one or more various forms of information storage mechanism **310**, which might include, for example, a media drive **312** and a storage unit interface **320**. The media drive **312** might include a drive or other mechanism to support fixed or removable storage media **314**. For example, a hard disk drive, a floppy disk drive, a magnetic tape drive, an optical disk drive, a CD or DVD drive (R or RW), or other removable or fixed media drive might be provided. Accordingly, storage media **314** might include, for example, a hard disk, a floppy disk, magnetic tape, cartridge, optical disk, a CD or DVD, or other fixed or removable medium that is read by, written to or accessed by media drive **312**. As these examples illustrate, the storage media **314** can include a computer usable storage medium having stored therein computer software or data.

In alternative embodiments, information storage mechanism **310** might include other similar instrumentalities for allowing computer programs or other instructions or data to be loaded into computing module **300**. Such instrumentalities might include, for example, a fixed or removable storage unit **322** and an interface **320**. Examples of such storage units **322** and interfaces **320** can include a program cartridge and cartridge interface, a removable memory (for example, a flash memory or other removable memory module) and memory slot, a PCMCIA slot and card, and other fixed or removable storage units **322** and interfaces **320** that allow software and data to be transferred from the storage unit **322** to computing module **300**.

Computing module **300** might also include a communications interface **324**. Communications interface **324** might be used to allow software and data to be transferred between computing module **300** and external devices. Examples of communications interface **324** might include a modem or softmodem, a network interface (such as an Ethernet, network interface card, WiMedia, IEEE 802.XX or other interface), a communications port (such as for example, a USB port, IR port, RS232 port Bluetooth® interface, or other port), or other communications interface. Software and data transferred via communications interface **324** might typically be carried on signals, which can be electronic, electromagnetic (which includes optical) or other signals capable of being exchanged by a given communications interface **324**. These signals might be provided to communications interface **324** via a channel **328**. This channel **328** might carry signals and might be implemented using a wired or wireless communication medium. Some examples of a channel might include a MoCA channel over coaxial cable, phone line, power line, a cellular link, an RF link, an optical link, a network interface, a local or wide area network, and other wired or wireless communications channels.

In this document, the terms "computer program medium" and "computer usable medium" are used to generally refer to media such as, for example, memory **308**, storage unit **320**, media **314**, and channel **328**. These and other various forms of computer program media or computer usable media may be involved in carrying one or more sequences of one or more instructions to a processing device for execution. Such instructions embodied on the medium, are generally referred to as "computer program code" or a "computer program product" (which may be grouped in the form of computer programs or other groupings). When executed, such instructions might enable the computing module **300** to perform features or functions of the disclosed method and apparatus as discussed herein.

While various embodiments of the disclosed method and apparatus have been described above, it should be understood that they have been presented by way of example only, and not of limitation. Likewise, the various diagrams may depict an example architectural or other configuration for the disclosed method and apparatus, which is done to aid in understanding the features and functionality that can be included in the disclosed method and apparatus. The claimed invention is not restricted to the illustrated example architectures or configurations, but the desired features can be implemented using a variety of alternative architectures and configurations. Indeed, it will be apparent to one of skill in the art how alternative functional, logical or physical partitioning and configurations can be implemented to implement the desired features of the disclosed method and apparatus. Also, a multitude of different constituent module names other than those depicted herein can be applied to the various partitions. Additionally, with regard to flow diagrams, operational descriptions and method claims, the order in which the blocks are presented herein shall not mandate that various embodiments be implemented to perform the recited functionality in the same order unless the context dictates otherwise.

Although the disclosed method and apparatus is described above in terms of various exemplary embodiments and implementations, it should be understood that the various features, aspects and functionality described in one or more of the individual embodiments are not limited in their applicability to the particular embodiment with which they are described, but instead can be applied, alone or in various combinations, to one or more of the other embodiments of the disclosed method and apparatus, whether or not such embodiments are described and whether or not such features are presented as being a part of a described embodiment. Thus, the breadth and

scope of the claimed invention should not be limited by any of the above-described embodiments which are presented as mere examples for illustration only.

Terms and phrases used in this document, and variations thereof, unless otherwise expressly stated, should be construed as open ended as opposed to limiting. As examples of the foregoing: the term "including" should be read as meaning "including, without limitation" or the like; the term "example" is used to provide exemplary instances of the item in discussion, not an exhaustive or limiting list thereof; the terms "a" or "an" should be read as meaning "at least one," "one or more" or the like; and adjectives such as "conventional," "traditional," "normal," "standard," "known" and terms of similar meaning should not be construed as limiting the item described to a given time period or to an item available as of a given time, but instead should be read to encompass conventional, traditional, normal, or standard technologies that may be available or known now or at any time in the future. Likewise, where this document refers to technologies that would be apparent or known to one of ordinary skill in the art, such technologies encompass those apparent or known to the skilled artisan now or at any time in the future.

The presence of broadening words and phrases such as "one or more," "at least," "but not limited to" or other like phrases in some instances shall not be read to mean that the narrower case is intended or required in instances where such broadening phrases may be absent. The use of the term "module" does not imply that the components or functionality described or claimed as part of the module are all configured in a common package. Indeed, any or all of the various components of a module, whether control logic or other components, can be combined in a single package or separately maintained and can further be distributed in multiple groupings or packages or across multiple locations.

Additionally, the various embodiments set forth herein are described in terms of exemplary block diagrams, flow charts and other illustrations. As will become apparent to one of ordinary skill in the art after reading this document, the illustrated embodiments and their various alternatives can be implemented without confinement to the illustrated examples. For example, block diagrams and their accompanying description should not be construed as mandating a particular architecture or configuration.

The invention claimed is:

1. A method comprising:

a) receiving in a first node, a probe request specifying a first plurality of parameters associated with the generation and transmission of a probe, wherein the first plurality of parameters at least specify content payload of the probe and a second node;

b) determining a second plurality of parameters associated with generation and transmission of the probe;

c) generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters; and

d) transmitting the probe from the first node to the second node.

2. The method of claim **1**, further including using within the first node, at least one of the probe parameters to determine a modulation profile for the probe.

3. The method of claim **1**, wherein at least one of the probe parameters indicates:

a) a modulation profile for the probe;

b) the number of times to transmit the probe;

c) a number of symbols for the payload of the probe;

d) a preamble type for the probe;

e) a cyclic-prefix length for the payload of the probe;

f) a transmit power for the probe; and

g) a transmit power scaling factor for the payload of the probe.

4. The method of claim **3**, wherein the probe request identifies a hidden node.

5. The method of claim **3**, wherein the modulation profile for the probe emulates an orthogonal frequency division multiple access (OFDMA) transmission.

6. The method of claim **1**, wherein the probe request is generated by the second node.

7. The method of claim **1**, wherein the probe request requests a probe that assists in diagnosing a network problem.

8. The method of claim **7**, wherein the probe request is generated by a network operator and uploaded to the second node.

9. A method comprising:

a) a first node transmitting a probe request to a second node, the probe request specifying a first plurality of probe parameters for a physical layer probe, the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe;

b) the first node receiving the probe from the second node, wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node.

10. The method of claim **9**, wherein the probe request is configured such that the probe emulates an OFDMA transmission.

11. The method of claim **9**, further comprising:

a) the first node transmitting a second probe request to a third node;

b) and the first node receiving a second probe from the third node, wherein the second probe is generated according to the second probe request; and

wherein the first probe and second probe are transmitted simultaneously using OFDMA.

12. The method of claim **9**, wherein the probe parameters further comprises:

a) an indication of the number of times to transmit the probe;

b) a number of symbols for the payload of the probe; a preamble type for the probe;

c) a cyclic-prefix length for the payload of the probe; a transmit power for the probe; and

d) a transmit power scaling factor for the payload of the probe.

13. The method of claim **12**, wherein the probe request is configured such that the probe identifies a hidden node.

14. The method of claim **9**, wherein the probe request is transmitted at a specific time.

15. The method of claim **9**, wherein the probe request is configured to diagnose a network problem.

16. The method of claim **15**, wherein the probe request is generated by a network operator and uploaded to the first node.

17. A system, comprising:

a) a first node on a communications network, the first node comprising a first processor and a first computer executable program code embodied on a first a computer readable medium, the first computer executable program code configured to transmit a probe request to a second node, on the communications network, the probe request specifying a first plurality of probe parameters for a physical layer probe, wherein the first plurality of probe

parameters comprising at least a payload content for the probe and a modulation profile for the probe; and

b) the second node on the communications network, the second node comprising a second processor and a second computer executable program code embodied on a second computer readable medium, the second executable program code configured to:

receive the probe request;

determine a second plurality of parameters associated with generation and transmission of the probe;

generate the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters; and

transmit the probe to the first node.

18. The system of claim **17**, wherein the probe request is configured such that the probe emulates an OFDMA transmission.

19. The system of claim **17**, wherein the first executable program code is further configured to transmit a second probe request to a third node on the communications network, the second probe request specifying a third first plurality of probe parameters for a second physical layer probe, the third plurality of probe parameters comprising a second payload content for the second probe and a second modulation profile for the probe, the second probe request further specifying a different second plurality of parameters associated with the generation and transmission of the second probe; and

further comprising the third node on the communications network, the third node comprising a third processor and a third computer executable program code embodied on a third computer readable medium, the third executable program code configured to receive the second probe request, generate the second probe according to the received probe request, and transmit the second probe to the first node on the communications network; and

wherein the first probe and second probe are transmitted simultaneously using OFDMA.

20. The system of claim **17**, wherein the probe parameters further comprises:

a) an indication of the number of times to transmit the probe;

b) a number of symbols for the payload of the probe;

c) a preamble type for the probe;

d) a cyclic-prefix length for the payload of the probe;

e) a transmit power for the probe; and

f) a transmit power scaling factor for the payload of the probe.

21. The system of claim **20**, wherein the probe request is configured such that the probe identifies a hidden node.

22. The system of claim **17**, wherein the probe request is generated by the first node.

23. The system of claim **17**, wherein the probe request is configured to diagnose a network problem.

24. The system of claim **23**, wherein the probe request is generated by a network operator and uploaded to the first node.

* * * * *

EXHIBIT 5

US009210362B2

(12) **United States Patent**
Reddy et al.

(10) **Patent No.: US 9,210,362 B2**
(45) **Date of Patent: *Dec. 8, 2015**

(54) **WIDEBAND TUNER ARCHITECTURE**

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(73) Assignee: **MaxLinear, Inc.**, Carlsbad, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/614,543**

(22) Filed: **Feb. 5, 2015**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 13/962,871, filed on Aug. 8, 2013, which is a continuation of application No. 12/762,900, filed on Apr. 19, 2010, now Pat. No. 8,526,898.

(60) Provisional application No. 61/170,526, filed on Apr. 17, 2009.

(51) **Int. Cl.**

H04B 1/16	(2006.01)
H04N 5/50	(2006.01)
H04B 1/00	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***H04N 5/50*** (2013.01); ***H04B 1/0014*** (2013.01); ***H04N 21/4263*** (2013.01); ***H04N 21/4383*** (2013.01); ***H04N 21/454*** (2013.01); ***H04N 21/6193*** (2013.01)

(58) **Field of Classification Search**

USPC 455/131, 140, 207, 214, 313, 315, 323, 455/324, 325, 334

See application file for complete search history.

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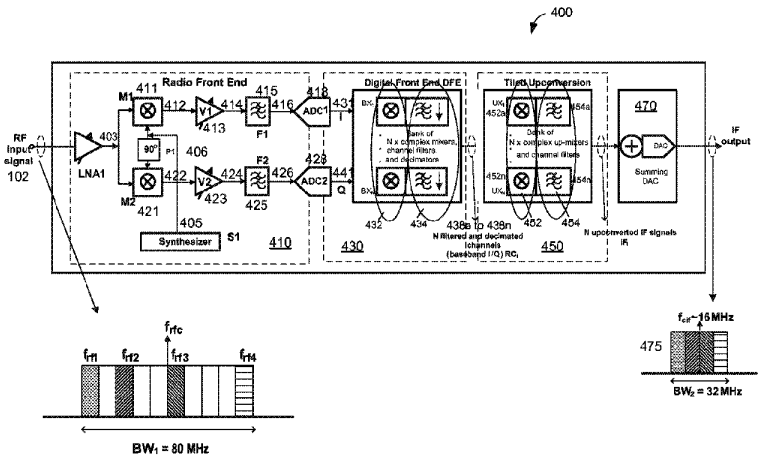
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Primary Examiner — Blane J Jackson
(74) *Attorney, Agent, or Firm* — McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

A wideband receiver system comprises a mixer module, a wideband analog-to-digital converter (ADC) module, and digital circuitry. The mixer module is configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels. The wideband ADC module is configured to digitize the swatch of frequencies comprising the plurality of desired television channels and the plurality of undesired television channels. The digital circuitry is configured to select the desired plurality of television channels from the digitized plurality of frequencies, and output the selected plurality of television channels to a demodulator as a digital datastream.

20 Claims, 10 Drawing Sheets



(51) **Int. Cl.**

H04N 21/426	(2011.01)
H04N 21/438	(2011.01)
H04N 21/454	(2011.01)
H04N 21/61	(2011.01)

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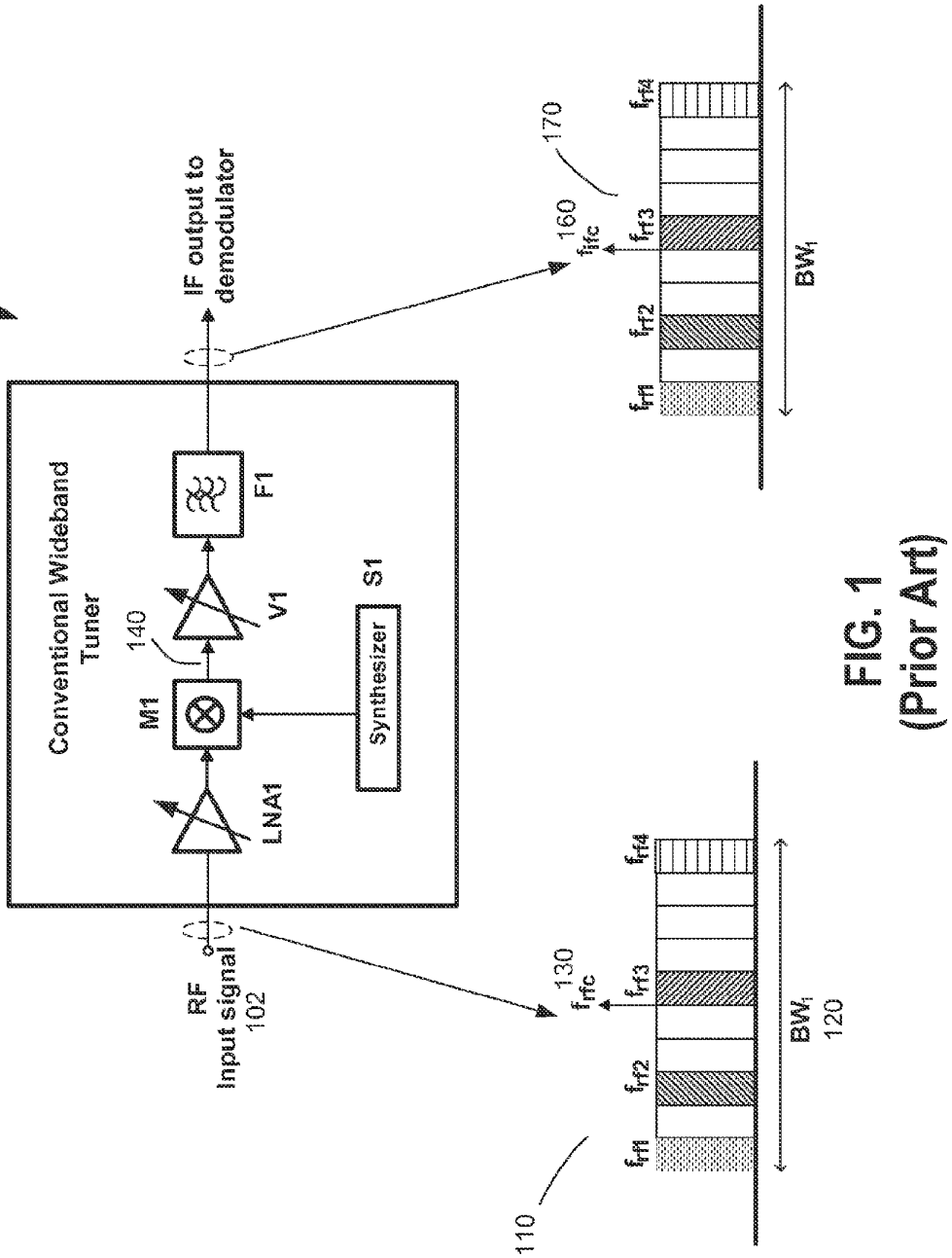


FIG. 1
(Prior Art)

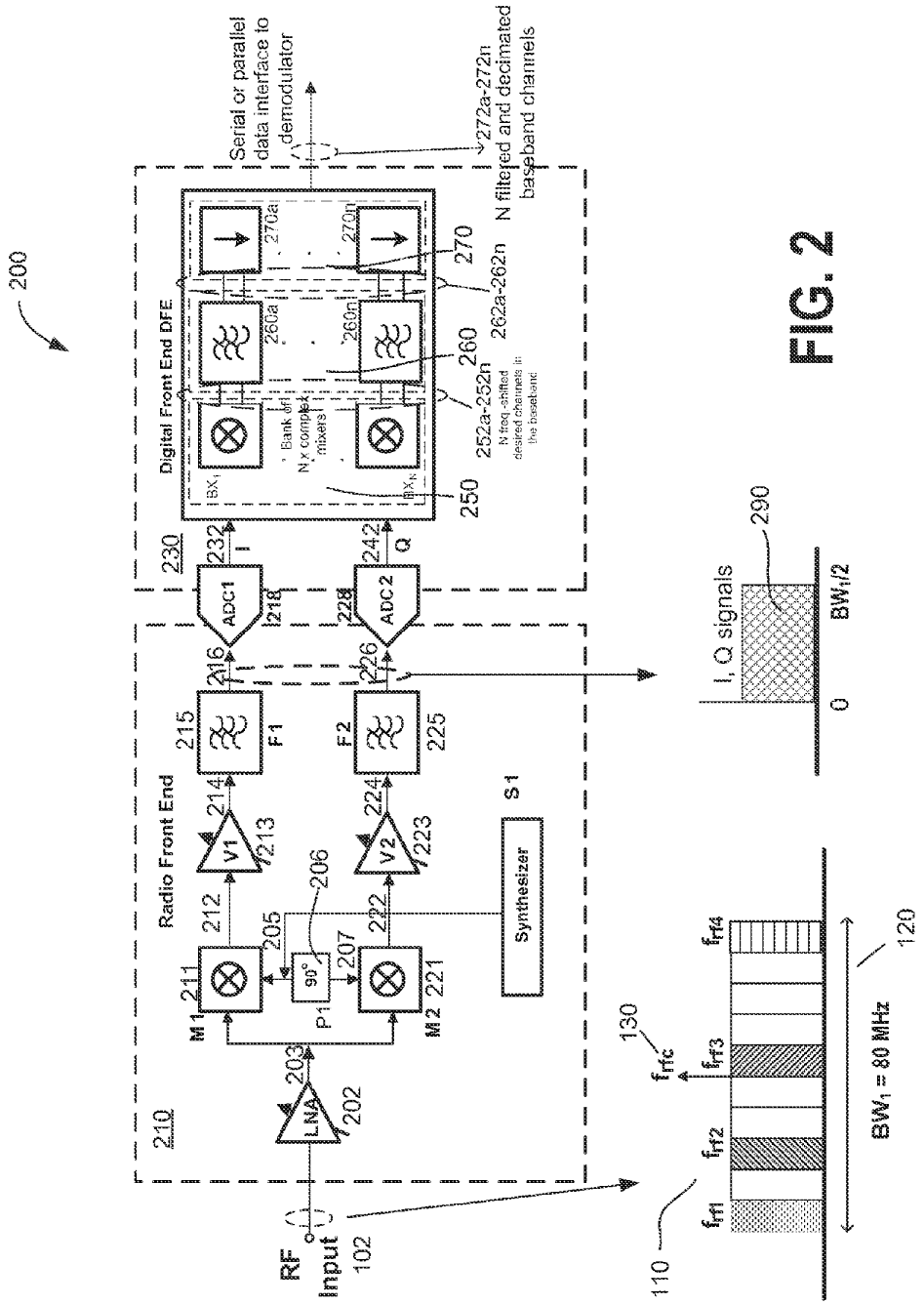

200
Digital Front End DFE
Serial or parallel data interface to demodulator
272a-272n
N filtered and decimated baseband channels
270
270a
270n
260
260a
260n
262a-262n
252a-252n
N freq.-shifted desired channels in the baseband
250
230
232
I
242
Q
ADC1
ADC2
218
228
216
226
Radio Front End
215
F1
F2
225
214
224
V1
V2
213
223
S1
Synthesizer
206
212
222
205
207
M1
211
P1
90°
M2
221
203
LNA
202
210
RF Input
102
130
f_{rfc}
f_{rf1}
f_{rf2}
f_{rf3}
f_{rf4}
110
120
BW_1 = 80 MHz
I, Q signals
290
0
$BW_1/2$

FIG. 2

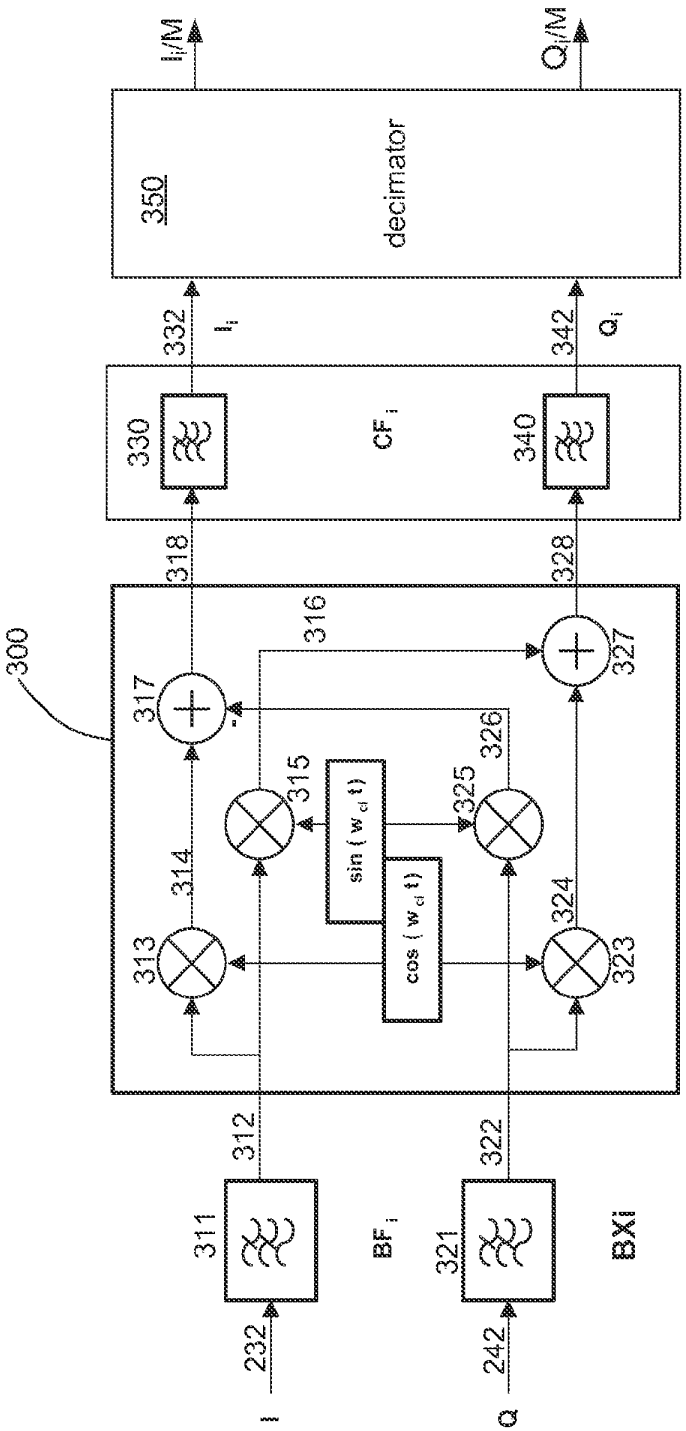

I/M
Q/M
350
decimator
332
I_i
342
Q_i
330
CF_i
340
318
328
316
300
317
327
326
315
325
sin (w_{ct} t)
314
324
313
cos (w_{ct} t)
323
312
322
311
BF_i
321
BXi
232
242
I
Q

FIG. 3

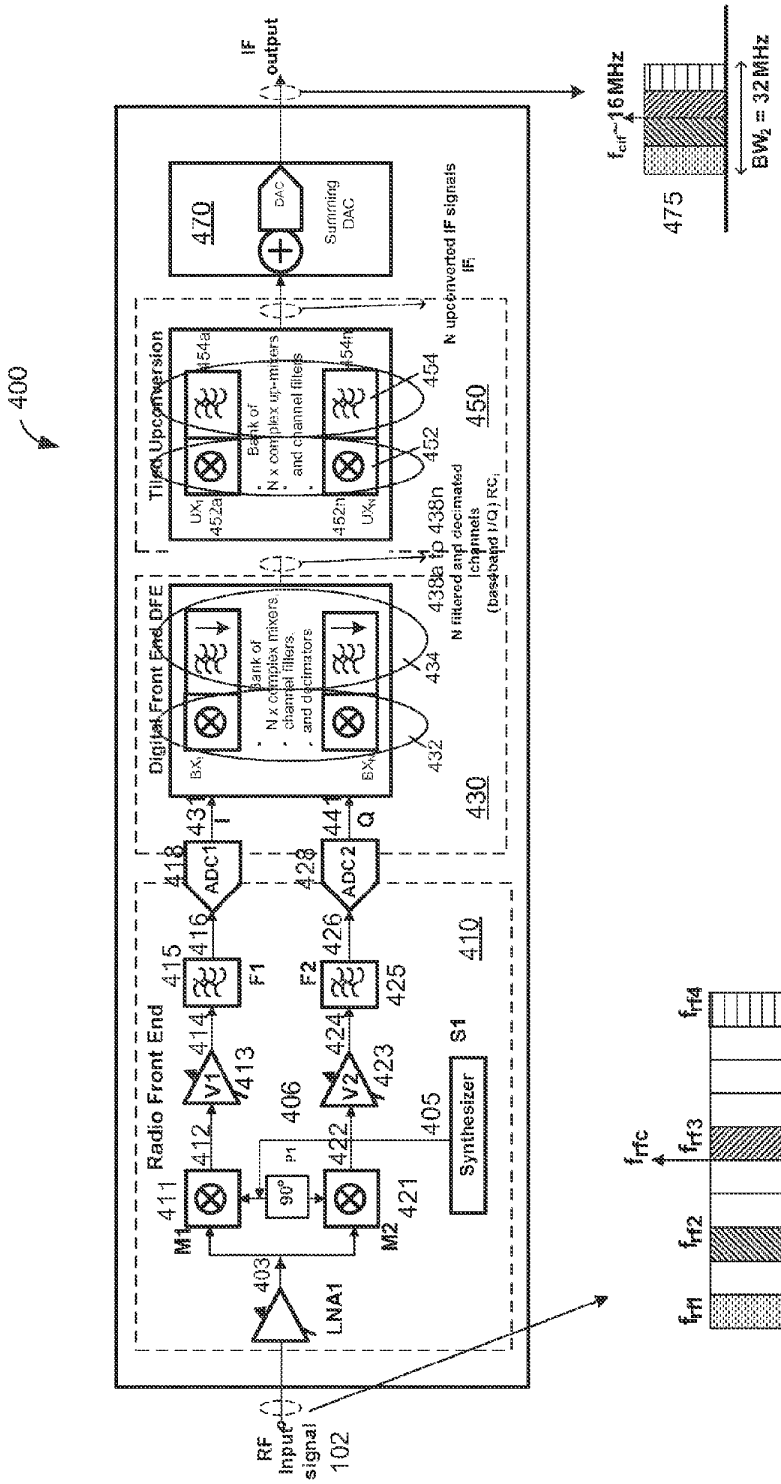

400
RF input signal 102
LNA1
403
M1
M2
411
421
412
422
90°
P1
406
405
Synthesizer
S1
410
Radio Front End
V1
V2
413
423
414
424
415
425
F1
F2
416
426
ADC1
ADC2
418
428
43
44
I
Q
Digital Front End, DFE
430
BX
N x complex mixers
channel filters
and decimators
432
434
N filtered and decimated
channels
(baseband I/Q) RC
438a to 438n
Tiled Upconversion
450
UX
452a
452n
Bank of
N x complex up-mixers
and channel filters
454a
454n
454
N upconverted IF signals
IF
470
DAC
Summing
DAC
IF
output
475
f_{off} = 16 MHz
BW_2 = 32 MHz
f_{rf1}
f_{rf2}
f_{rfc}
f_{rf3}
f_{rf4}
BW_1 = 80 MHz

FIG. 4

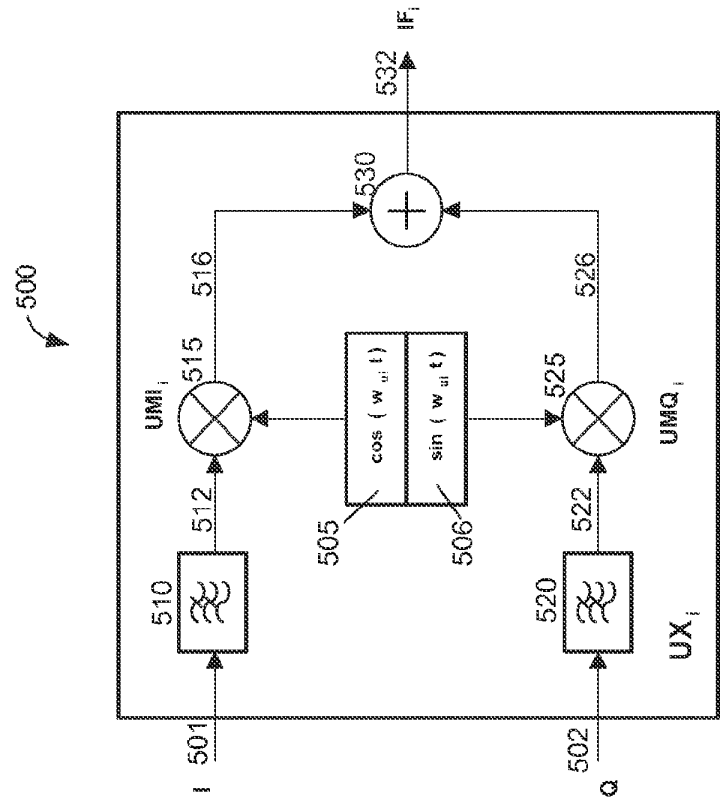

500
532
IF_i
530
516
526
515
UMI_i
525
UMQ_i
cos (w_ui t)
sin (w_ui t)
505
506
512
522
510
520
UX_i
501
I
502
Q

FIG. 5

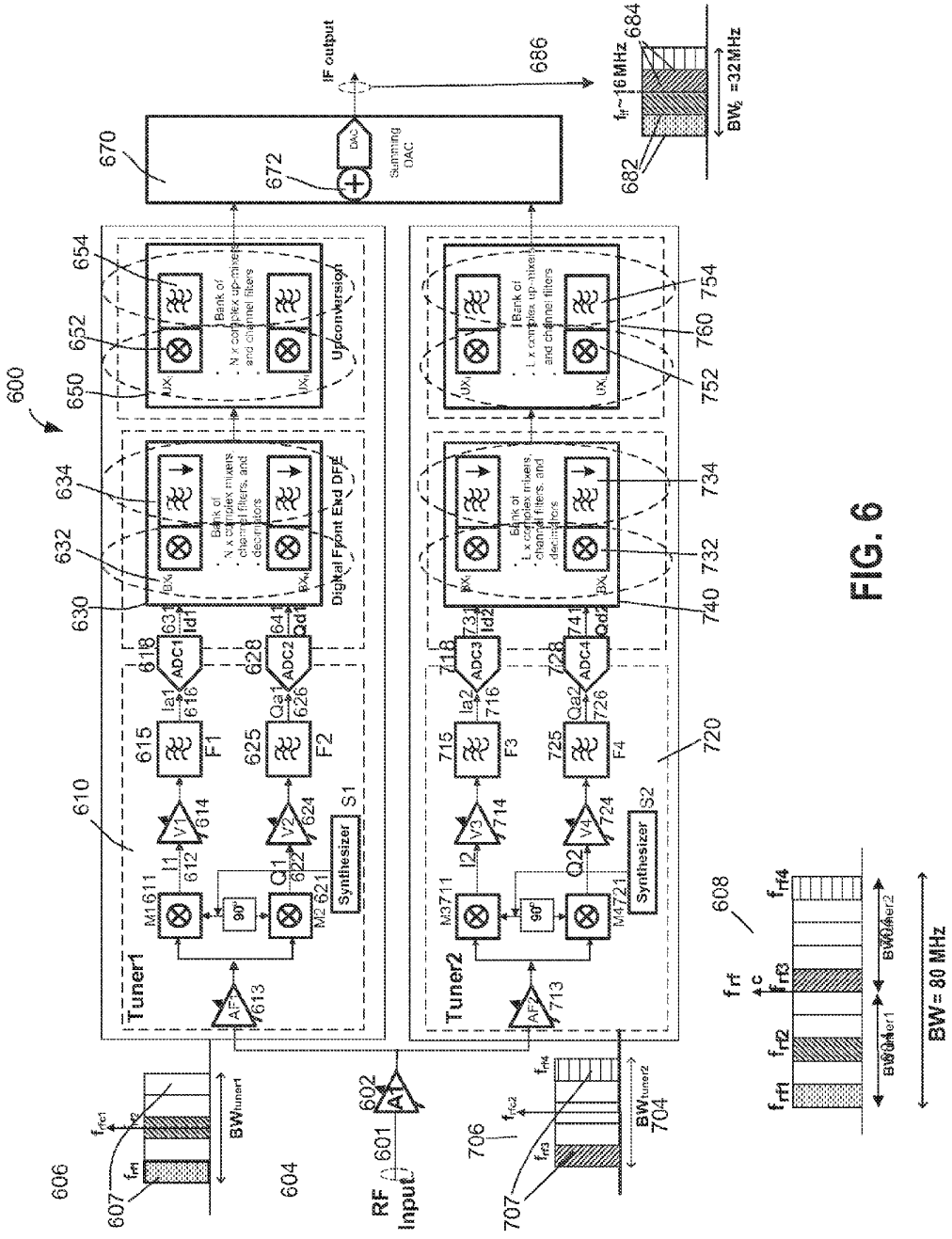

600
Tuner1
Tuner2
Digital Front End DFE
Upconversion
Bank of N x complex mixers, channel filters, and decimators
Bank of L x complex up-mixers and channel filters
Summing DAC
IF output
686
670
672
684
682
f_{IF}~16 MHz
BW_{IF} =32MHz
654
652
650
634
632
630
618
628
718
728
615
625
715
725
610
720
614
624
714
724
612
622
712
722
611
621
711
721
613
713
602
601
RF Input
606
607
604
706
707
704
608
f_{rf}
f_{rf1}
f_{rf2}
f_{rf3}
f_{rf4}
BW= 80 MHz
760
754
752
740
734
732
ADC1
ADC2
ADC3
ADC4
F1
F2
F3
F4
V1
V2
V3
V4
Synthesizer
S1
S2
AF
A1
90°

FIG. 6

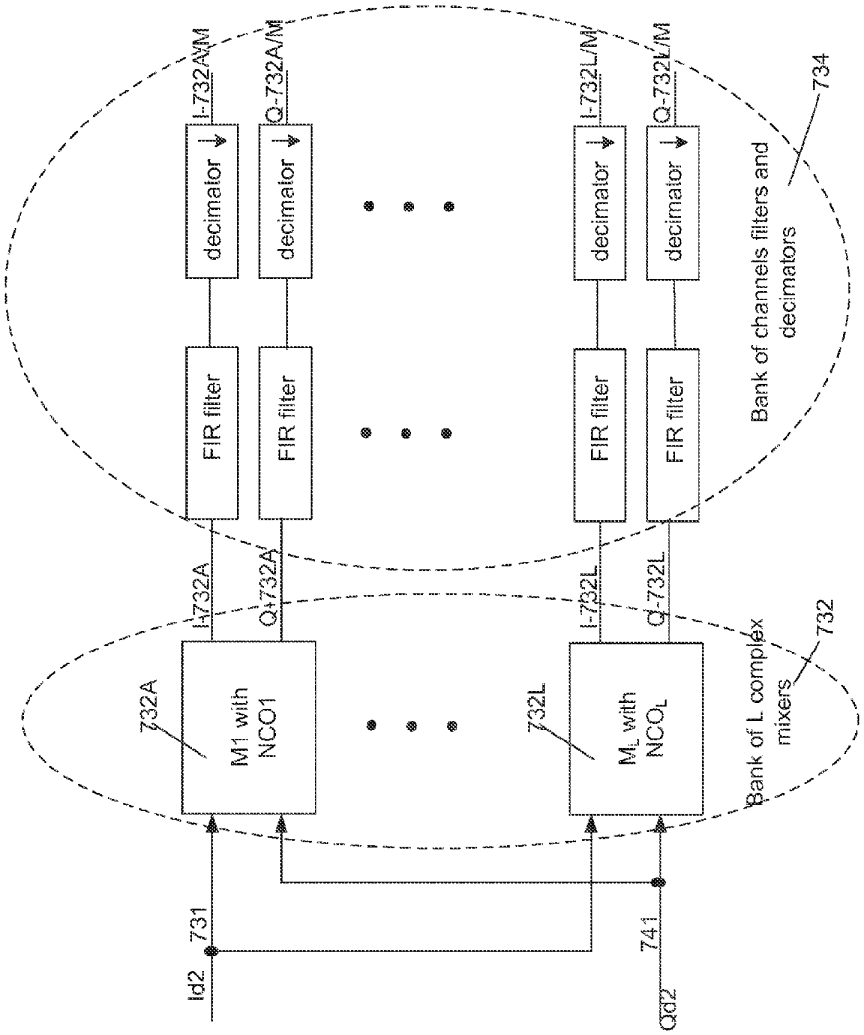

I-732A/M
Q-732A/M
I-732L/M
Q-732L/M
decimator
FIR filter
Bank of channels filters and decimators
734
I-732A
Q-732A
I-732L
Q-732L
732A
M1 with NCO1
732L
ML with NCOL
Bank of L complex mixers
732
731
741
Id2
Qd2

FIG. 7

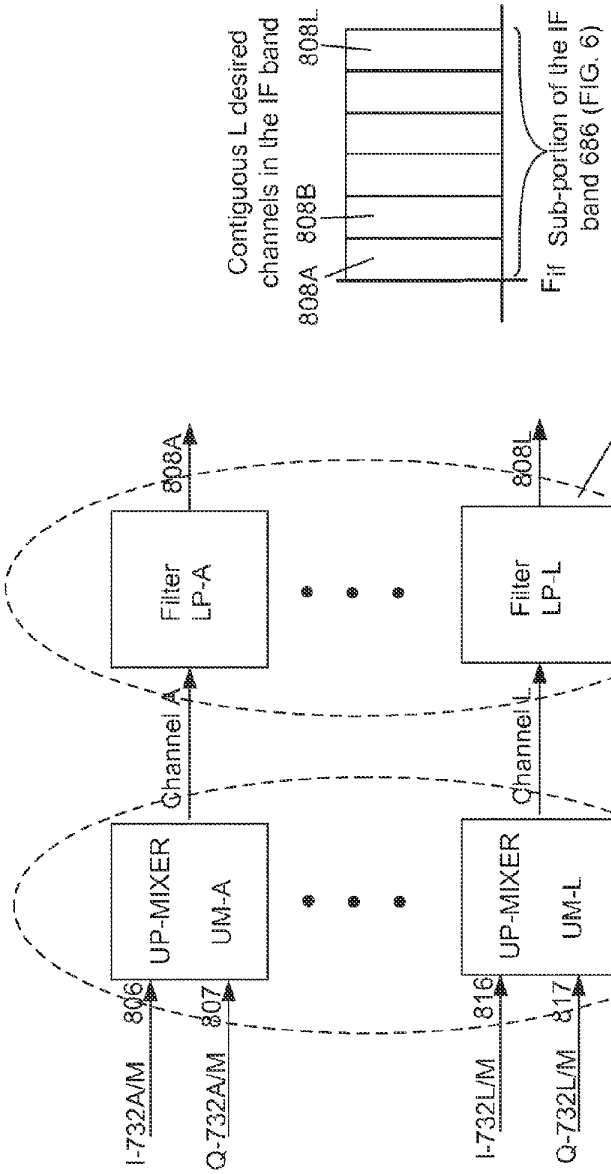

Contiguous L desired channels in the IF band
808A
808B
808L
Fif
Sub-portion of the IF band 686 (FIG. 6)
754
Bank of L channel filters
Filter LP-A
Filter LP-L
808A
808L
Channel A
Channel L
752
Bank of L complex up-mixers
UP-MIXER
UM-A
UP-MIXER
UM-L
806
807
816
817
I-732A/M
Q-732A/M
I-732L/M
Q-732L/M

FIG. 8

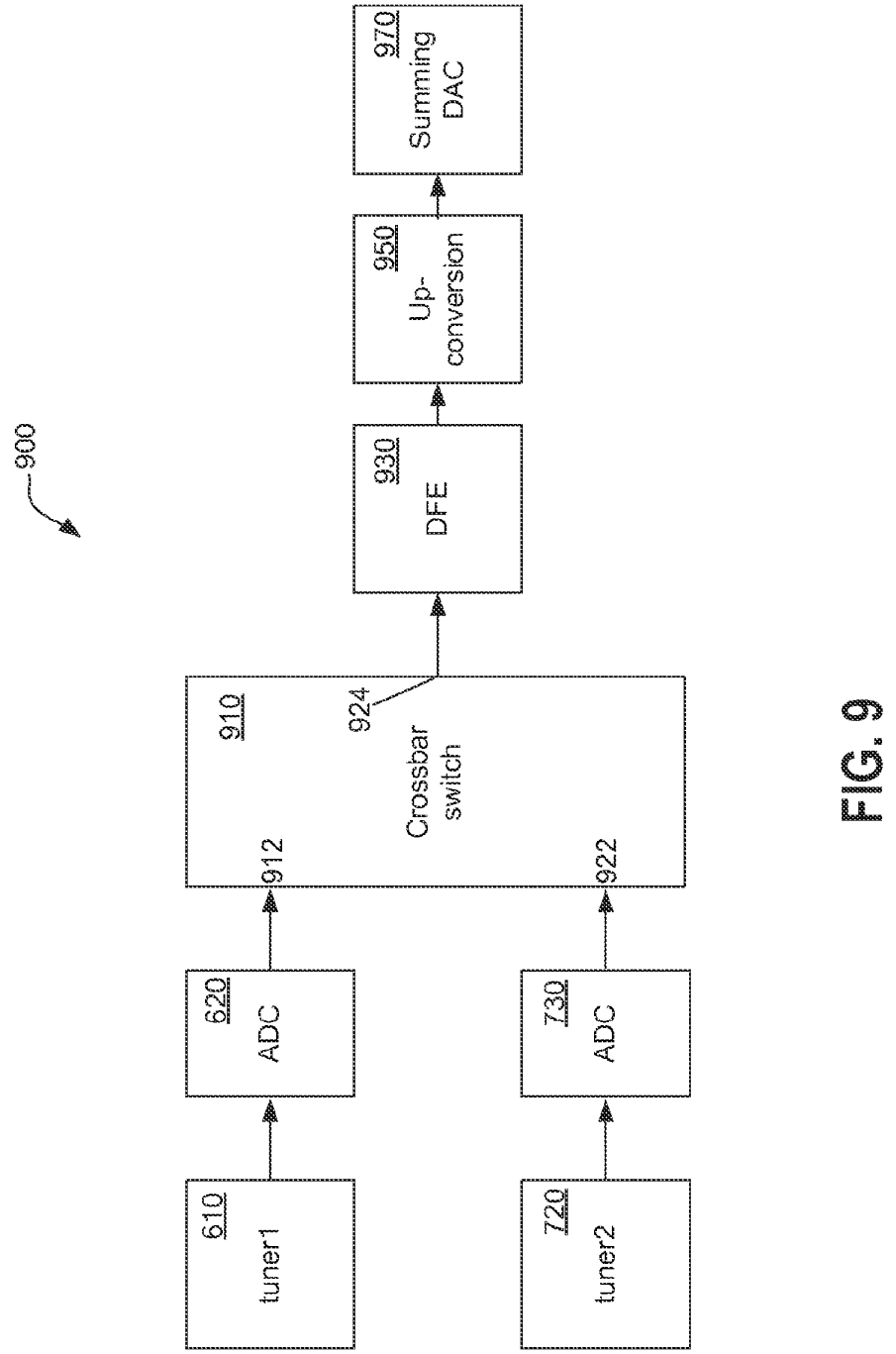

900
610
tuner1
620
ADC
720
tuner2
730
ADC
910
Crossbar switch
912
922
924
930
DFE
950
Up-conversion
970
Summing DAC

FIG. 9

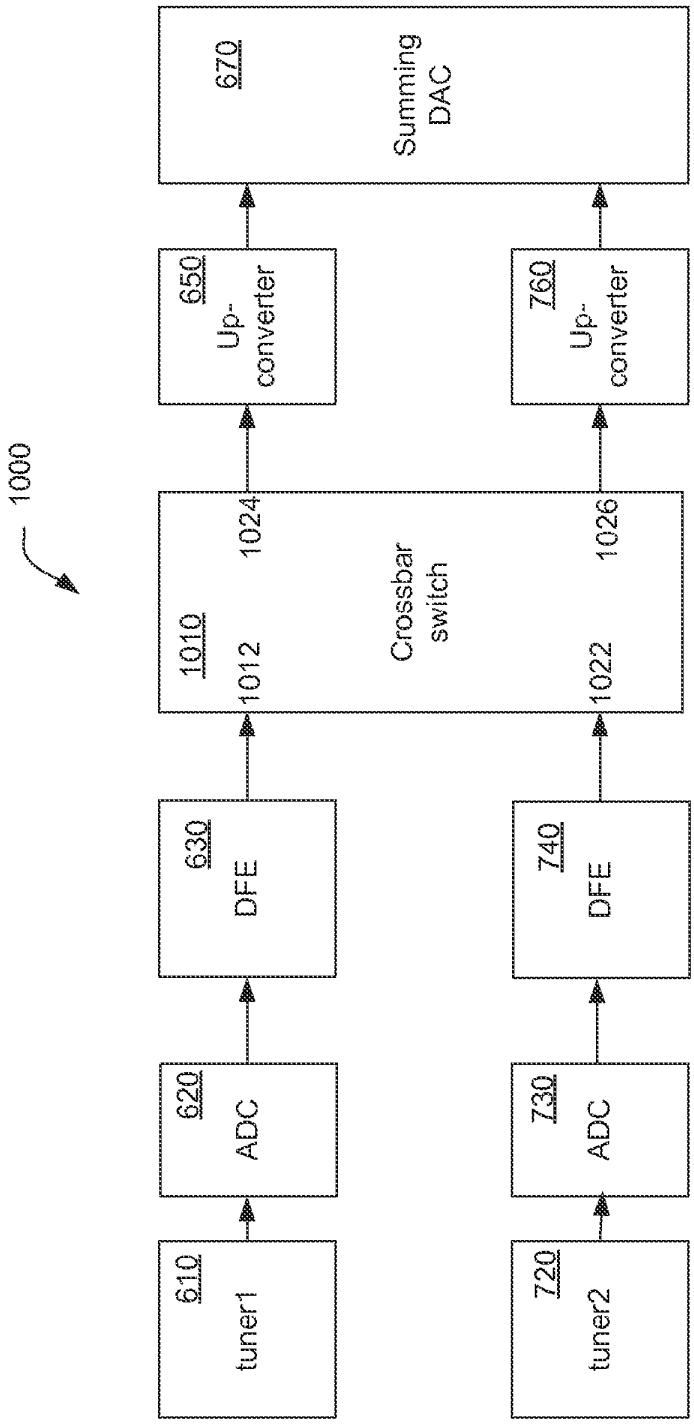

1000
610
tuner1
620
ADC
630
DFE
720
tuner2
730
ADC
740
DFE
1010
1012
1022
1024
1026
Crossbar switch
650
Up-converter
760
Up-converter
670
Summing DAC

FIG. 10

WIDEBAND TUNER ARCHITECTURE

PRIORITY CLAIM

This application is a continuation of U.S. patent application Ser. No. 13/962,871 filed on Aug. 8, 2013, which is a continuation of U.S. patent application Ser. No. 12/762,900 filed on Apr. 19, 2010 (now U.S. Pat. No. 8,526,898), which claims the benefit of priority to U.S. provisional application 61/170,526 filed Apr. 17, 2009. Each of the above referenced documents is hereby incorporated by reference in its entirety.

BACKGROUND

This invention relates to wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum. In particular, the invention relates to wideband receiver systems that are capable of receiving multiple desired television channels that extend over multiple non-contiguous portions of the broad frequency spectrum and grouping them into a contiguous, or substantially-contiguous, frequency spectrum.

Receivers used to down-convert and selectively filter TV channels are referred to as tuners, and tuners designed to concurrently receive several TV channels are referred to as wideband tuners. Existing tuners for these applications down-convert a swath of channels to an intermediate frequency, which are then sent to a demodulator. Because the swath of channels is not contiguous, this swath includes the desired channels as well as undesired channels. The demodulator employs a high-speed data converter to capture this swath of desired and undesired channels in the digital domain and subsequently filters out the desired channels.

In general, television channels broadcasted over the air or over cable networks are distributed across a broad frequency spectrum. That is, the channel frequencies may not be adjacent to each other. In certain applications such as DVR and picture-in-picture, the receiver system may have to concurrently receive several desired channels that may or may not be contiguous. The wideband receiver requirement poses a trade-off to the system to limit either the dynamic range of the wideband tuner or reduce the bandwidth covered by the tuner so that fewer channels may be received and processed by the demodulator.

FIG. **1** shows a conventional wideband tuner **100**. Tuner **100** may be a direct conversion tuner and includes a low noise amplifier LNA1 having an input terminal coupled to a radio frequency (RF) input signal **102** and an output terminal coupled to a mixer M1. The RF signal may include one or more television channels receiving from a cable network via an RF connector or wirelessly via an antenna. The RF input signal may include the VHF and UHF television channels in a terrestrial television broadcasting system or the CATV channels in cable networks. In order to receive all broadcasted channels present in the RF input signal, LNA1 must necessarily have a wide tuning range, high linearity, and low noise. Mixer M1 is coupled to a synthesizer S1 that can generate an oscillator frequency located around the center of the RF signal. Mixer M1 frequency down-converts the received RF input signal to a more convenient intermediate frequency (IF) band. Tuner **100** includes an amplifier V1 having a programmable gain for amplifying the IF signal, which is then bandpass filtered by a filter F1 before outputting to a demodulator.

In general, the RF signal includes multiple desired channels that are located in non-contiguous portions of a radio frequency spectrum. As shown in FIG. **1**, the swath of channels **110** occupies a bandwidth BW1 **120** at an RF center frequency f_{rfc} **130**. Synthesizer S1 may be tuned to a frequency around the center frequency f_{rfc} **130** for mixing channels **110** to an intermediate frequency f_{ifc} **160**, the frequency down-mixed channels **140** are amplified by amplifier V1 and then filtered by F1 to produce a swath of channels **170** centered around frequency f_{ifc} **160**. In an exemplary application shown in FIG. **1**, bandwidth BW1 contains 10 channels. In the case where channels are TV channels that are spaced at either 6 MHz or 8 MHz in most parts of the world, bandwidth BW1 **120** would span from 60-80 MHz, i.e., the down-converted bandwidth at the intermediate frequency would require a bandwidth equal to at least BW1, or at least 80 MHz when such architecture is used. It is noted that in other applications where the desired RF channels are located in the low band such as channels numbers 2 to 6 (VHF in the terrestrial TV broadcast or CATV) and in the high band such as channels numbers 14 to 83 of the UHF TV broadcast or channel numbers 63-158 of the CATV's ultra band, the bandwidth BW1 can be 800 MHz or higher. This wide bandwidth of 800 MHz would require a very expensive digital processing circuitry such as very high-speed analog to digital conversion and high-speed processor in the demodulator.

It is desirable to have wideband receiver systems that can increase the dynamic range without requiring expensive data conversion, filtering and channel selection at the demodulator.

BRIEF SUMMARY

An embodiment of the present invention includes a wideband receiver system that is configured to concurrently receive multiple radio frequency (RF) channels including a number of desired channels that are located in non-contiguous portions of a frequency spectrum and group the desired channels in a contiguous or substantially-contiguous frequency band at an intermediate frequency spectrum, where the term "substantially-contiguous" includes spacing the desired channels close to each other (e.g. as a fraction of the total system bandwidth, or relative to a channel bandwidth) but with a spacing that can be variable to accommodate the needs of overall system. The term "contiguous" heretofore encompasses "substantially-contiguous." The term "spacing" is referred to as the frequency difference between adjacent channels. The system includes a wideband receiver having a complex mixer module for down-shifting the multiple RF channels and transforming them to an in-phase signal and a quadrature signal in the baseband or low intermediate frequency (IF) band. The system further includes a wideband analog-to-digital converter module that digitizes the in-phase and quadrature signals. The digital in-phase and quadrature signals are provided to a digital frontend module that contains a bank of complex mixers that frequency-shift the number of desired channels to a baseband where the desired channels are individually filtered.

The digital frontend module may also include a decimator module that decimates the desired RF channels by a factor M before demodulating them to a digital data stream.

In certain embodiments of the present invention, the wideband receiver system additionally includes an up-converter module having multiple complex up-mixers, each of the complex up-mixers is configured to frequency up-shift each one of the desired RF channels to a sub-portion of an IF spectrum, wherein all sub-portions of the desired chamels are adjacent to each another and form a contiguous frequency band in the IF spectrum. The act of frequency shifting the desired channels to the IF spectrum allows the wideband receiver system

to directly interface with commercially available demodulators. Allowing the spacing of the desired channels in the contiguous spectrum to be variable allows a system to optimize placement of these desired channels for the purposes of avoiding sensitive portions of the spectrum which may either be vulnerable to spurious signals and interference; or which may generate interference directly or as a harmonic product, to other systems.

In another embodiment of the present invention, a multi-tuner receiver system having two or more tuners is provided to receive multiple desired RF channels that extend over several non-contiguous sub-portions of a broad frequency spectrum and group them into a contiguous frequency spectrum. The multi-tuner system includes at least a first tuner that processes a first sub-portion of the broad frequency spectrum into a first in-phase signal and a first quadrature signal and a second tuner that processes a second sub-portion of the broad frequency spectrum into a second in-phase signal and a second quadrature signal. The multi-tuner receiver system further includes a first analog-to-digital converter module that digitizes the first in-phase and quadrature signals and a second analog-to-digital converter module that digitizes the second in-phase and quadrature signals. In addition, the multi-tuner system includes a first digital frontend module having a first number of complex mixers corresponding to a first number of the desired RF channels located in the first sub-portion of the broad frequency spectrum and a second digital frontend module having a second number of complex mixers corresponding to a second number of the desired RF channels located in the second sub-portion of the broad frequency spectrum. The first digital frontend module frequency shifts the first number of the desired RF channels to a first plurality of baseband signals and the second digital frontend module frequency shifts the second number of the desired RF channels to a second plurality of baseband signals.

The multi-tuner system further includes a first up-converter module having a plurality of N complex mixers, wherein N is an integer value equal to the number of desired channel. The first up-converter module frequency up-shifts the first plurality of the baseband signals to a first portion of an intermediate frequency. In addition, the multi-tuner system includes a second up-converter module that frequency up-shifts the second plurality of the baseband signals to a second portion of an intermediate frequency. The first and the second portions of the intermediate frequency are non-overlapping and located adjacent to each other to form a contiguous intermediate frequency (IF) band. The multi-tuner system further includes a digital-to-analog converter that converts the contiguous IF band to an analog waveform signal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block diagram of a conventional wideband tuner;

FIG. **2** is a schematic block diagram of a wideband receiver system according to an embodiment of the present invention;

FIG. **3** is a simplified circuit diagram of a complex down-mixer according to an embodiment of the present invention;

FIG. **4** is a simplified schematic block diagram of a wide-band receiver system according to another embodiment of the present invention;

FIG. **5** is a simplified circuit diagram of a complex up-mixer according to an embodiment of the present invention;

FIG. **6** is a simplified schematic block diagram of a wide-band multi-tuner receiver system according to an embodiment of the present invention;

FIG. **7** is a block diagram illustrating an exemplary digital front end according to an embodiment of the present invention in more detail;

FIG. **8** is a block diagram illustrating an exemplary tiled up-converter module according to an embodiment of the present invention in more detail;

FIG. **9** is a simplified block diagram of a wideband multi-tuner receiver system **900** according to an embodiment of the present invention; and

FIG. **10** is a simplified block diagram of a wideband multi-tuner receiver system **1000** according to another embodiment of the present invention.

DETAILED DESCRIPTION

FIG. **2** is a schematic block diagram of a wideband receiver system **200** according to an embodiment of the present invention. Wideband receiver system **200** includes a radio front end **210** and a digital front end **230**. Radio front end **210** may be a single very wide-band tuner receiver that captures the desired swath of channels located in non-contiguous portions of the spectrum having a frequency bandwidth BW1 **120**. In this example, the number of available channels in BW1 **120** is assumed to be 10 with each channel occupying an 8 MHz bandwidth for a total of 80 MHz. Radio front end **210** is shown as including a low noise amplifier LNA **202** having an input terminal configured to receive an RF input signal **102**. In the example shown, RF signal **102** includes four desired RF channels having the respective carrier frequency f_{rf1}, f_{rf2}, f_{rf3}, and f_{rf4} that are located in non-contiguous portions of the wide frequency spectrum BW1. It is understood, however, that spectrum BW1 **120** may have any other number of desired frequencies that are not contiguous. LNA **202** has a very low noise figure and very high linearity and a wide tuning range (i.e., very high IIP2 and IIP3 intercept points) to maximize a signal-to-noise-and distortion ratio (SNDR) at the amplifier output. LNA **202** may have a programmable gain to amplify RF signal **102** to adequate voltage levels for mixers M1 **211** and M2 **221**.

Mixers M1 **211** and M2 **221** may be conventional mixers formed using, for example, differential Gilbert cells. Each of the mixers **211** and **221** multiplies (mixes) an amplified RF signal **203** with a respective first oscillator frequency signal **205** and a second oscillator frequency signal **207** to generate an in-phase signal **212** and a quadrature signal **222** that have a phase shift of 90° degree between them. Mixers **211** and **221** are identical so that the amplitude of the in-phase signal **212** and quadrature signal **222** are the same. The first and second oscillator frequencies **205** and **207** are identical and have a 90° degree phase shift generated through a 90° degree phase shifter P1 **206**. Synthesizer S1 may be a single local oscillator operable to generate the oscillator frequency **205** for converting the receive RF signal **102** to a zero-IF or low-IF band. Synthesizer S1 can be a coarse (large step) phase locked loop. Synthesizer S1 can also be programmable to cover the wide-band frequency of the analog and digital terrestrial broadcast and/or the cable television system. The RF signal **102** may have relatively uniform signal strength in a cable network. However, its signal strength may extend in several orders of magnitude in a terrestrial broadcast system, thus, LNA **202** and/or mixers M1 **211**, M2 **221** are required to have a relatively high dynamic range to handle the large variations in the signal strength.

In-phase signal **212** and quadrature signal **222** are further amplified and filtered by respective amplifiers V1 **213**, V2 **223** and filters F1 **215**, F2 **225** to generate a filtered in-phase signal **216** and a filtered quadrature signal **226**. Filters F1 **215**

and F2 **225** may be passive or active low-pass filters to filter out any unwanted frequency components of the signals **214** and **224** before digitizing them for further processing in digital front end **230**. It is understood that the in-phase path **216** and the quadrature path **226** must have the same amplitude spectrum and maintain a fixed phase relationship, i.e., amplifiers V1 **213**, V2 **223** and filters F1 **215**, F2 **225** must be substantially identical. Because the two paths **216** and **226** are in quadrature, the spectral components from both positive and negative frequencies can be overlaid so that the bandwidth (cutoff frequency) of filters F1 **215** and F2 **225** can be one half of the BW1 bandwidth **120**.

Analog-to-digital converters ADC1 **218** and ADC2 **228** are high-speed (i.e., high sampling rate) converters to maximize the dynamic range. In an exemplary application, radio front end **210** operates as a nominal zero-IF down-mixer so that signals **216** and **226** have a nominal bandwidth **290** equal to one half of the RF signal bandwidth BW1 thanks to the complex down-mixer architecture. In other embodiment, radio front end **210** operates as a low-IF down-mixer so that the nominal bandwidth **290** of signals **216** and **226** is greater than one half of the bandwidth BW1. In practice, the sampling rate of ADC1 **218** and ADC2 **228** is chosen to be higher than the Nyquist sampling requirement, i.e., the filtered analog quadrature signals **216** and **226** may be over-sampled in order to reduce or avoid aliasing of undesired signals into the digitized I and Q signals.

ADC1 **218** generates a digital signal I **232** that is a digital representation of the analog filtered signal **216**; ADC2 **228** generates a digital signal Q **242** that is a digital representation of the analog filtered signal **226**. Digital signals I **232** and Q **242** are then applied to a bank of N complex mixers **250**, wherein N is an integer value corresponding to the number of desired RF channels located in the non-contiguous portions of the frequency spectrum BW1. It is understood that the number N can be any integer value. In one embodiment, N can be equal to the number of all available channels that exist in the licensed frequency spectrum to provide system flexibility. In other embodiments, N can be equal to the number of all receivable channels within a geographic area. In yet another embodiment, N can be an integer value less than the number of receivable channels with the geographic area to reduce system costs. In the exemplary embodiment shown in FIG. **2**, the number of desired channels is 4. That is, each of the 4 complex mixers **250** mixes in-phase and quadrature signals **232** and **242** with an associated frequency to generate a corresponding baseband, which is then individually filtered, decimated and provided to an associated demodulator.

Each of the N complex mixers **250** receives the digital signals I **232** and Q **242** from ADCs **218** and **228** to extract a different one of the desired channels and frequency-shifts the extracted signals to the baseband frequency. Each of the frequency shifted desired channels **252** is filtered by an associated filter module (identified as **260***a* to **260***n*). In an embodiment, each of the filtered signals **260***a* to **260***n* may be sent directly to an associated demodulator (identified as **270***a* to **270***n*) for extracting the original information transmitted in the associated desired channel. In another embodiment, each of the filtered signals **262***a* to **262***n* is further decimated before providing to a demodulator. A path of digital front end **230** is described in more detail below.

FIG. **3** is a simplified circuit diagram of one of the signal paths **272***a* to **272***n* of digital front end **230** shown in FIG. **2** according to an embodiment of the present invention. In an embodiment, digital signal I **232** may be further filtered by a filter **311** to obtain a filtered signal **312**. Similarly, digital signal Q **242** may be further filtered by a filter **321** to obtain a filtered signal **322**. Thus, digital signals **312** and **322** only contain low-frequency components with undesired high-frequency components being eliminated by respective filters **311** and **321**. It is noted that filtered signals **312** and **322** are interposed between the respective ADCs **218**, **228** and the bank of N complex mixers **250**.

Mixer **300**, which represents one of the N complex mixers **250**, includes four multipliers **313**, **315**, **323**, and **325**. Multipliers **313** and **315** multiply the filtered signal **312** with respective $\cos(\omega_{ci}t)$ and $\sin(\omega_{ci}t)$ signals and generate respective products **314** and **316**. Similarly, multipliers **323** and **325** multiply the filtered Q signal **322** with respective $\cos(\omega_{ci}t)$ and $\sin(\omega_{ci}t)$ signals and generate respective products **324** and **326**. An adder **317** sums the products **314** and **326** to generate a frequency-shifted signal I **318**. An adder **327** sums the products **324** and **316** to generate a frequency-shifted signal Q **328**. Basically, complex mixer **300** causes a frequency shift of the filtered components **312** and **322** to respective baseband signals **318** and **328** in the digital domain according to the operation:

$$Y(t)=X(t)*e^{-j\omega_{ci}t} \quad (1)$$

or taken the Fourier transform, we obtain:

$$Y(\omega)=X(\omega-\omega_c) \quad (2)$$

Multipliers **313**, **315**, **323**, and **325** are identical digital multipliers. In an embodiment, a numerically controlled oscillator with quadrature output generates the $\cos(\omega_{ci}t)$ and $\sin(\omega_{ci}t)$ signals. Numerically controlled oscillators (NCO) can be implemented using a phase accumulator and a look-up table. NCOs are known to those of skill in the art and will not be described herein. The frequency ω_{ci} is so chosen that each one of the desired channels embedded in the digital signals I **232** and Q **242** will be downshifted to the baseband. In the given example shown in FIG. **2**, the bank of N complex mixers will have four complex mixers, each one of the N (i.e., four) complex mixers is coupled to an individual NCO having a distinct frequency ω_{ci} so that when mixing the filtered digital I and Q signals **312** and **322** with that frequency, each one of the complex mixers will generate the signals I (**318**) and Q (**328**) of a corresponding one of the desired channels at the baseband.

In an embodiment, baseband signals **318** and **328** are further individually filtered by respective filters **330** and **340** that are identified as one of the filters **260***a-n* in FIG. **2**. Filters **330** and **340** may be band-pass or low-pass filters having a narrow bandwidth equal to the bandwidth of a desired channel. In certain embodiments, filters **330** and **340** can be analog passive or active low-pass or complex band-pass filters such as polyphase filters. In another embodiment, filters **330** and **340** can be digital low-pass filters, such as finite impulse response (FIR) filters to eliminate high frequency components that may be aliased back to the baseband signals Ii (**332**) and Qi (**342**) when decimated by subsequent decimator **350**.

The reduced sampling rate of the N desired baseband channels will be sent as a serial or parallel digital data stream to a demodulator using a serial or parallel data interface according to commonly known methods, as shown in FIG. **2**. This approach provides several advantages over conventional tuner architectures. First, it eliminates the need of expensive data conversion, filtering and channel selection on the demodulator side. Second, it removes undesired channels from the signal path at an early stage, thus relieves the large dynamic range requirement in the demodulator.

FIG. **4** shows a simplified schematic block diagram of a wideband receiver system **400** according to another embodiment of the present invention. Wideband receiver system **400**

includes a radio front end **410**, a digital front end **430**, a tiled up-conversion module **450**, and a summing digital-to-analog converter module DAC **470**. Radio front end **410** includes a low noise amplifier LNA1 that receives an RF input signal **102** and provides an amplified RF signal **403** to mixers M1 **411** and M2 **421**. Mixer M1 **411** is coupled to an oscillator frequency **405** of a synthesizer S1 whereas mixer M2 **421** is coupled with the oscillator frequency **405** via a phase shifter P1 **406** that generates a 90° degree phase-shift to the oscillator frequency **405**. Mixers M1 **411** and M2 **421** generate respective in-phase signal **412** and quadrature signal **422** that are further amplified by respective amplifiers V1 **413** and V2 **423**. The amplified in-phase and quadrature signals **414**, **424** are then filtered by filters F1 **415** and F2 **425** to eliminate undesired frequency components that would be aliased back to the in-phase and quadrature signals when digitally sampled by subsequent analog-to-digital converters ADC1 **418** and ADC2 **428**. Digital signals I **422** and Q **442** at the input of digital front end **430** are digital representations of the filtered analog in-phase and quadrature signals **416**, **426** before the ADCs. Digital front end **430** include a bank of N complex mixers **432** comprising **432***a* to **432***n* identical mixers, where N is an integer value corresponding to the number of the desired channels located in non-contiguous portions of the frequency spectrum. Each of the N complex mixers **432***a* to **432***n* frequency down-converts signals I **432** and Q **442** to an associated baseband. Each of the frequency down-converted I and Q signals are coupled to respective low-pass, band-pass, or decimating filters **434**. In this regard, the radio front end **410** and the digital front end **430** are similar to respective radio front end **210** and digital front end **230** of FIG. **2** that have been described in detail above.

In an alternative embodiment of the present invention, the N filtered and decimated channels **438***a* to **438***n* (where indices a to n correspond to the associated number of desired channels) are not provided to a demodulator for demodulation. Instead, the N filtered and decimated channels **438***a* to **438***n* are further frequency up-converted to an intermediate frequency (IF) spectrum. In order to achieve that, the N filtered and decimated channels are coupled to a tiled up-conversion module **450** that includes a bank of N complex up-mixers, where N is an integer value correspond to the number of desired received channels. The N complex up-mixers include identical digital mixers **452***a* to **452***n* that will be described further in detail below with reference to FIG. **5**. The N up-shifted channels are then filtered by a subsequent bank of channel filters **454** that, in an embodiment, comprises N individual finite impulse response (FIR) filters. The N filtered channels are then digitally combined and converted to the analog domain by a summing digital-to-analog converter module DAC **470**. The N up-shifted channels are adjacent to each other and form a contiguous or substantially-contiguous set of channels **475** in the IF spectrum centered around f_{if} as illustrated in FIG. **4**. In an embodiment, the spectra of the mixed products are spaced in such a way so as to avoid overlap with known frequency bands containing potential or actual interferers. In another embodiment, the spectra of the mixed products are spaced in such a way so as to avoid overlap with frequency bands that might introduce interference to other systems. In general, because the bandwidth BW_2 is substantially lower than BW_1, the IF frequency f_{if} can be set proportionally lower, e.g., typically about 16 MHz to accommodate the spectrum of BW2 of up to 32 MHz (corresponding to the total bandwidth of the four desired channels, each having a bandwidth of 8 MHz in this example).

The up-conversion approach of FIG. **4** provides several advantages over conventional tuner architectures. First, it allows the demodulator to operate the data converter at a lower data rate and with lower resolution (fewer bits) due to the fact that the contiguous channels have a narrower bandwidth. Second, the up-conversion approach provides full compatibility with existing demodulators that require an analog IF signal. Third, it removes undesired channels from the signal path at an early stage, thus relieves the requirement of a high dynamic range requirement of the demodulator's analog-to-digital converter and the demodulator itself.

FIG. **5** shows a simplified exemplary circuit diagram of a complex up-mixer **500** according to an embodiment of the present invention. Up-mixer **500** is one of the N complex up-mixers **452***a* to **452***n* in tiled up-conversion module **450** shown in FIG. **4**. Up-mixer **500** includes filter **510** and **520** configured to eliminate unwanted frequency components present in respective input signals I **501** and Q **502**. Filtered signals **512** and **522** are provided to up-mixers UMI **515** and UMQ **525** that multiply the filtered signals **512** and **522** with respective $\cos(\omega_u t)$ and $\sin(\omega_u t)$. The products **516** and **526** are summed in an adder **530** to generate an IF signal **532** according to the following equation:

$$IF(t)=I(t)*\cos(\omega_u t)+Q(t)*\sin(\omega_u t) \quad (3)$$

Up-mixers UMI **515** and UMQ **525** are identical digital multipliers that multiply the respective filtered signal **512** and **522** with a cosine function **505** and a sine function **506** that can be generated from a NCO using a digital phase accumulator and a look-up table.

As described above, TV channels are grouped into multiple frequency bands in North America. For example, channels 2 through 6 are grouped in VHF-low band (aka band 1 in Europe), channels 7 through 13 in VHF-high band (band III), and channels 14 through 69 in UHF band (bands IV and V). In order to receive such a wide frequency spectrum, the low noise amplifier and mixer must have very low noise, wide tuning range and high linearity as described above in the wideband receiver systems **200** and **400**. However, a wideband receiver having a single tuner with high sensitivity may have a high power consumption. For certain applications, it may be advantageous to use multiple tuners that are optimized for a given frequency band, such as a dedicated tuner for the low VHF band, another dedicated tuner for the high VHF band and the UHF band, and yet other dedicated tuners for receiving the digital video broadcasting (DVB) via satellite (DVB-S), via cable (DVB-C), or terrestrial digital video broadcasting (DVB-T). The multi-tuner approach may also be advantageously applied to cable networks that carry TV programs on an 88 MHz to 860 MHz according to the Data Over Cable Service Interface Specification (DOCSIS) protocol.

FIG. **6** shows a simplified schematic block diagram of a wideband multi-tuner receiver system **600** according to an embodiment of the present invention. In an embodiment, multi-tuner system **600** includes low noise amplifier A1 **602** for receiving an RF input signal **601**. Amplifier A1 **602** is coupled to at least a tuner1 **610** and a tuner2 **720**. In another embodiment, multi-tuner system **600** may not include amplifier **602** so that RF input signal **601** can be received directly at each tuner **610** and **720**.

Tuner1 **610** includes an amplifying filter AF1 **613** that filters and amplifies a first portion BWtuner1 **604** of a broad frequency spectrum **608** that contains a first plurality of RF channels **606** including desired channels **607** having respective channel frequencies f_{rf1} and f_{rf2}. The first portion of the broad frequency spectrum BWtuner1 **604** is then frequency down-converted to a low-IF or zero-IF in-phase signal I1 **612** and a quadrature signal Q1 **622** through respective mixer M1

611 and M2 621. Signals I1 612 and Q1 622 are further amplified and low-pass filtered before applying to respective analog-to-digital converters ADC1 618 and ADC2 628 that convert analog signals Ia1 616 and Qa1 626 to respective digital in-phase signal Id1 631 and digital quadrature signal Qd1 641. Because tuner1 610 only covers a portion BWtuner1 604 of the entire frequency spectrum 608 having fewer channels, the ADC1 618 and ADC2 628 can be slower-speed analog-to-digital converters with a large number of bits, i.e., large dynamic range.

Digital signals Id1 631 and Qd1 641 are then provided to a digital front end DFE 630 that includes a first bank of N complex mixers 632 and channel and decimating filters 634. The first bank of N complex filters 632 has N identical complex mixers, where N is an integer value equal to the number of desired channels located in the first portion BWtuner1 604 of the broad frequency spectrum 608. In an embodiment, each one of the first bank of N complex mixers includes four digital mixers that multiply digital stream Id1 631 and Qd1 641 with respective digitized cosine function and sine function to generate the sum and difference frequency components, as shown in FIG. 3. The digitized cosine and sine frequency, i.e., the mixer frequency is so chosen so that when mixing signals Id1 631 and Qd1 641 will move them to a baseband or a low-IF band. In an embodiment, channel and decimating filters have similar structures as filters 330 and 340 and demodulator 350 as shown in FIG. 3. That is, channel and decimating filters include digital low-pass filters 330 and 340 that eliminates unwanted high frequency components of the baseband signals I and Q prior to applying them to a decimator 350 (FIG. 3) that reduces the sample frequency without any loss of information since Id1 631 and Qd1 641 are sampled at a much higher frequency by the respective ADC1 618 and ADC2 628.

The decimated desired channels are then provided to an up-converter module 650 that includes a bank of N up-mixers. The bank of N up-mixers includes N identical up-mixers whose structure is shown in FIG. 5. In an embodiment, N is an integer value equal to the number of desired channels present in BWtuner1 604. Each one of the up-mixer frequency-shifts the baseband signals I and Q of each one of the desired channels to an appropriate portion of the intermediate frequency band according to Equation (3). In other words, the bank of N up-mixers is "frequency multiplexing" the desired channels onto a first portion 682 of an IF band 686.

Similarly, tuner2 720 includes an amplifying filter AF2 713 that is configured to receive a second portion BWtuner2 704 of the broad frequency spectrum 608. The second portion 704 contains a second plurality of RF channels 706 including a second number of desired channels. In the exemplary illustration of FIG. 6, the second portion 704 has a frequency bandwidth of BWtuner2 that contains desired channels 707 having respective channel frequencies f_{rf3} and f_{rf4}. Tuner2 720 includes elements such as mixers M3 711, M4 721, amplifiers V3 714, V4 724, filters F3 715, F4 725 and analog-to-digital converters ADC3 731 and ADC4 741 that are substantially the same as the like-named elements of the signal path of tuner1 610. Thus, redundant description is omitted herein.

Digital in-phase signal Id2 731 and digital quadrature signal Qd2 741 are then provided to digital front end 740. Digital front end 740 includes a bank of L complex filters, where L is an integer value equal to the number of desired channels in the second portion BWtuner2 704 of the broad frequency spectrum 608. Each one of the bank of L complex filters is a digital complex mixer configured to transform the signals Id2 731 and Qd2 741 to baseband signals that are further filtered by individual digital low-pass filters such as FIR filters before decimated by a subsequent decimator. The elements of digital front end 740 are substantially similar to those described in digital front end 630. Thus, redundant description is omitted herein.

The decimated baseband I and Q channels are further provided to a subsequent up-conversion module 760 that performs a function substantially similar to that of the up-conversion module 650 already described above. The outputs of up-conversion module 650 and 760 can be tiled to generate a contiguous set of IF frequencies 682, 684 centered at f_{if} 686. In an embodiment, the outputs of up-conversion module 650 and 760 are digitally summed and converted to an analog signal by summing DAC 670. In another embodiment, the up-conversion modules 650 and 760 and the digital summing function 672 can be performed using an inverse discrete Fourier transform or an inverse Fast Fourier transform operation.

The multi-tuner architecture provides the flexibility that multiple commercially available tuners can be used without the need of designing a wideband tuner. For example, a tuner designed for a terrestrial broadcast digital TV can be used together with a tuner dedicated to receiving a cable signal and/or a tuner for receiving a satellite broadcast signal. The multi-tuner receiver system provides an additional advantage that other tuners can be added quickly to the system to accommodate any future applications. Additionally, the multi-tuner architecture allows the use of slower speed (i.e., lower cost) analog-to-digital converters with a larger number of bits for achieving large dynamic range.

FIG. 7 shows a block diagram of an exemplary digital front end of the invention in more detail. In an embodiment, in-phase signal Id2 731 and quadrature signal Qd2 741 at the output of respective ADC converters 718 and 728 are provided to each of the L complex mixers 732 comprising mixers 732A to 732L. A more detailed description of each of L complex mixers is shown in FIG. 3. Mixer 732A multiplies Id2 731 and Qd2 741 with a cosine signal and a sine signal that are generated from an NCO1 and produces an I-732A signal and a Q-732A signal that are further individually filtered by an FIR filter before decimating. The bank of L complex mixers corresponds to the block 732 in FIG. 6; and the set of FIR filters and decimator corresponds to the block 734 in FIG. 6. Each decimated pair of I-732*i*/M in the baseband, where the index "i" is from A to L, is further provided to a subsequent up-mixer for frequency-shifting to an intermediate frequency as shown in FIG. 8.

FIG. 8 shows an exemplary embodiment of a bank of L complex up-mixers according to the present invention. Each decimated pair of complex signals I-732*i*/M and Q-732*i*/M is provided to an associated complex up-mixer, whose frequency is so chosen that when mixing with the pair of complex signals I-732*i*/M and Q-732*i*/M will generate an associated channel at a predetermined sub-portion of the intermediate frequency band 686 (FIG. 6). A more detailed schematic block of one of the L up-mixers is described above together with FIG. 5.

FIG. 9 is a simplified block diagram of a wideband multi-tuner receiver system 900 according to an embodiment of the present invention. In an embodiment, system 900 includes a crossbar switch 910 having at least an input terminal 912 configured to receive signals from an analog-to-digital converter (ADC) 912 and an input terminal 922 configured to receive signals from an ADC 922. Crossbar switch 910 also includes an output terminal 924 that is coupled to a digital front end 930. In an embodiment, input terminals 912 and 922 of crossbar switch 910 have P inputs, where P is an integer value that is equal to the total number of desired channels received by tuner1 610 and tuner2 720. Output terminal 924

of crossbar switch **910** have Q outputs, where Q is an integer value that is equal to the total number of desired channels received by tuned **610** and tuner2 **720**.

In an embodiment, digital front end **930** may include a bank of R complex mixers that frequency shifts the received channels to a baseband. Digital front end **930** may combine digital front end **630** and **740** shown in FIG. **6**. Similarly, a tiled up-conversion module **950** may include up-converter modules **650** and **760** of FIG. **6**.

System **900** further includes a summing DAC that operates similarly as summing DAC **470** and **670** that have been described in detail in relation with respective FIG. **4** and FIG. **6** above. Thus, redundant description is omitted herein.

FIG. **10** is a simplified block diagram of a wideband multi-tuner receiver system **1000** according to another embodiment of the present invention. System **1000** includes at least tuner1 **610** coupled with digital front end **630** through an analog-to-digital converter **620** and tuner2 **720** coupled with digital front end **740** through an analog-to-digital converter **730**. System **1000** further includes a crossbar switch **1010** that is interposed between digital front ends **630**, **740** and up-conversion modules **650**, **760**. Crossbar switch **1010** includes an input terminal **1012** having S inputs coupled with DFE **630** and an input terminal **1022** having T inputs coupled with DFE **740**. In an embodiment, S is an integer value equal to the number of desired channels processed in DFE **630** and T is an integer value equal to the number of desired channels processed in DFE **740**. Crossbar switch **1010** further includes an output terminal **1024** having U outputs coupled with up-converter module **650** and an output terminal **1024** having V outputs coupled with up-converter module **760**. In an embodiment, the total number of the outputs U and V is equal to the sum of the inputs S and T. Thus, crossbar switch **1010** allows the routing of any channel from either DFE **630** or DFE **740** to up-converters **650** or **760**. It is understood that system **1000** is not as flexible as system **900** because DFE **630** and DFE **740** are already pre-assigned to respective tuner1 (**610**) and tuner2 (**720**). However, this pre-assigned arrangement allows a simpler implementation of crossbar switch **1010** that operates at lower speeds.

While several embodiments in accordance with the present invention have been described, it is to be understood that the above description is intended to be illustrative and not restrictive. Many embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined not with reference to the above description, but instead should be determined with reference to the appended claims along with their full scope of equivalents.

What is claimed is:

1. A wideband receiver system comprising:

a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

digital circuitry configured to:

select said plurality of desired television channels from said digitized plurality of frequencies; and

output said selected plurality of television channels to a demodulator as a digital datastream.

2. The wideband receiver system of claim **1**, wherein said output of said digital datastream is via a serial interface.

3. The wideband receiver system of claim **1**, wherein said output of said digital datastream is via a parallel interface.

4. The wideband receiver system of claim **1**, wherein said mixer module comprises a first mixer configured to generate an in-phase signal and a second mixer configured to generate a quadrature signal.

5. The wideband receiver system of claim **1**, wherein said wideband analog-to-digital converter comprises:

a first ADC configured to generate a digital in-phase signal; and

a second ADC configured to generate a digital quadrature signal.

6. The wideband receiver system of claim **5**, wherein said digital circuitry comprises a plurality of complex mixers configured to frequency shift said selected plurality of desired television channels.

7. The wideband receiver system of claim **6**, wherein:

prior to said frequency shift, said selected plurality of desired television channels occupy non-contiguous portions of a frequency spectrum; and

after said frequency shift, said selected plurality of desired television channels occupy a contiguous frequency spectrum.

8. The wideband receiver system of claim **1**, wherein said digital circuitry comprises a plurality of channel filters configured to perform said selection of said plurality of desired television channels.

9. The wideband receiver system of claim **8**, wherein each one of said plurality of channel filters is a finite impulse response filter.

10. The wideband receiver system of claim **1**, wherein said digital circuitry comprises a decimator circuit configured to decimate one or more of said selected plurality of television channels prior to said output of said selected plurality of desired television channels.

11. A method comprising:

in a wideband receiver system:

downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

12. The method of claim **11**, comprising outputting, by said digital circuitry of said wideband receiver system, said digital datastream via a serial interface.

13. The method of claim **11**, comprising outputting, by said digital circuitry of said wideband receiver system, said digital datastream via a parallel interface.

14. The method of claim **11**, comprising:

generating, by a first mixer of said mixer module, an in-phase signal; and

generating, by a second mixer of said mixer module, a quadrature signal.

15. The method of claim **11**, comprising:

generating, via a first ADC of said wideband analog-to-digital converter, a digital in-phase signal; and

generating, via a second ADC of said wideband analog-to-digital converter, a digital quadrature signal.

16. The method of claim **15**, comprising frequency shifting said selected plurality of desired television channels via a plurality of complex mixers of said digital circuitry.

17. The method of claim **16**, wherein:

prior to said frequency shifting, said selected plurality of desired television channels occupy non-contiguous portions of a frequency spectrum; and

after said frequency shifting, said selected plurality of desired television channels occupy a contiguous frequency spectrum.

18. The method of claim **11**, wherein said digital circuitry comprises a plurality of channel filters configured to perform said selecting.

19. The method of claim **18**, wherein each one of said plurality of channel filters is a finite impulse response filter.

20. The method of claim **11**, comprising decimating, by said digital circuitry, one or more of said selected plurality of desired television channels prior to said outputting of said selected plurality of television channels.

* * * * *

EXHIBIT 6

US010135682B2

(12) **United States Patent**
Ling et al.

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(54) **METHOD AND SYSTEM FOR SERVICE GROUP MANAGEMENT IN A CABLE NETWORK**

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Related U.S. Application Data

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(51) **Int. Cl.**
H04L 12/24 (2006.01)
H04L 1/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04L 41/0823*** (2013.01); ***H04B 17/318*** (2015.01); ***H04L 1/0009*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC . H04L 12/2801; H04L 1/0009; H04L 1/0026; H04L 27/2601; H04L 41/0823; H04L 43/08; H04L 43/12
See application file for complete search history.

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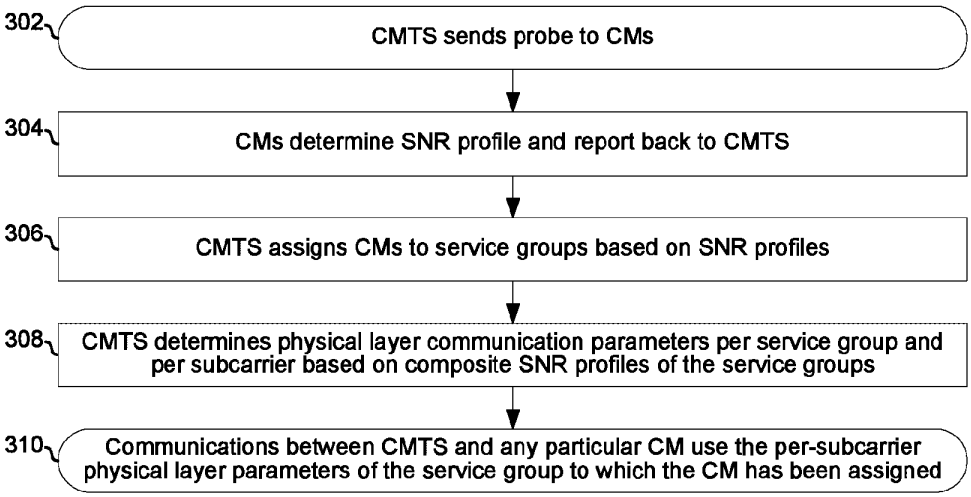
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(57) **ABSTRACT**

A cable modem termination system (CMTS) may determine, for a plurality of cable modems served by the CMTS, a corresponding plurality of SNR-related metrics. The CMTS may assigning the modems among a plurality of service groups based on the SNR-related metrics. For any one of the modems, the CMTS may configure physical layer communication parameters to be used by the one of the modems based on a SNR-related metric of a service group to which the one of the modems is assigned. The physical layer communication parameters may include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate. The CMTS and the modems may communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers, and the physical layer communication parameters may be determined on a per-subcarrier basis.

18 Claims, 7 Drawing Sheets



Related U.S. Application Data

continuation of application No. 15/228,703, filed on Aug. 4, 2016, now Pat. No. 9,577,886, which is a continuation of application No. 13/948,444, filed on Jul. 23, 2013, now Pat. No. 9,419,858.

(60) Provisional application No. 61/674,742, filed on Jul. 23, 2012.

(51) **Int. Cl.**

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H04L 12/28	(2006.01)
H04L 12/26	(2006.01)

(52) **U.S. Cl.**

CPC ***H04L 1/0026*** (2013.01); ***H04L 12/2801*** (2013.01); ***H04L 27/2601*** (2013.01); ***H04L 27/2602*** (2013.01); ***H04L 43/08*** (2013.01); ***H04L 43/12*** (2013.01)

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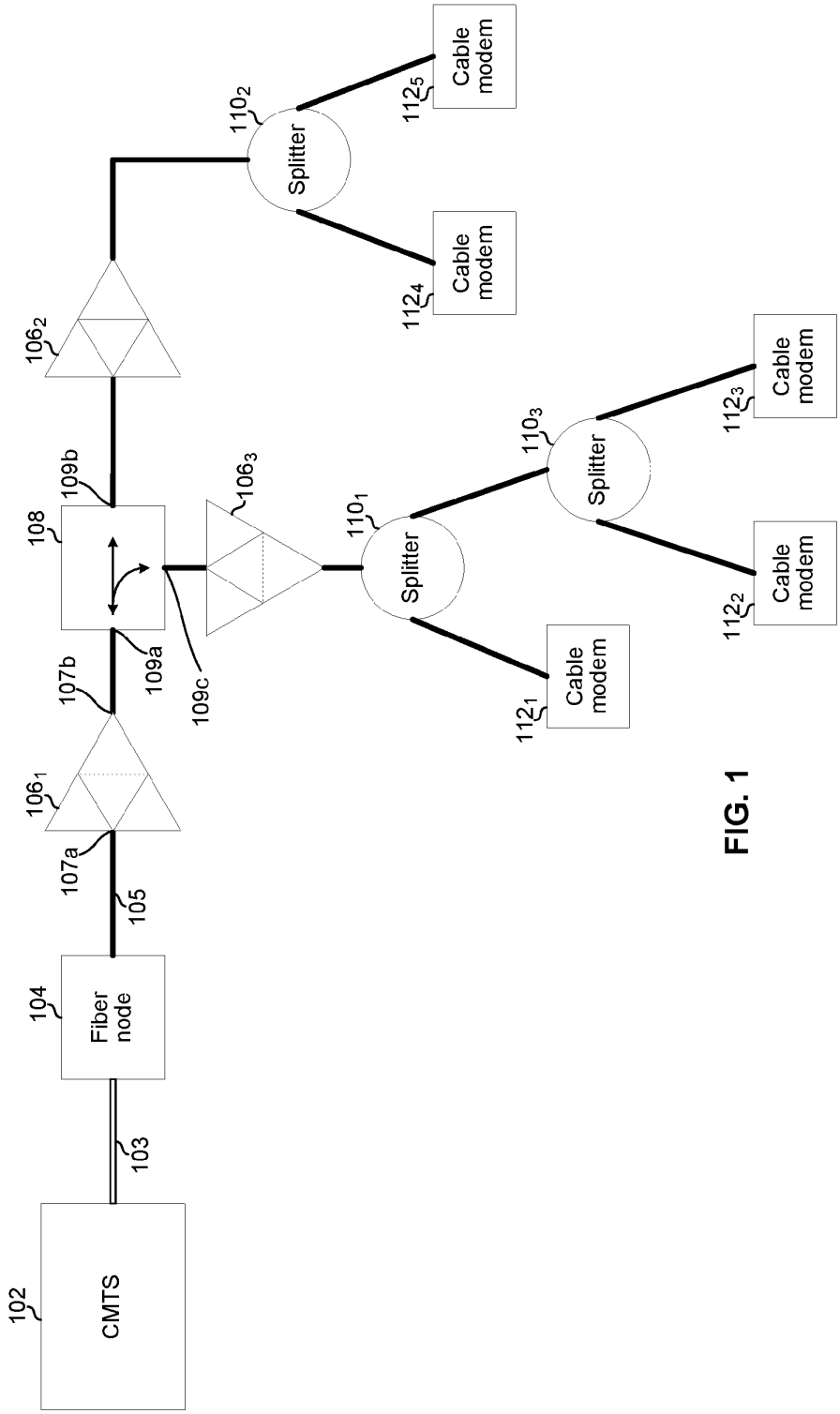

CMTS
102
103
Fiber node
104
105
107a
106$_1$
107b
109a
109c
106$_3$
108
109b
106$_2$
110$_2$
Splitter
112$_5$
Cable modem
112$_4$
Cable modem
110$_1$
Splitter
110$_3$
Splitter
112$_3$
Cable modem
112$_2$
Cable modem
112$_1$
Cable modem

FIG. 1

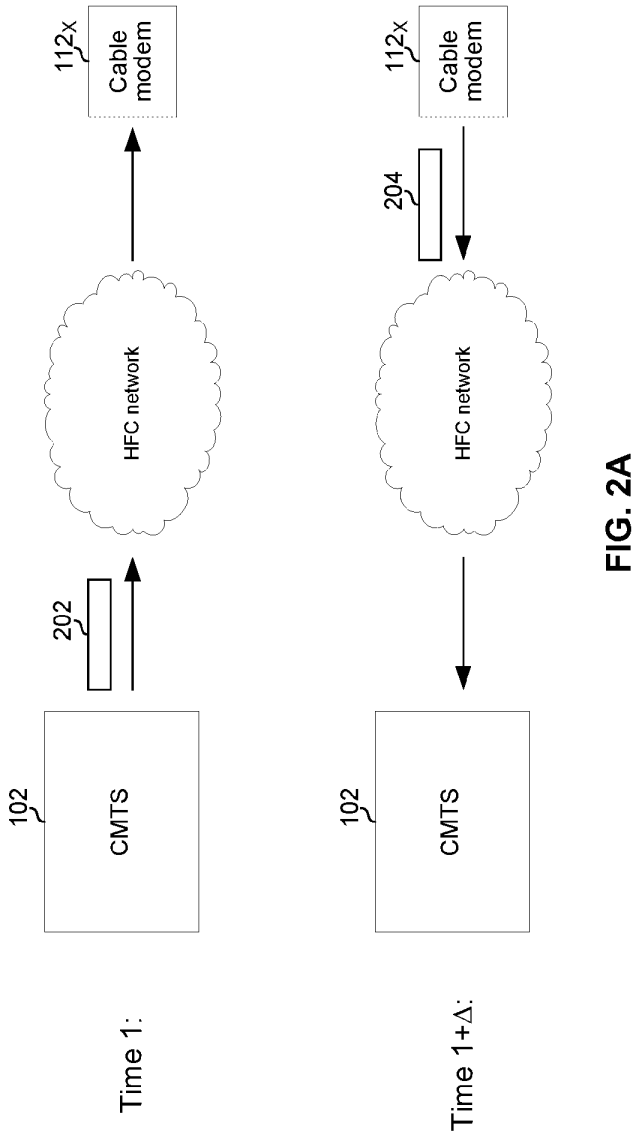

112x
Cable modem
HFC network
202
102
CMTS
Time 1:
112x
Cable modem
204
HFC network
102
CMTS
Time 1+Δ:

FIG. 2A

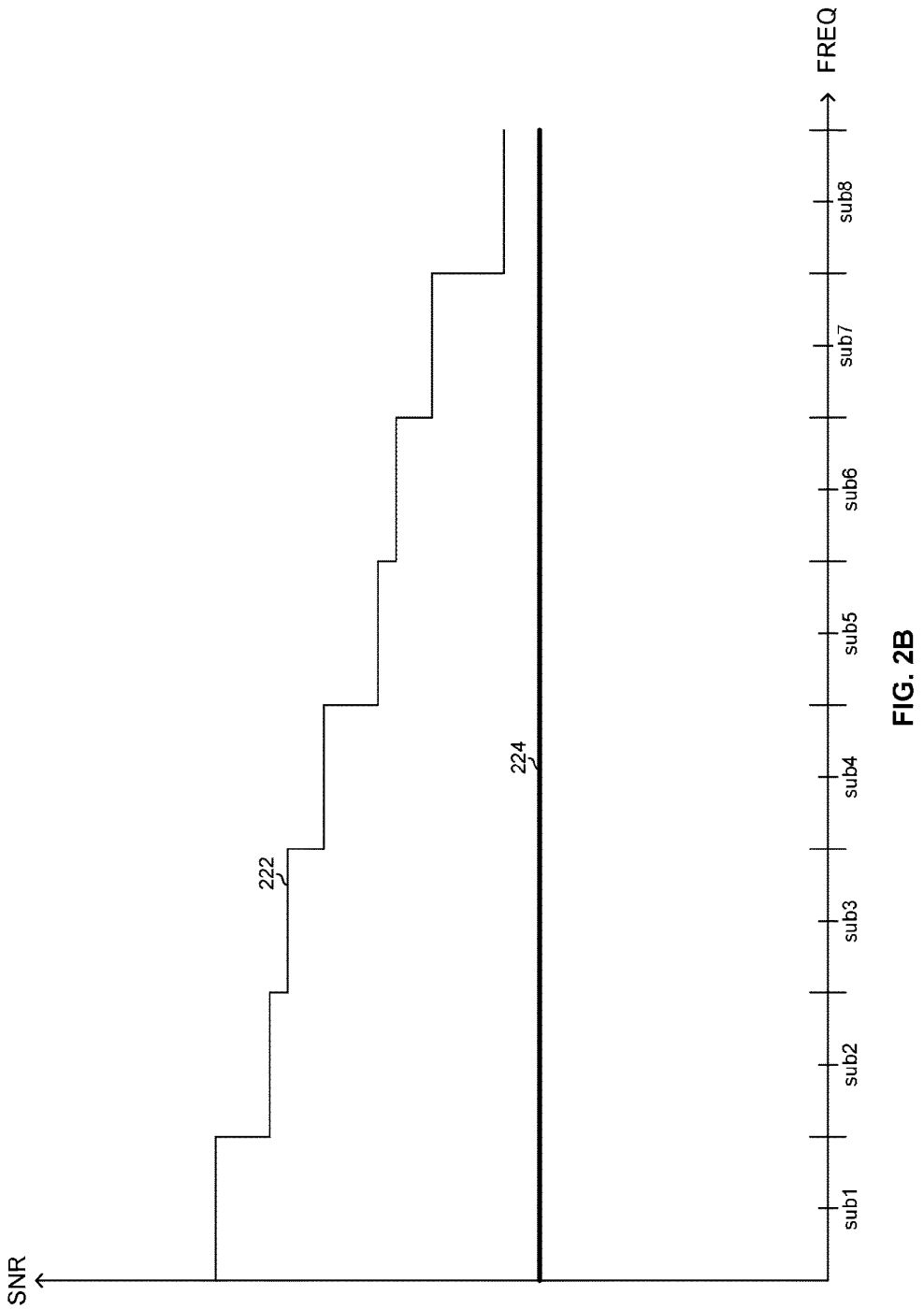


FIG. 2B

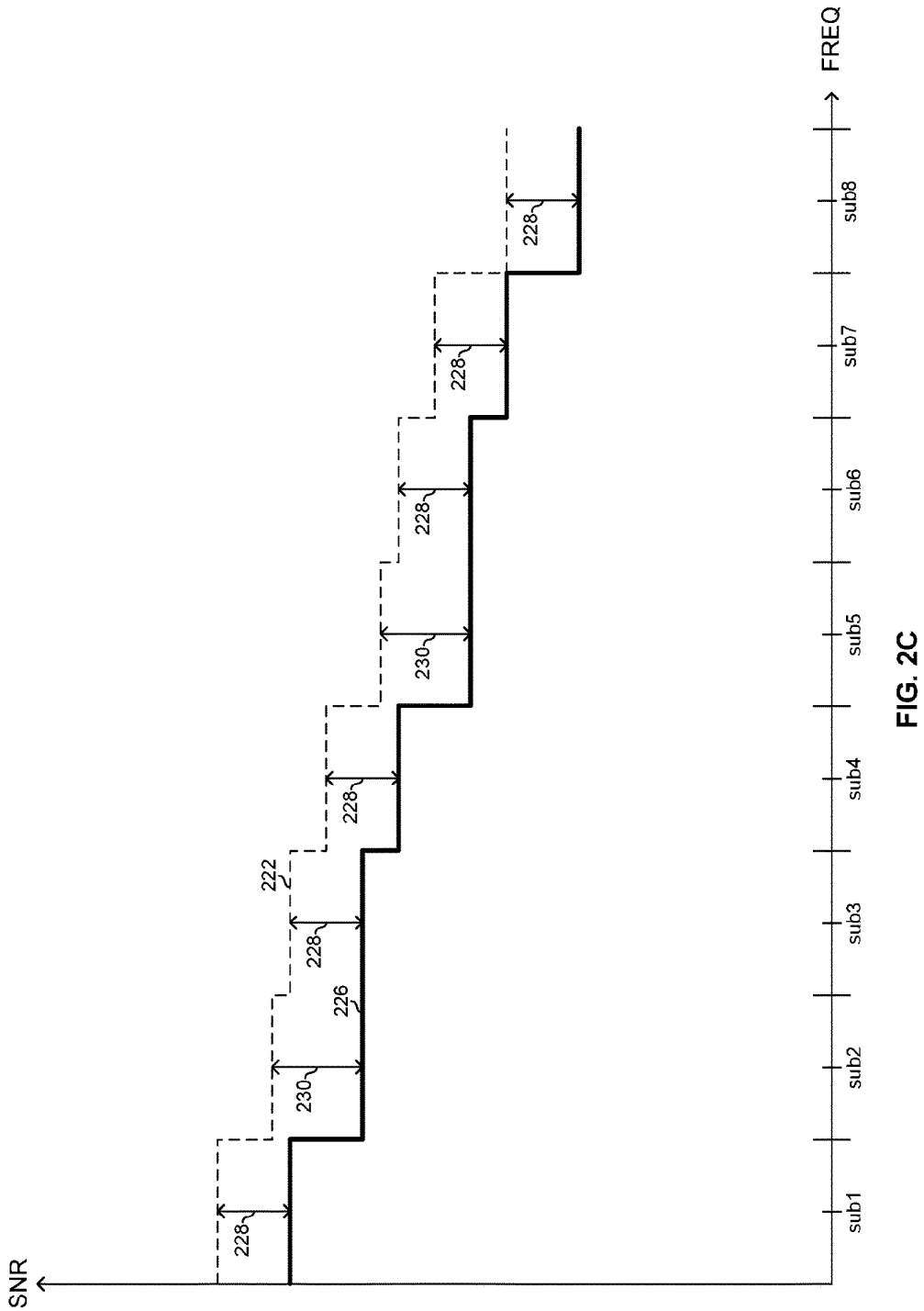

FREQ
SNR
sub1
sub2
sub3
sub4
sub5
sub6
sub7
sub8
228
230
222
226

FIG. 2C

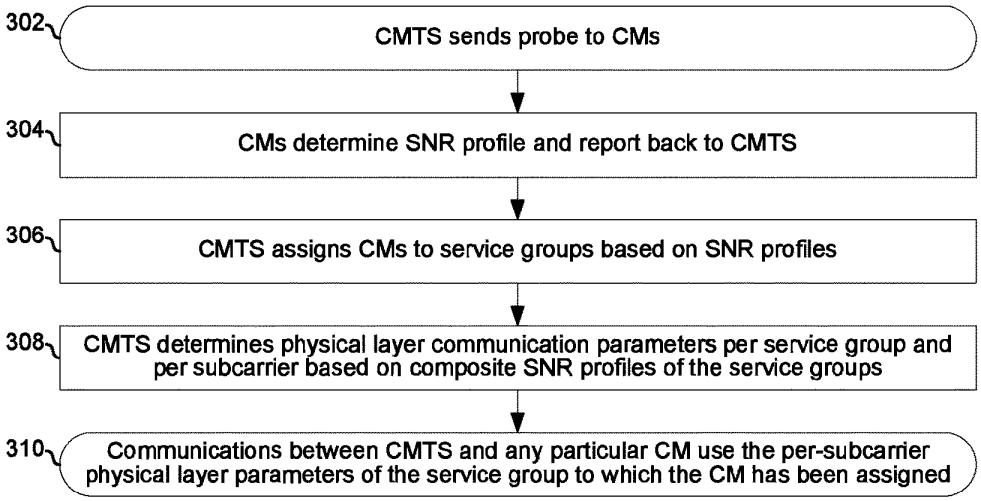

302
CMTS sends probe to CMs
304
CMs determine SNR profile and report back to CMTS
306
CMTS assigns CMs to service groups based on SNR profiles
308
CMTS determines physical layer communication parameters per service group and per subcarrier based on composite SNR profiles of the service groups
310
Communications between CMTS and any particular CM use the per-subcarrier physical layer parameters of the service group to which the CM has been assigned

FIG. 3A

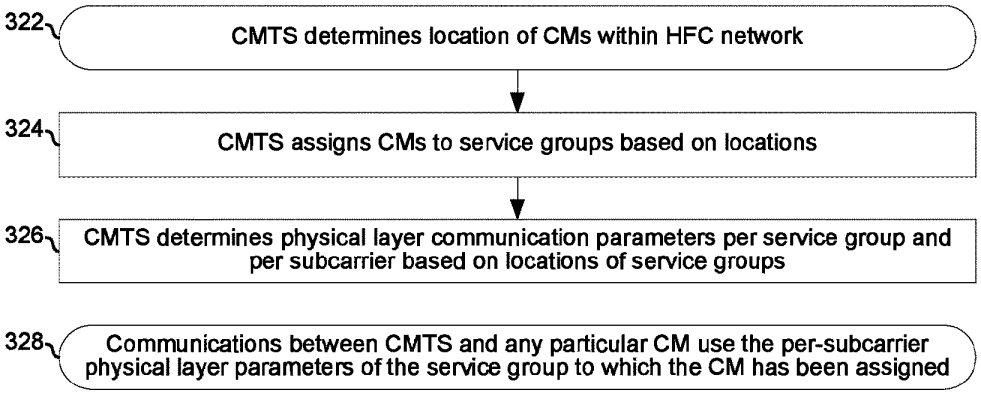

322
CMTS determines location of CMs within HFC network
324
CMTS assigns CMs to service groups based on locations
326
CMTS determines physical layer communication parameters per service group and per subcarrier based on locations of service groups
328
Communications between CMTS and any particular CM use the per-subcarrier physical layer parameters of the service group to which the CM has been assigned

FIG. 3B

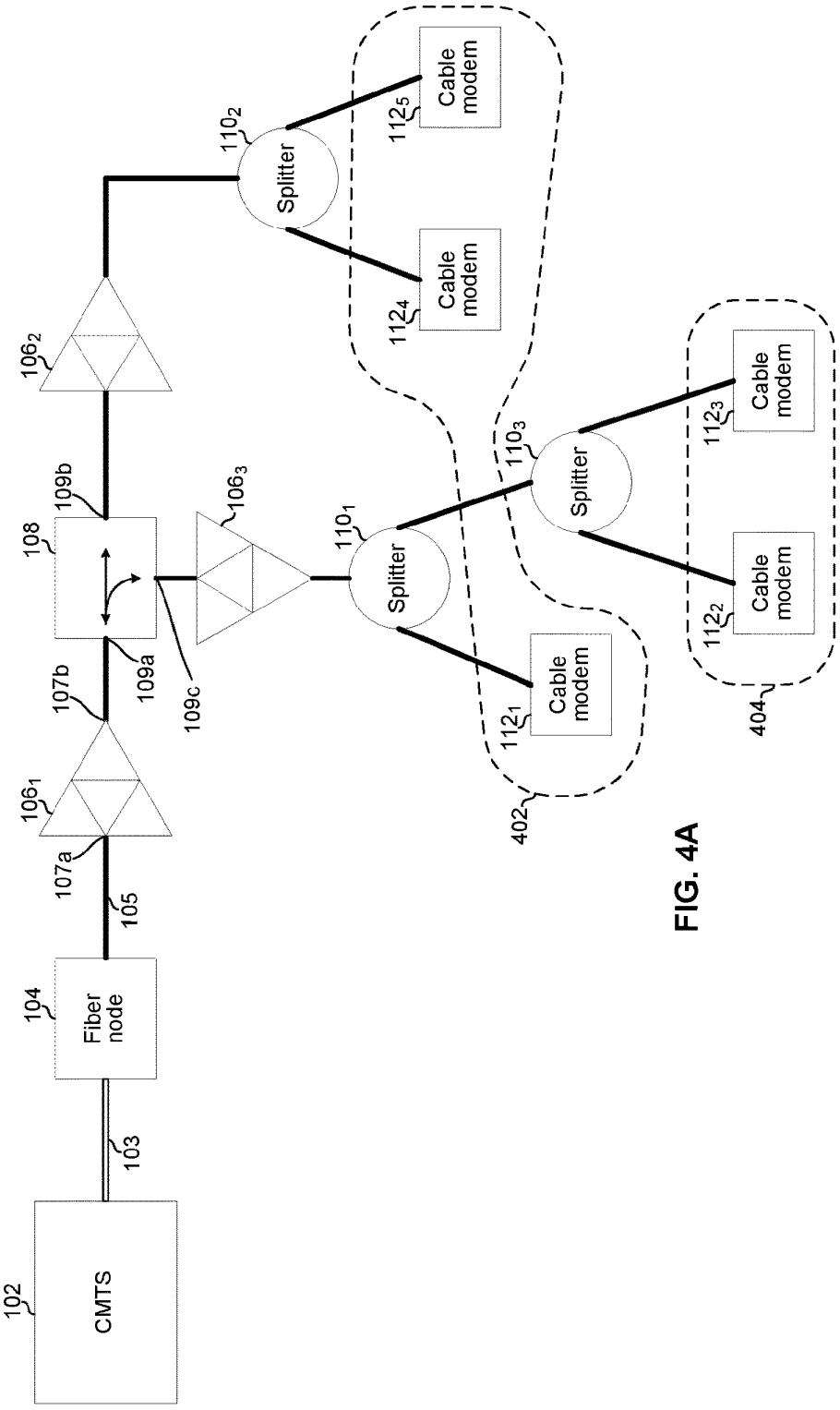

CMTS
102
103
Fiber node
104
105
107a
106$_1$
107b
109a
109b
108
109c
106$_2$
106$_3$
110$_1$
110$_2$
110$_3$
Splitter
Splitter
Splitter
112$_1$
112$_2$
112$_3$
112$_4$
112$_5$
Cable modem
Cable modem
Cable modem
Cable modem
Cable modem
402
404

FIG. 4A

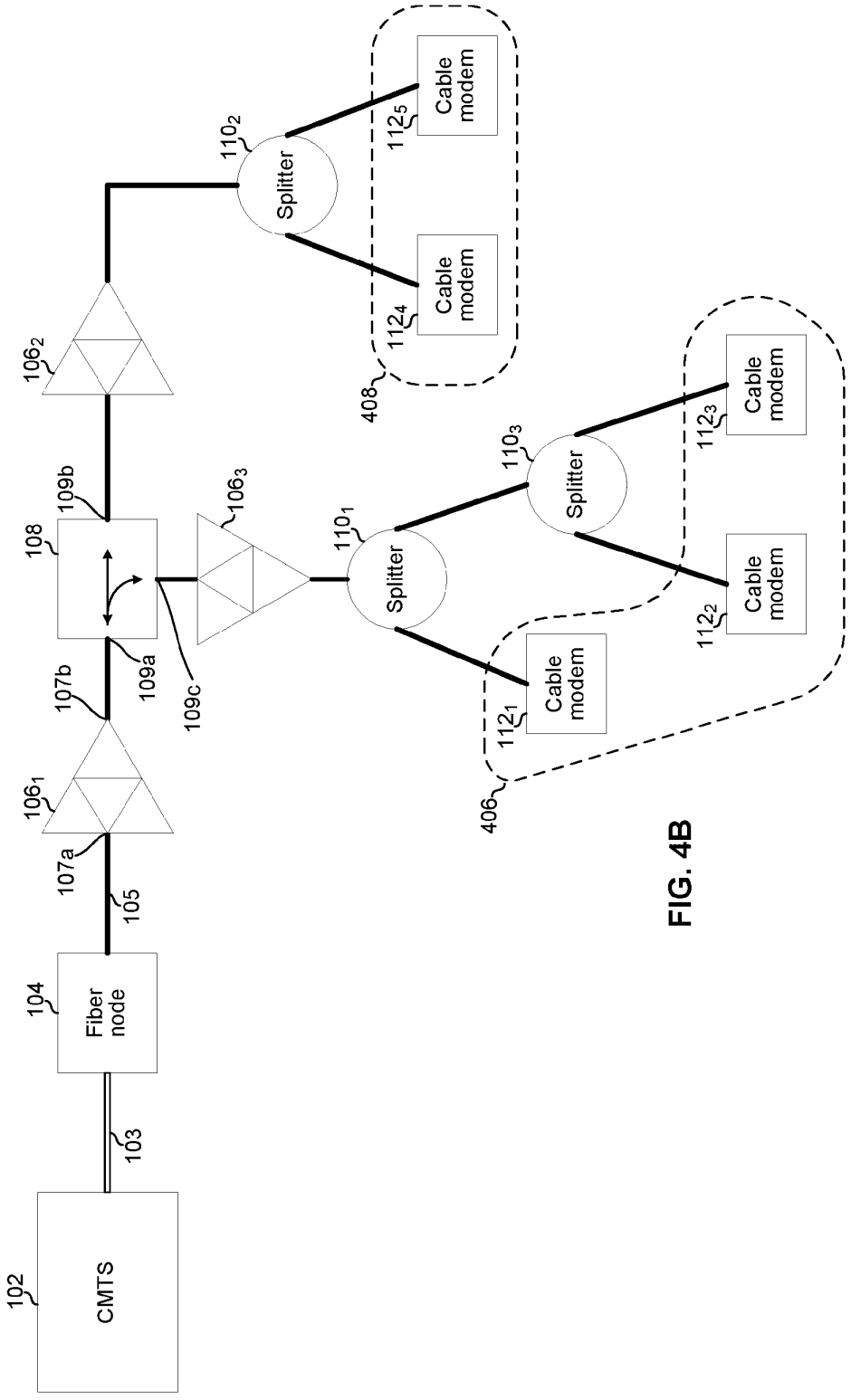

CMTS
102
103
Fiber node
104
105
107a
106$_1$
107b
109a
109c
108
109b
106$_2$
106$_3$
110$_1$
110$_2$
110$_3$
Splitter
Splitter
Splitter
112$_1$
112$_2$
112$_3$
112$_4$
112$_5$
Cable modem
Cable modem
Cable modem
Cable modem
Cable modem
406
408

FIG. 4B

METHOD AND SYSTEM FOR SERVICE GROUP MANAGEMENT IN A CABLE NETWORK

PRIORITY CLAIM

This patent application is a continuation of U.S. patent application Ser. No. 15/434,673 filed on Feb. 16, 2017, which is a continuation of U.S. patent application Ser. No. 15/228,703 filed on Aug. 4, 2016, now U.S. Pat. No. 9,577,886, which is a continuation of U.S. patent application Ser. No. 13/948,444 filed on Jul. 23, 2013, now U.S. Pat. No. 9,419,858, which makes reference to, claims priority to and claims benefit from U.S. Provisional Patent Application Ser. No. 61/674,742 titled "Method and System for Service Group Management in a Cable Television Network" and filed on Jul. 23, 2012.

The entirety of each of the above-mentioned applications is hereby incorporated herein by reference.

INCORPORATION BY REFERENCE

This application also makes reference to:

U.S. patent application Ser. No. 13/553,328 titled "Method and System for Client-Side Message Handling in a Low-Power Wide Area Network," and filed on Jul. 19, 2012;

U.S. patent application Ser. No. 13/485,034 titled "Method and System for Server-Side Message Handling in a Low-Power Wide Area Network," and filed on May 31, 2012;

U.S. patent application Ser. No. 13/553,175 titled "Method and System for a Low-Power Client in a Wide Area Network," and filed on Jul. 19, 2012;

U.S. patent application Ser. No. 13/553,195 titled "Method and System for Server-Side Handling of a Low-Power Client in a Wide Area Network," and filed on Jul. 19, 2012;

U.S. patent application Ser. No. 13/948,401 titled "Method and System for a High Capacity Cable Network," and filed on the same date as this application; and

U.S. patent application Ser. No. 13/948,417 titled "Method and System for Noise Suppression in a Cable Network," and filed on the same date as this application.

The entirety of each of the above-mentioned applications is hereby incorporated herein by reference.

FIELD OF THE INVENTION

Certain embodiments of the invention relate to cable television networks. More specifically, certain embodiments of the invention relate to a method and system for service group management in a cable television network.

BACKGROUND OF THE INVENTION

Convention cable television networks can be inefficient and have insufficient capacity. Further limitations and disadvantages of conventional and traditional approaches will become apparent to one of skill in the art, through comparison of such systems with some aspects of the present invention as set forth in the remainder of the present application with reference to the drawings.

BRIEF SUMMARY OF THE INVENTION

A system and/or method is provided for service group management in a cable television network, substantially as shown in and/or described in connection with at least one of the figures, as set forth more completely in the claims.

These and other advantages, aspects and novel features of the present invention, as well as details of an illustrated embodiment thereof, will be more fully understood from the following description and drawings.

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

FIG. **1** is a diagram of an example cable/DOCSIS network.

FIG. **2**A depicts an example method of determining locations of CMs within the HFC network.

FIGS. **2**B and **2**C depict signal-to-noise ratio (SNR) versus frequency profiles for an example cable/DOCSIS network.

FIG. **3**A is a flowchart illustrating an example process for configuring a cable/DOCSIS HFC network based on measured performance metrics.

FIG. **3**B is a flowchart illustrating an example process for configuring a cable/DOCSIS HFC network based on location of CMs within the network.

FIGS. **4**A and **4**B illustrate the network of FIG. **1**, with different groupings of CMs based on one or both of: measured performance metric(s) and location within the HFC network.

DETAILED DESCRIPTION OF THE INVENTION

As utilized herein the terms "circuits" and "circuitry" refer to physical electronic components (i.e. hardware) and any software and/or firmware ("code") which may configure the hardware, be executed by the hardware, and or otherwise be associated with the hardware. As used herein, for example, a particular processor and memory may comprise a first "circuit" when executing a first one or more lines of code and may comprise a second "circuit" when executing a second one or more lines of code. As utilized herein, "and/or" means any one or more of the items in the list joined by "and/or". As an example, "x and/or y" means any element of the three-element set {(x), (y), (x, y)}. As another example, "x, y, and/or z" means any element of the seven-element set {(x), (y), (z), (x, y), (x, z), (y, z), (x, y, z)}. As utilized herein, the term "exemplary" means serving as a non-limiting example, instance, or illustration. As utilized herein, the terms "e.g.," and "for example" set off lists of one or more non-limiting examples, instances, or illustrations. As utilized herein, circuitry is "operable" to perform a function whenever the circuitry comprises the necessary hardware and code (if any is necessary) to perform the function, regardless of whether performance of the function is disabled, or not enabled, by some user-configurable setting.

FIG. **1** is a diagram of an example cable/DOCSIS network. The example network comprises a cable modem termination system (CMTS) **102**, a fiber node **104**, amplifiers **106**$_1$-**106**$_3$, a directional coupler **108**, splitters **110**$_1$-**110**$_3$, and cable modems (CMs) **112**$_1$-**112**$_5$.

The CMTS **102** may comprise circuitry operable to manage connections to the CMs **112**$_1$-**112**$_5$. This may include, for example: participating in ranging operations to determine physical layer parameters used for communications between the CMTS **102** and CMs **112**$_1$-**112**$_5$; forwarding of dynamic host configuration protocol (DHCP) messages between a DHCP server and the CMs **112**$_1$-**112**$_5$; forwarding of time of

day messages between a time of day server and the CMs $\mathbf{112}_1$-$\mathbf{112}_5$; directing traffic between the CMs $\mathbf{112}_1$-$\mathbf{112}_5$ other network devices (e.g., Ethernet interfaces of the CMTS **102** may face the Internet, Optical RF interfaces of the CMTS **102** may face the CMs, and the CMTS may direct traffic between and among the Ethernet and Optical RF interfaces); and managing registration of the CMs $\mathbf{112}_1$-$\mathbf{112}_5$ to grant the cable modems network (e.g., Internet) access. The registration process for a CM $\mathbf{112}_X$ (X between 1 and 5 for the example network of FIG. **1**) may comprise the CM **112** sending a registration request along with its configuration settings, and the CMTS **102** accepting or rejecting the cable modem based on the configuration settings. The registration process may additionally comprise an exchange of security keys, certificates, or other authentication information.

The fiber node **104** may comprise circuitry operable to convert between optical signals conveyed via the fiber optic cable **103** and electrical signals conveyed via coaxial cable **105**.

Each of the amplifiers $\mathbf{106}_1$-$\mathbf{106}_3$ may comprise a bidirectional amplifier which may amplify downstream signals and upstream signals, where downstream signals are input via upstream interface **107***a* and output via downstream interface **107***b*, and upstream signals are input via downstream interface **107***b* and output via upstream interface **107***a*. The amplifiers $\mathbf{106}_1$, which amplifies signals along the main coaxial "trunk" may be referred to as a "trunk amplifier." The amplifiers **1062** and **1063** which amplify signals along "branches" split off from the trunk may be referred to as "branch" or "distribution" amplifiers.

The directional coupler **108** may comprise circuitry operable to direct downstream traffic incident on interface **109***a* onto interfaces **109***b* and **109***c*, and to direct upstream traffic incident on interfaces **109***b* and **109***c* onto interface **109***a*. The directional coupler **108** may be a passive device.

Each of the splitters $\mathbf{110}_1$-$\mathbf{110}_3$ may comprise circuitry operable to output signals incident on each of its interfaces onto each of its other interfaces. Each of the splitters $\mathbf{110}_1$-$\mathbf{110}_3$ may be a passive device.

Each of the cable modems (CMs) $\mathbf{112}_1$-$\mathbf{112}_5$ may comprise circuitry operable to communicate with, and be managed by, the CMTS **1102** in accordance with one or more standards (e.g., DOCSIS). Each of the CMs $\mathbf{112}_1$-$\mathbf{112}_5$ may reside at the premises of a cable subscriber.

The components (including, fiber optic cables, coaxial cables, amplifiers, directional couplers, splitters, and/or other devices) between the CMTS and the CMs may be referred to as a hybrid fiber coaxial (HFC) network. Any of the amplifiers, directional coupler, and splitters may be referred to generically as a coupling device.

FIG. **2**A depicts an example method of determining locations of CMs within the HFC network. As shown in FIG. **2**A, to determine one or more measured performance metric(s) (e.g., an SNR-related metric such as SNR at a particular frequency or SNR over a range of frequencies (an SNR profile), noise levels, strength of desired signals, and/or the like) for any particular CM $\mathbf{112}_X$, the CMTS **102** may transmit, at time **1**, a message **202** that is destined (unicast, multicast, or broadcast) for the CM $\mathbf{112}_X$ and that functions as a probe to enable determination of the metric(s) for the CM $\mathbf{112}_X$. The message **202** may be sent on multiple channels spanning multiple frequencies. Similarly, where OFDM is used for communications between the CMTS **102** and the CM $\mathbf{112}_X$, the message **202** may be transmitted on each subcarrier, or may be sent on a subset of subcarriers and then interpolation may be used for determining the SNR of subcarriers on which the message **202** was not sent.

The message **202** may be transmitted with such encoding, modulation, and transmit power such that even a CM $\mathbf{112}_X$ with a worst-case performance metric(s) can receive the message and accurately measure the metric(s). In this regard, FIG. **2**B shows a SNR versus frequency graph for an example HFC network that uses eight channels/subcarriers. The line **222** in FIG. **2**B represents a composite worst-case SNR profile for one or more CM(s) in the HFC network to which the message **202** is destined. For example, line **222** may be a SNR profile for a single CM $\mathbf{112}_X$ to which the message **202** is to be unicast. As another example, the line **222** may be a composite worst-case SNR profile for a plurality of CMs **112** of a particular service group to which the message **202** is to be multicast. As another example, the line **222** may be a composite worst-case SNR profile for all CMs of an HFC network handled by the CMTS **102** to which the message **202** is to be broadcast. The message **202** may be transmitted such that the minimum SNR needed to receive and accurately measure the SNR profile is below the line **222** (e.g., SNR needed for receiving the message **202** may be the line **224**).

Upon receipt of the message **202**, a CM $\mathbf{112}_X$ may measure, over the channels/subbands on which the message was sent, one or more metrics (e.g., SNR versus frequency profile) for the transmission **202**. The CM $\mathbf{112}_X$ may then report the metrics(s) back to the CMTS **102** via a message **204**. In an example implementation, the message **202** may contain information about when and/or how the CM(s) are supposed to report their metric(s) (e.g., SNR profiles) back to the CMTS **102**. In this regard, the message **202** may contain information that is the same as and/or or analogous to what may be found in a MAP, UCD, and/or other MAC management message defined in a DOCSIS standard. Accordingly, the message **202** may have specified a format of the message **204** and that the message **204** is to be transmitted at time T+□.

Once the metric(s) of one or more CMs are known to the CMTS **102**, physical layer communication parameters to be used for communications between the CMTS **102** and the CMs **112** may be determined based on the metric(s). In this regard, physical layer communication parameters may be determined per-CM based on each CM's respective metric(s) (e.g., each CM's SNR profile), per-service-group based on a composite metric(s) of the CM(s) assigned to that service group (e.g., composite SNR profile for the CM(s) of that service group), per physical region of the HFC network based on a composite metric of the CMs located in that physical region (e.g., composite SNR profile for the CM(s) in that physical region), and/or the like. Furthermore, once the metric(s) of a CM $\mathbf{112}_X$ is determined, the CMTS **102** may assign that CM $\mathbf{112}_X$ to one or more service groups based on its metric(s), as, for example, described below with reference to FIG. **4**A. Example physical layer parameters include: encoding parameters, modulation parameters, transmit power, receive sensitivity, timeslot duration, channel(s) or subcarrier(s) on which to listen, channel(s) or subcarrier(s) on which to transmit, and/or the like. Example encoding parameters include: type of forward error correction (FEC) to be used (e.g., Reed-Solomon, LDPC, etc.), FEC block size, FEC code rate, etc. Example modulation parameters include: type of modulation (e.g., frequency shift keying (FSK), phase shift keying (PSK), quadrature amplitude modulation (QAM), etc.), modulation depth, modulation order, etc.

In an example implementation, the transmission of messages **202**, the calculation of metrics, such as SNR profile, by the CM(s), the transmission **204**, and subsequent configuration of physical layer parameters based on the metric(s) may take place in parallel with other operations performed during the registration/ranging process.

Referring now to FIG. **2**C, there is again shown the line **222** which represents the applicable SNR profile (e.g., an individual SNR profile if configuring physical layer parameters per CM, a composite SNR profile for a service group if configuring physical layer parameters per service group, or a composite SNR profile for a particular physical region). Also shown is a line **226** corresponding to SNR utilization for communications with the CM(s) associated with the profile **222**. Assuming the distance **228** is the minimum desired headroom, then the physical layer communication parameters resulting in line **226** are nearly optimal in the sense that there is minimal headroom on each of channels/subbands **1**, **3**, **4**, **6**, **7**, **8**, and only slightly more than minimal headroom on channels/subbands **2** and **5**.

Physical layer parameters may be configured/coordinated using upstream and/or downstream MAP messages, upstream channel descriptors (UCDs), other MAC management messages defined in DOCSIS protocols, and/or purpose-specific messages tailored to configuring the parameters based on measured performance metrics such as SNR profiles as described in this disclosure.

FIG. **3**A is a flowchart illustrating an example process for configuring a cable/DOCSIS HFC network based on SNR profiles. For clarity of illustration the process is described with reference to the network of FIG. **1** and the messages of FIG. **2**A. The process begins with block **302** in which the CMTS **102** sends one or more probe messages **202** to the CMs $\mathbf{112}_1$-$\mathbf{112}_5$. In block **304**, each of the CMs $\mathbf{112}_1$-$\mathbf{112}_5$ determines its respective SNR profile based on a received one of the messages **202**, and reports the SNR profile back to the CMTS **102** in the form of a message **204**. In block **306**, the CMTS **102** assigns the CMs to service groups based on the SNR profiles.

In block **308**, physical layer communication parameters are determined per service group and per channel/subcarrier. For example, for any particular service group, the modulation order and FEC code rate to be used on a particular subcarrier may be determined based on the worst case SNR for that subcarrier among the CMs in that particular service group. Thus, it can be seen that grouping CMs based on SNR profiles may enable configuring physical layer communications parameters to such that one or more communication parameters (throughput, reliability, etc.) is optimal, or near-optimal, for all of the CMs in the service group. For example, without such grouping by SNR profile, one CM in a particular service group may have substantially lower SNR on one or more channels/subcarriers. As a result, all CMs in that particular service group may be forced to use physical layer parameters supported by this "lowest common denominator" CM. This may result in a lot of wasted capacity for the remaining CMs.

To illustrate with a specific example: assume that CMs $\mathbf{112}_1$, $\mathbf{112}_4$, and $\mathbf{112}_5$ of FIG. **1** have sufficient SNR on channel z to support 64-QAM on channel z, but that CMs $\mathbf{112}_2$ and $\mathbf{112}_3$ only have sufficient SNR on channel z to support 16-QAM. If $\mathbf{112}_1$ is assigned to the same service group as $\mathbf{112}_2$ or $\mathbf{112}_3$, then $\mathbf{112}_1$ may be forced to use 16-QAM on channel z. Conversely, if $\mathbf{112}_1$, $\mathbf{112}_4$, and $\mathbf{112}_5$ are assigned to a first service group and $\mathbf{112}_2$ and $\mathbf{112}_3$ are assigned to a second service group, then the first service group consisting of $\mathbf{112}_1$, $\mathbf{112}_4$, and $\mathbf{112}_5$ can use 64-QAM on channel z while the second service group consisting of $\mathbf{112}_2$ and $\mathbf{112}_3$ uses 16-QAM on channel z.

In block **310**, communications between the CMTS **102** and any particular service group use the per-service-group and per-subcarrier/channel physical layer parameters determined in block **308**.

FIG. **3**B is a flowchart illustrating an example process for configuring a cable/DOCSIS HFC network based on location of CMs within the network. For clarity of illustration, and as a non-limiting example, the process is described with reference to the network of FIG. **1** and the messages of FIG. **2**B. The process begins with block **322** in which the CMTS **102** determines a location of each of the CMs $\mathbf{112}_1$-$\mathbf{112}_5$ in the network. Location of a CM $\mathbf{112}_X$ may be characterized in a variety of ways including, for example: total distance of fiber and/or coaxial cable between the CMTS **102** and the CM $\mathbf{112}_X$, total attenuation between the CMTS **102** and the CM $\mathbf{112}_X$, which trunk amplifier(s) are upstream of the CM $\mathbf{112}_X$, how many coupling elements (amplifiers, splitters, directional couplers, etc.) are between the CMTS **102** and the CM $\mathbf{112}_X$, GPS coordinates, and street address. In block **324**, the CMTS **102** assigns the CMs $\mathbf{112}_1$-$\mathbf{112}_5$ to service groups based on their determined locations. Blocks **326** and **328** are substantially similar to blocks **308** and **310**, respectively, of FIG. **3**A.

The locations of the CMs $\mathbf{112}_1$-$\mathbf{112}_5$ may be determined by, for example, transmitting sounding signals into the network. In order to characterize the channel with more precision, the channel sounding signal may be sent repeatedly over an interval of time and the CMs may average multiple measurements over the time interval until they can resolve identifying characteristics in the signal which indicate, for example, how many branch amplifiers and/or other coupling elements that the signal traveled through to reach the CM. In another example implementation, the CMTS may communicate with a server that stores subscriber information that associates the CMs with their geographic location (e.g., street address).

While FIGS. **3**A and **3**B depict SNR profiles and location as two separate bases on which to assign CMs to service groups, the two may be used in combination.

FIGS. **4**A and **4**B illustrate the network of FIG. **1**, with different groupings of CMs based on one or both of: measured performance metric(s) and location within the HFC network.

In the example of FIG. **4**A, CMs $\mathbf{112}_1$, $\mathbf{112}_4$, and $\mathbf{112}_5$ are assigned to service group **402** and CMs $\mathbf{112}_2$ and $\mathbf{112}_3$ are assigned to service group **404**. The assignment of FIG. **4**A may result from, for example, assigning CMs based on the number of coupling elements between the CMTS **102** and the CMs—four each for CMs $\mathbf{112}_1$, $\mathbf{112}_4$, and $\mathbf{112}_5$; five each for CMs $\mathbf{112}_2$ and $\mathbf{112}_3$. The number of coupling elements may be determined based on, for example, measured performance metrics (e.g., SNR profile) of the CMs and/or address or GPS information associated with the CMs. Alternatively, the assignment of FIG. **3**A may result from, for example, assigning the CMs to service groups based directly on their respective measured performance metric(s) (e.g., the extra device in the path between CMTS **102** and CMs $\mathbf{111}_2$ and $\mathbf{112}_3$ may cause CMs $\mathbf{112}_2$ and $\mathbf{112}_3$ to have significantly poorer SNR).

In the example of FIG. **4**B, CMs $\mathbf{112}_1$, $\mathbf{112}_2$, and $\mathbf{112}_3$ are assigned to service group **406** and CMs $\mathbf{112}_4$ and $\mathbf{112}_5$ are assigned to service group **408**. The assignment of FIG. **4**B may result from, for example, assigning CMs based on which trunk amplifiers are downstream of the CMs. Alternatively, the assignment of FIG. **3**A may result from, for

example, assigning the CMs to service groups based directly on their respective measured performance metric(s) (e.g., the distance between CMTS **102** and CMs $\mathbf{112}_4$ and $\mathbf{112}_5$ may be substantially greater than the distance between the CMTS **102** and the CMs $\mathbf{112}_1$, $\mathbf{112}_2$, and $\mathbf{112}_3$, thus resulting in poorer SNR in CMs $\mathbf{112}_4$ and $\mathbf{112}_5$).

Grouping CMs according to which trunk or distribution amplifiers are upstream of them may enable duty cycling power branch and/or distribution amplifiers. For example, when a CM in service group **406** is the talker, the upstream path through amplifier **1062** may be disabled such that noise from group **408** does not interfere with transmissions from the talker of service group **406**. Grouping CMs according to which trunk or distribution amplifier(s) serve(s) them may enable using more efficient physical layer parameters. For example, where there is a relatively long distance of cable between amplifier $\mathbf{106}_1$ and $\mathbf{106}_2$ but relatively short distance of cable between amplifiers $\mathbf{106}_1$ and $\mathbf{106}_3$, grouping the CMs by geography/distance to the CMTS may enable a lower transmit power to be used by the CMTS **102** when talking to service group **406** as compared to when talking to service group **408**.

Other embodiments of the invention may provide a non-transitory computer readable medium and/or storage medium, and/or a non-transitory machine readable medium and/or storage medium, having stored thereon, a machine code and/or a computer program having at least one code section executable by a machine and/or a computer, thereby causing the machine and/or computer to perform processes described.

Accordingly, the present invention may be realized in hardware, software, or a combination of hardware and software. The present invention may be realized in a centralized fashion in at least one computing system, or in a distributed fashion where different elements are spread across several interconnected computing systems. Any kind of computing system or other apparatus adapted for carrying out the methods described herein is suited. A typical combination of hardware and software may be a general-purpose computing system with a program or other code that, when being loaded and executed, controls the computing system such that it carries out the methods described herein. Another typical implementation may comprise an application specific integrated circuit or chip.

The present invention may also be embedded in a computer program product, which comprises all the features enabling the implementation of the methods described herein, and which when loaded in a computer system is able to carry out these methods. Computer program in the present context means any expression, in any language, code or notation, of a set of instructions intended to cause a system having an information processing capability to perform a particular function either directly or after either or both of the following: a) conversion to another language, code or notation; b) reproduction in a different material form.

While the present invention has been described with reference to certain embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted without departing from the scope of the present invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the present invention without departing from its scope. Therefore, it is intended that the present invention not be limited to the particular embodiment disclosed, but that the present invention will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A method comprising:

determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;

assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;

generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups;

selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and

communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter.

2. The method of claim **1**, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.

3. The method of claim **1**, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.

4. The method of claim **3**, comprising selecting, by said CMTS, said one or more physical layer communication parameter on a per-OFDM-subcarrier basis.

5. The method of claim **4**, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.

6. The method of claim **1**, wherein:

said plurality of service groups comprises a first service group and a second service group;

said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus frequency profile; and

said assigning said each cable modem among said plurality of service groups comprises, for the particular cable modem:

assigning said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and

assigning said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.

7. The method of claim **1**, comprising assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.

8. The method of claim **1**, comprising assigning any particular one of said cable modems to one of said plurality

of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.

9. The method of claim **1**, wherein said determining said plurality of SNR-related metrics comprises:

transmitting a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and

receiving a metric reporting message from each cable modem.

10. A system comprising:

circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:

said processor is configured to determine, for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;

said processor is configured to assign each of said cable modems among a plurality of service groups based on a respective corresponding SNR-related metric;

said processor is configured to generate, for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups;

said processor is configured to select one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and

said network interface is configured to communicate with one or more cable modems corresponding to said one of said plurality of service groups using the one or more selected physical layer communication parameter.

11. The system of claim **10**, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.

12. The system of claim **10**, wherein said network interface and said cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers.

13. The system of claim **12**, wherein said network interface is configured such that at least one of said one or more physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.

14. The system of claim **12**, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.

15. The system of claim **10**, wherein:

said plurality of service groups comprises a first service group and a second service group;

said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus frequency profile;

said assignment of said each cable modem among said plurality of service groups comprises, for the particular cable modem:

assignment of said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and

assignment of said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.

16. The system of claim **10**, wherein said processor is configured to assign said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.

17. The system of claim **10**, wherein said processor is configured to assign each of said cable modems among said plurality of service groups based on one or more branch amplifier that serves said each of said cable modems.

18. The system of claim **10**, wherein said determination of said plurality of SNR-related metrics comprises:

transmission, via said network interface, of a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and

reception, via said network interface of said CMTS, of a metric reporting message from each cable modem.

* * * * *

EXHIBIT 7

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ENTROPIC COMMUNICATIONS, LLC, Plaintiff, v. CHARTER COMMUNICATIONS, INC., Defendant.	Civil Action No. 2:22-cv-00125-JRG

REBUTTAL EXPERT DECLARATION OF RICHARD A. KRAMER PH.D.
REGARDING CLAIM CONSTRUCTION

TABLE OF CONTENTS

Page

I. Introduction 1
II. Qualifications 3
III. Compensation 10
IV. Materials Considered 10
V. Legal Standards 11
VI. Level of Skill in the Art 13
VII. '775 Patent 15
A. Overview of the '775 Patent 15
B. Summary of The '775 Patent File History 17
C. Disputed Terms of the '775 Patent 28
1. "a data networking engine implemented in a first circuit . . ." and "a cable modem engine implemented in a second circuit . . ." (Claim 18) 29
a. Among other things, Dr. Almeroth's opinions assume a POSITA would ignore "circuit" as used in the plain claim language 29
2. "DOCSIS MAC processor" / "DOCSIS controller" (Claim 18) 32
a. A POSITA would understand the meaning of "DOCSIS MAC processor" and "DOCSIS controller" 32
b. Dr. Almeroth misconstrues "DOCSIS MAC processor" and "DOCSIS controller" by requiring them to be implemented on separate, specific physical processors 33
3. "data bus" (Claim 18) 36
VIII. '690 Patent 43
A. Overview of the '690 Patent 43
B. Prosecution History of the '690 Patent 46
C. Disputed Terms of the '690 Patent 46
1. "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters" (Claim 1) 47
a. The claim language is clear on its face that not all parameters relate to the "form" of the probe 48
b. The specification further confirms a POSITA's understanding that not all parameters relate to the "form" of the probe 49
c. Dr. Almeroth fails to show support for his view that all parameters define the "form" of the probe 50

2. "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" (Claim 9) / "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe" (Claim 9) 51

a. A POSITA would understand, in view of the intrinsic evidence, that not all parameters "compris[e] a form for the probe" 52

b. Among other things, Dr. Almeroth is incorrect that "both the requesting node and the transmitting node separately determine a 'plurality of parameters'" as if Claim 1 and Claim 9 are the same in this regard 53

IX. '682 Patent 54

A. Overview of the '682 Patent 54

B. Prosecution History of the '682 Patent 55

C. Disputed Terms of the '682 Patent 56

1. "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" 56

a. I disagree that "worst case" and "composite worst case SNR" are the "same thing" in the context of Claim 1 or are otherwise indefinite 57

b. I disagree with Dr. Almeroth's opinion that "worst case" SNR is unintelligible or always 0 in the context of Claim 1 60

2. "[communicating with/corresponding to] said one of said plurality of service groups" 61

a. Among other things, Dr. Ameroth is wrong that there is no antecedent basis 61

X. Additional Remarks 63

I, Richard A. Kramer, declare as follows:

I. INTRODUCTION

1. I am over the age of 18 and am competent to make this Rebuttal Declaration ("Declaration"). I have personal knowledge, or have developed knowledge of these technologies based upon education, training, or experience, of the matters set forth herein. If called upon to do so, I would testify competently thereto.

2. I have been retained by counsel for Entropic Communications, LLC ("Entropic") in the above-captioned action as an independent consultant to offer opinions regarding how a person of ordinary skill in the art would understand certain claim terms in U.S. U.S. Patent No. 8,223,775 (the "'775 Patent"); U.S. Patent No. 8,284,690 (the "'690 Patent"); and U.S. Patent No. 10,135,682 (the "'682 Patent"), (collectively, the "Patents at Issue"). Specifically, I am submitting this Declaration to address the meaning and construction of certain disputed terms in response to the Expert Declaration of Dr. Kevin Almeroth Regarding Claim Construction. For the purposes of this Declaration, I have not been asked to opine on the meaning of any other disputed terms not addressed below.

3. In forming my opinions, I understand that the claims should be interpreted as they would be understood by a person of ordinary skill in the art ("POSITA") of the patent at the time its application was filed. I understand that the claims are to be construed with reference to the patent's specification, the claims, and the prosecution history, in light of the plain meaning of the terms used in the claims, and with reference to other sources of information, such as dictionaries, textbooks, and literature or other patents in the same or related fields.

4. My opinions are based on my years of education, research and experience, as well as my investigation and study of relevant materials, including those identified in this Declaration.

5. I may rely upon these materials, my knowledge and experience, and/or additional materials in forming any necessary opinions. Further, I may also consider additional documents and information to rebut arguments raised by the Defendants. I reserve any right that I may have to supplement this Declaration if further information becomes available or if I am asked to consider additional information. Furthermore, I reserve any right that I may have to consider and comment on any additional expert statements or testimony of Defendant's expert(s) in this matter.

6. My analysis of the materials produced in this investigation is ongoing and I will continue to review any new material as it is provided. This Declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

7. If requested, I am prepared to explain at a technology tutorial or claim construction hearing the technology disclosed in the Patents at Issue, including the state of the art around the filing dates of this patent. This may include, among other things, background information on communication systems, broadband communications systems / cable systems (*e.g.,* cable TV systems, HFC (Hybrid Fiber Coax) cable systems, etc.), satellite communication systems, RF (Radio Frequency)[1] systems, including systems architectures, components, and applications thereof for these types of systems. Any explanations that I may provide with respect to a technology tutorial or claim construction hearing may also include the use of visual aids or other demonstrations. I am also prepared to rebut, as necessary, matters raised by the expert(s) of

[1] "RF," which means "Radio Frequency," is a term and technology that not only applies to wireless systems, but also applies to terrestrial systems such as, for example, cable systems (including cable and/or HFC systems) and related devices. This was likewise true well before the earliest possible priority dates of the Patents at Issue.

Defendant Charter Communications, Inc. ("Charter")—whether in declarations, reports, depositions, or hearings—and to address related matters raised in the course of claim construction.

II. QUALIFICATIONS

8. In this section, I provide a summary of my educational background, employment background, and other relevant qualifications. A more detailed statement of my professional qualifications, including education, publications, honors and awards, professional activities, consulting engagements, and other relevant experience is included in my curriculum vitae, attached as Exhibit A to this Declaration, and is incorporated by reference herein.

9. I have 30 plus years of in-depth industry experience developing and deploying successful communication systems, broadband communications systems / cable systems (*e.g.*, cable TV systems, HFC (Hybrid Fiber Coax) cable systems, etc.), satellite communication systems, and RF systems, including systems architectures, components, and applications thereof for these types of systems—to name a few.

10. From 2007 to present, I currently serve as President of SIS Development, Inc. / Security Industry Services, Inc., an engineering and technical services company specializing in the technical areas of, for example, communication systems (including cable TV/broadband systems), video systems, wireless networking, Internet technologies, and client-server systems. Exemplary technical services that I have provided include assisting companies in the cable TV and communications industry. For example, I assisted a company in the development an SoC (System on a Chip) for a cable TV set-top box.

11. From 2003 to 2007, I served as the Vice President-Engineering and General Manager-Technology at GE-Security, a division of General Electric (GE) which is now owned by United Technologies Corporation (UTC). At GE, I was the lead engineer for the world-wide "Video Systems Group" that developed video products, multimedia communications systems and

products, and HFC based systems and products. At GE, I was also the lead engineer for residential and commercial security systems engineering and development for North America.

12. From 1998 to early 2003, I was the top technology leader at a number of high-tech start-up companies. Those high-tech start-up companies included Miraxis Corporation (a division of EMS Technologies, Inc., now Honeywell, Inc.). At Miraxis, I was the Vice President of Product Development from late 2001 to early 2003, developing IP network and digital video solutions in the satellite TV industry (*e.g.,* a DTH (Direct to Home) / DBS (Direct Broadcast Satellite) solution). As the Vice President of Product Development, I was responsible for all aspects of the system architecture and components to provide both multimedia content and two-way modem communications.

13. In 2000, I joined Ivex Corporation ("Ivex"), where I served as the Vice President of Engineering and led all technology development. At Ivex I led the development of video surveillance solutions including a product called the VSA (Video Streaming Appliance) and an Internet/network system/software solution called ViewOps. Our solutions allowed retail chains like Ace Hardware, Finish Line, and Eddie Bauer to remotely view their sites and facilities using servers. Further, the user could log into the ViewOps system to obtain pre-recorded events that were triggered by a wide variety of sensor inputs.

14. In 1998, I joined Home Wireless Networks, Inc., where I was promoted to Vice President of Engineering. At Home Wireless Networks, I led all engineering in the development of leading-edge wireless products, including 900 MHz RF circuits, antennas, and transceivers. Home Wireless Networks' products—which included the first integrated voice and low-cost IEEE 802.11 WiFi access point—were launched under the British Telecom and Telenor brands in Europe and the BellSouth and MCI brands in the United States. At the time we used well known

IC (Integrated Circuit) design methods and SoC (System on a Chip) design methods. For example, as Vice President of Engineering at Home Wireless Networks, I was responsible for the development of an SoC (System on a Chip) that integrated an ARM processor. The ARM processor core was provided to us in the form of a hardware library (*e.g.*, in the form of HDL (Hardware Description Language)) that we then integrated into our SoC as a whole. We then had an outside semiconductor foundry manufacture our SoC.

15. From 1995 to 1998, I was the engineering/technology leader for multimedia cable TV set-top boxes in North America for Scientific-Atlanta, Inc. (prior to being acquired by Cisco Systems, Inc.) within the Advanced Video Systems (AVS) Division. My group developed and successfully launched Scientific-Atlanta's first internally designed cable TV set-top box (also called an HCT which means Home Communication Terminal). The development of the cable TV set-top boxes that I led engineering for included responsibility for RF, analog, and digital design for the finished products.

16. At Scientific-Atlanta, in addition to my leadership in the development of cable TV products, I was also responsible for testing the products for our entire division as a whole. Subsequently, I directly managed the construction and operation of our own complete cable TV Head End (HE) system. When we designed products, we evaluated the performance of our products within the entire cable TV system including within the cable TV HE that we operated. Such evaluations of performance included the measurement and monitoring of a whole host of system impairments related to cable TV system two-way communications including those measurements related to SNR (Signal to Noise Ratio) and other modulation impairments.

17. At Scientific-Atlanta I was later promoted and served as the top technology leader on the Strategic Planning Team for the AVS Division, working on the next generation advanced

video products including the overall system design, software and HCTs. In this role, each of the functional technology areas including firmware, hardware, system software and cable system communication headend equipment reported to me in a dotted line matrix/cross-functional organizational structure for the development of our next generation of products and solutions.

18. As part of my responsibilities at Scientific-Atlanta, I stayed current with industry standards that we implemented into our systems such as, for example, the DOCSIS (Data Over Cable Service Interface Specification) standard, the MPEG (Motion Pictures Expert Group) standard, and various Internet/networking standards such as the SNMP (Simple Network Management Protocol) standard. Moreover, the products and solutions that I led the development of at Scientific-Atlanta included a plethora of technologies that included, for example, the development of cable TV communication circuits and systems and RF circuit design.

19. From 1987 to 1995, I held a number of technology positions at Schlumberger Industries, Electricity Management North America. From 1987 until 1989, I was an Electronic Design Engineer at Schlumberger. As an Electronic Design Engineer, I designed circuitry and firmware for solid-state electronic electric meters including the design of a PLC (Programmable Logic Controller) which was an IC that did not include a processor. I also designed an Application Specific Integrated Circuit (ASIC). The use of ASICs and PLCs were well known technologies at the time. I worked on many aspects of design for our core metering products including the design of AMR (Automatic Meter Reading) electronics. The electricity meters that I designed further employed a wide array of sensors to measure electric power consumption, low battery conditions, tamper detection, and the like.

20. In 1989, I was promoted to Senior Electronic Design Engineer at Schlumberger. In 1990, I was promoted to Hardware Manager of the Recorders and Translation Systems where I led

the development of data interfaces between electricity meters and a utility's remote central office. In 1994, I was promoted to Engineering Manager, Residential and Commercial Metering.

21. As Engineering Manager, Residential and Commercial Metering for Schlumberger, I oversaw product development of residential and commercial solid-state electronic electric meters for North America. For example, I was responsible for the engineering design of the "MACS" (Metering And Communications System) that was used to remotely read and control electricity meters installed within multi-tenant buildings using the existing power lines. We called this PLC (Power Line Carrier) communication technology. In fact, PLC was one of the first communication methods used for "Smart Homes" which at that time was in its early infancy. PLC was seen as a means to communicate between various appliances and the utility meter within a home. As part of my R&D (Research and Development) duties, I extensively researched Smart Home technology and PLC technology and as a result I attended a Parks Associates Smart Home workshop in or around 1994.

22. In 1984, I began work as an Electronic Design Engineer in the Nuclear Power Division at Babcock & Wilcox. I was later promoted to Senior Electronics Design Engineer.

23. In the Special Products and Integrated Field Services team at Babcock & Wilcox, my work involved designing and developing both: (a) monitoring systems to monitor the operation of the nuclear power plant equipment, and (b) inspection/robotic repair systems to inspect and repair nuclear power plant components inside the nuclear containment buildings. My work required me to implement a wide variety of sensor technologies into the control room monitoring and robotic systems that I designed.

24. Related to monitoring systems at Babcock & Wilcox, as just one example, I helped redesign portions of a Safety Parameter Display System (SPDS). The SPDS was a system used in

the control room of nuclear power plants to allow the operators to monitor the plethora of equipment and related sensors within a nuclear power plant. For example, such sensors determined temperature, the state of valves and other equipment (closed / not closed), water levels, pressure, and radiation levels to name a few.

25. Related to inspection/robotic repair systems at Babcock & Wilcox, I was one of the key designers of the electronics, software, and firmware (for measurement, control, and communications) for a robot called "ROGER" (Remotely Operated Generator Exam and Repair). My work in designing ROGER required me to work with a plethora of sensor technologies including cameras (to monitor activities and position of the robot), temperature sensors (for monitoring equipment health) and motion sensors (that enabled us to detect and control ROGER's position and movement within a nuclear power plant steam generator). My developments further implemented of cable TV systems to enable the visual inspection within that containment building and other high-radiation areas. ROGER was also outfitted with various exchangeable "tools" that allowed us to perform different types of inspections and repairs on nuclear steam generators which utilized a wide variety of sensor technologies to monitor remote equipment. The sensor states and parameters, including temperature and switch positions, were sent back via a dedicated serial communications network channel called "SDLC," to remote systems operated by personnel far away from the highly radioactive steam generator.

26. In 1984, I received a Bachelor of Science in Electrical Engineering, magna cum laude, from the University of Toledo.

27. In 2017, I received a Master of Science in Electrical and Computer Engineering from Oregon State University, where I graduated with a 4.0 GPA (Grade Point Average). My thesis, entitled "Optimization of Interactive Live Free Viewpoint Multiview Video Streaming

Bandwidth," was based on my own research in streaming multiview video over the Internet using peer-to-peer networks and wireless broadcast transmissions.

28. In 2022, I received a Ph.D. in Electrical and Computer Engineering from Oregon State University based on my academic research that I started in 2015. I graduated with a 4.0 GPA (Grade Point Average). My dissertation, entitled "Machine Learning Bandwidth Optimization of Interactive Live Free-Viewpoint Multiview Video for Sporting Events," was based on my own research combined with my applied industry knowledge in the fields of artificial intelligence, machine learning, classifiers, video / video detection / video analytics / video content prediction, and communication systems (including cable/HFC and satellite systems). The heart of my dissertation was to intelligently predict and then optimally communicate multimedia data over two-way DVB (Direct Video Broadcast) terrestrial systems (which include two-way DVB cable TV systems and DVB IPTV (Internet Protocol TV) systems)), two-way DVB satellite systems, and P2P (Peer-to-Peer) systems.

29. I am a member of the Institute of Electrical and Electronics Engineers (IEEE).

30. I am a lifetime member of the honor society of Phi Kappa Phi.

31. In 2003, I further attended Emory University's, Goizueta Business School and took numerous MBA (Master of Business Administration) courses. Emory's business school program at the time was ranked in the top 10 globally by Business Week and The Financial Times.

32. I have received two U.S. patents: (a) U.S. Patent No. 5,701,253, entitled "Isolated Current Shunt Transducer," which describes and at the time new transducer sensor design for measuring electricity, and (b) U.S. Patent No. and 5,422,939, entitled "Parallel Off-Hook Detection for Both Line-Available and Phone Pick-Up Detection," which describes an at the time new device for sensing the state of telephone lines.

III. COMPENSATION

33. I am being compensated for my services in this matter at my standard consulting rate of $725 per hour. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study, the substance of my opinions, or the outcome of any proceeding involving the challenged claims. I have no financial interest in the outcome of this matter.

IV. MATERIALS CONSIDERED

34. In preparing this declaration, I reviewed and considered the following materials, and any others referenced in the body of my declaration:

1) the Patents at Issue and their file histories, as well as the patents and file histories for the applications identified as Related U.S. Applications on the face of the Patents at Issue;

2) the parties' proposed claim constructions;

3) the Declaration of Dr. Kevin Almeroth Regarding Claim Construction ("Almeroth Declaration"); and

4) the extrinsic evidence cited herein.

35. I may use these documents and information, or other information obtained during the course of this or related proceedings, as well as representative charts, graphs, schematics and diagrams, animations, and models based on those documents and information, to support and to explain my testimony. I am informed that discovery in this action is ongoing and I reserve the right to modify or supplement my opinions, this declaration, and/or to submit additional declarations to address any information obtained, or positions taken, as discovery continues.

36. My opinions are based in part on a review and analysis of the above-mentioned documents and materials. The materials relied upon within this Declaration are of the type that an expert in my field would have reasonably relied upon in forming opinions. I have also drawn on

my education, experience, and knowledge of basic engineering principles for communication systems, broadband communications systems / cable systems (*e.g.*, cable TV systems, HFC (Hybrid Fiber Coax) cable systems, etc.), satellite communication systems, RF systems, including systems architectures, components, and applications thereof, that were already in use prior to, and within the timeframe of the earliest priority dates for the claimed subject matter in the Patents at Issue.

V. LEGAL STANDARDS

37. I am not an attorney or a patent attorney, and I offer no opinions on the law. I have, however, been informed by counsel regarding various legal standards that may apply to this case, and I have applied those standards where necessary in arriving at my conclusions.

38. I understand that patent claims are construed from the viewpoint of a person of ordinary skill in the art ("POSITA") at the time of the invention. I understand that this hypothetical POSITA is considered to have the normal skills and knowledge of a person in the applicable technical field. The factors that may be considered in determining the level of ordinary skill include: i) the education level of the inventor; ii) the types of problems encountered in the art; iii) the prior art solutions to those problems; iv) the rapidity with which innovations are made; v) the sophistication of the technology; and vi) the education level of active workers in the field.

39. I understand that the most important evidence to consider in construing the claims is the "intrinsic" evidence, which I understand includes the claim language, the patent specification, and the prosecution history, including *inter partes* review ("IPR") and other post-grant proceedings with the United States Patent and Trademark Office's ("USPTO") Patent Trial and Appeal Board ("PTAB").

40. I further understand that a POSITA must read the claim terms in the context of the claim itself, as well as in the context of the entire patent specification. I understand that in the

specification and/or prosecution history, the patentee may specifically define a claim term in a way that differs from the plain and ordinary meaning of the term. I understand that the prosecution history of the patent is a record of the proceedings before the USPTO and may contain explicit representations or definitions made during prosecution that affect the scope of the patent claims. I understand that an Applicant may, during the course of prosecuting the patent application, limit the scope of the claims to overcome prior art or to overcome an Examiner's rejection, by clearly and unambiguously arguing to overcome or distinguish a prior art reference or by clearly and unambiguously disclaiming claim coverage.

41. In interpreting the meaning of the claim language, I understand that a POSITA may also consider "extrinsic" evidence, which consists of all evidence external to the patent and prosecution history, including expert and inventor testimony, positions taken by the patent owner in other litigations, dictionaries, and learned treatises. I understand that extrinsic evidence may not be relied on if it contradicts or varies the meaning of the claim language provided by the intrinsic evidence, particularly if the Applicant has explicitly defined a term in the extrinsic record.

42. I also understand that patent claim may not be interpreted one way to avoid invalidity and another way to find infringement. In other words, a claim must be read the same way for validity as for infringement.

43. I understand that Section 112 of the Patent Laws requires that a patent claim particularly point out and distinctly claim the subject matter that the Applicant regards as his or her invention. I understand that a patent claim is invalid for indefiniteness if it fails to inform, with reasonable certainty, a person of ordinary skill in the art about the scope and bounds of the invention claimed. I understand a claim is indefinite if its scope is not clear enough that a POSITA could have determined with reasonable certainty whether a particular embodiment infringes the

claim. I also understand that when considering whether a claim is indefinite, a POSITA may consider both the intrinsic and extrinsic evidence.

44. I understand that a term may be found to be indefinite when the claim language is facially subjective or ambiguous and the meaning of a term and/or scope of the claims is not "reasonably certain" to one skilled in the art.

45. I understand that failure to provide explicit antecedent basis for a term does not always render a claim indefinite. If the scope of a claim would be reasonably ascertainable by those skilled in the art, then the claim is not indefinite.

46. I understand there are instances where inherent components of elements recited have an antecedent basis in the recitation of the components themselves. For example, the limitation "the outer surface of said sphere" would not require an antecedent recitation that the sphere has an outer surface.

VI. LEVEL OF SKILL IN THE ART

47. In rendering the opinions set forth in this Declaration, I was asked to consider the patent claims and the prior art through the eyes of a person of ordinary skill in the art ("POSITA"). The "art" is the field of technology to which a patent is related. In my Declaration, I use the term POSITA to refer to the same hypothetical person of ordinary skill in the art. I considered factors such as the educational level and years of experience of those working in the pertinent art, patents and publications of other persons or companies, the sophistication of the technology, the types of problems encountered in the art, the prior art solutions to those problems, and the speed at which innovations are made. I understand that a POSITA is not a specific real individual but rather a hypothetical individual having the qualities reflected by the factors discussed above.

48. The Patents at Issue relate to communication systems such as broadband communications systems / cable systems (*e.g.*, cable TV systems, HFC (Hybrid Fiber Coax) cable

systems, etc.), satellite communication systems, and RF systems, including systems architectures, components, and applications. I note that each of the Patents at Issue relate to these types of systems as I further discuss below. These types of technologies were typically designed by Electrical, Firmware, and Software Engineers that had experience working with these types of communication systems. I have performed such development myself, and I have further worked with and directly managed these types of Engineers in the industry. I am therefore very familiar with the common skill sets required for this type of work.

49. Taking these factors into consideration and based on my experience in the industry at the time of the earliest priority dates of the Patents at Issue, it is my opinion that a POSITA at the time of the earliest possible priority date of each of the Patents at Issue would have been an Engineer with at least a Bachelor's Degree in Electrical Engineering (or equivalent), with at least two years of experience developing broadband/cable TV/satellite communication systems and solutions.

50. I understand Charter's expert Dr. Almeroth has proposed that the level of ordinary skill would be a person having at least i) a bachelor-level degree in electrical engineering or a related subject and three or more years of experience working in the field of cable television signal processing and communication systems; ii) a master's-level degree in electrical engineering or a related subject and one or more years of experience working in the field of cable television signal processing and communication systems; or iii) a Ph.D.-level degree in electrical engineering or a related subject and at least some experience working in the field of cable television signal processing and/or communication systems. *See* Almeroth Decl. ¶ 27.

51. I am qualified to provide opinions concerning what a POSITA would have known and understood at that time, and my analysis and conclusions herein are from the perspective of a POSITA as of that date and would apply under either party's proposed set of qualifications.

52. As of approximately 2003, I was at least as qualified as the POSITA identified above. Thus, I understand the perspective of a POSITA as of at least as early as 2003, the earliest priority date of any of the Patents at Issue.

VII. '775 PATENT

A. Overview of the '775 Patent

53. The '775 Patent is titled "Architecture For A Flexible And High-Performance Gateway Cable Modem," was filed on September 30, 2003, and issued on July 17, 2012. Accordingly, for my analysis herein, I have assumed the date of September 30, 2003 as the earliest possible priority date for the '775 Patent.

54. The '775 Patent is directed towards a novel architecture for cable modems. As the '775 Patent explains "[t]he future gateway cable modem (CM) will provide a wide range of data networking and VoIP service" and "[t]he major challenge in designing such a gateway cable modem is integration of these services with the basic cable modem functionality in an efficient and cost effective [way]." '775 Patent, 1:13–18.

55. The '775 Patent discloses various embodiments providing a "highly flexible, high performance system capable of handling multiple cable modem voice, data and networking services" where a cable modem engine is "completely partitioned" from the data networking engine. *Id.* at 1:61–2:4. In the disclosed embodiments, complete partitioning is accomplished, for example, by "localizing data networking functions in the data networking engine processor and localizing cable modem functions in the cable modem engine processor." *Id.* at 4:16–19.

56. Figure 1 illustrates an exemplary cable modem system architecture 100 according to the '775 Patent. I have annotated Figure 1 below.

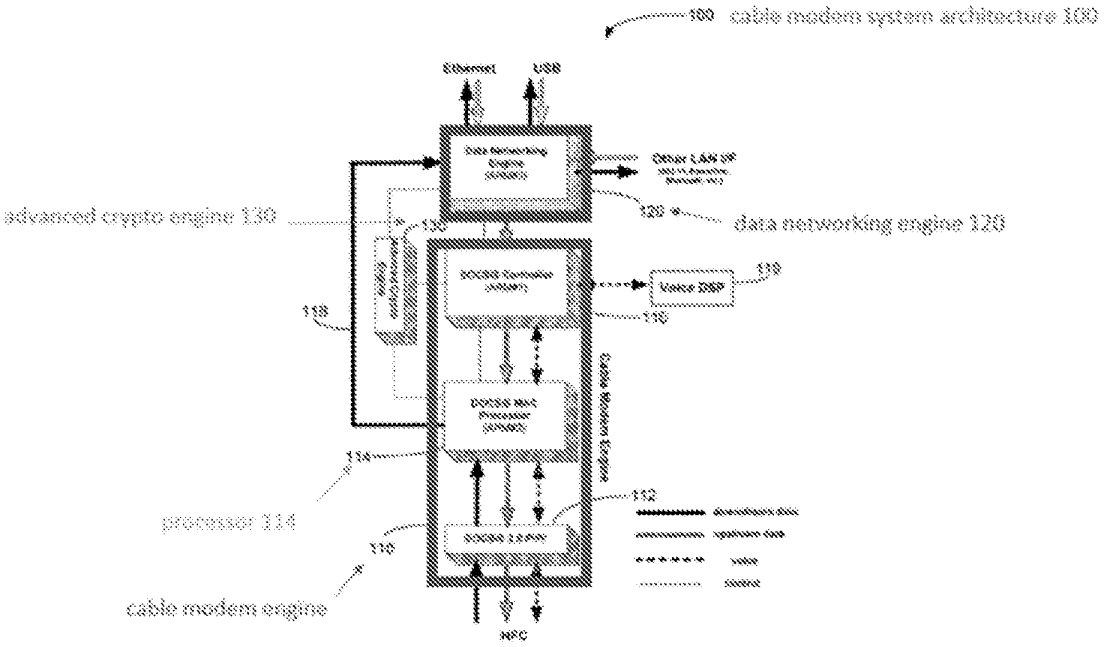


Figure 1

57. System 100 includes three major subsystems: cable modem engine 110, data networking engine 120, and advanced crypto engine 130. *Id.* at 2:49–52. Cable modem engine 110 implements DOCSIS cable modem functions. *Id.* at 2:55–56. The data networking engine 120 implements data networking functions. *Id.* at 3:49–53. "Advanced crypto engine 130 provides hardware support for crypto functions." *Id.* at 4:4–5.

58. In the embodiment of Figure 1, the cable modem engine includes a "processor 114," and the data networking engine also includes a processor such as, for example, an ARM processor. *See id.* at FIG. 1.

59. At least one data bus is implemented at, for example, path 118. This allows communication between the "Data Networking Engine" "120" and the "Cable Modem Engine" "110" while still retaining functional partitioning. *See id.*

B. Summary of The '775 Patent File History

60. I have reviewed the prosecution history leading to the issuance of the '775 Patent. A copy of the file history is attached as Exhibit B.

61. On September 30, 2003, the Applicant filed the application leading to the '775 Patent. The originally filed claims are reproduced below:

1. A cable modem system comprising:

a data networking engine that performs data networking functions; and

a cable modem engine that performs all other cable modem functions; the cable modem engine being completely partitioned from the data networking engine.

2. A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine that performs all crypto functions.

5. A cable modem system as claimed in claim 1, wherein the cable modem engine comprises:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller.

6. A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer comprises a hardware transmitter and receiver.

7. A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor processes downstream PDU packets and forwards the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. A cable modem system as claimed in claim 5, wherein the data networking engine is responsible for all data networking processing including advanced multi-port briding/routing with NAT/firewall and VPN, and home networking applications.

11. A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. A cable modem architecture comprising:

a cable modem engine comprising:

a DOCSIS PHY layer comprising a transmitter and receiver;

a DOCSIS MAC processor that implements real-time critical MAC functions for both upstream and downstream communications; and

a DOCSIS controller implementing VoIP functionality; and

a data networking engine implementing all data networking processing and home networking applications, wherein the data networking engine is completely decoupled from the cable modem engine.

13. A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller provides VoIP functionality in accordance with the PacketCable specification, and wherein the data networking engine provides the embedded portal services functionality of the CableHome specification, wherein the CableHome functionality is provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

> 15. A method for providing a flexible and partitioned cable modem gateway comprising:
>
> providing data and home networking functionality in a data networking engine;
>
> providing DOCSIS and VoIP functionality in a cable modem engine; and
>
> partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

Exhibit B at ENTROPIC_CHARTER_0005459–0005462.

62. On February 19, 2009, the Examiner issued a non-final rejection. Among other things, the Examiner rejected originally filed Claims 1–15 as being anticipated by Brooks (U.S. Publication No. 2001/0039600). By way of example, at the time, Claim 1 recited the following:

> 1. A cable modem system comprising:
>
> a data networking engine that performs data networking functions; and
>
> a cable modem engine that performs all other cable modem functions; the cable modem engine being completely partitioned from the data networking engine.

Id. at ENTROPIC_CHARTER_0005459.

63. The Examiner asserted:

> As per claim 1, Brooks teaches a cable modem system comprising: a data networking engine that performs data networking functions (Abstract; paragraphs 0013-0016); and a cable modem engine that performs all other cable modem functions (Abstract; paragraphs 0013-0016); the cable modem engine being completely partitioned from the data networking engine (Abstract; paragraphs 0013-0016).

Id. at ENTROPIC_CHARTER_0005497.

64. On May 19, 2009, the Applicant responded to the February 19, 2009 rejection. The Applicant amended the claims, including Claim 1, as shown below.

> 1. (Currently Amended) A cable modem system comprising:
>
> a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform ~~that performs~~ home ~~data~~ networking functions including interfacing with customer provided equipment; ~~and~~
>
> a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable mode engine to perform ~~that performs all other~~ cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and
>
> a data bus that connects the data networking engine to the cable modem engine,
>
> wherein the cable modem functions performed by the cable modem engine are ~~being~~ completely partitioned from the home networking functions performed by the data networking engine.

Id. at ENTROPIC_CHARTER_0005510.

65. The Applicant also traversed the rejection "because the cited portions of [Brooks] ***do not correspond to aspects of the claimed invention*** *directed to the data networking functions performed by a data networking engine being* ***completely partitioned/decoupled*** *from the other cable modem functions performed by a cable engine*." *Id.* at ENTROPIC_CHARTER_0005514 (emphasis added).

66. The Applicant further explained that the office action created uncertainty as to how the Examiner was interpreting and applying the disclosures of Brooks to the claims at issue. Specifically, the Applicant stated:

> [T]he Office action does not identify what element of [Brooks] is being asserted as ***corresponding to Applicant's data networking engine***.

Id. at ENTROPIC_CHARTER_0005514 (emphasis added).

67. On February 5, 2010, the Examiner issued a final rejection. Among other things, the Examiner again issued a rejection of the claims as anticipated by Brooks. The Examiner stated the following with respect to Claim 1:

> As per claim 1, Brooks teaches a cable modem system comprising: a data networking engine implemented in a first circuit that includes at least one processor (Figure 2), the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment (Abstract; paragraphs 0014, 0026, 0037, 0066-0068); a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine (paragraphs 0026, 0037, 0042-0046, 0050-0052); a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine (0042-0046).

Id. at ENTROPIC_CHARTER_0005540.

68. The Examiner also provided the following response to the Applicant's remarks:

Almeroth Decl. ¶¶ 57–63; *see also* ¶ 79. There is no redefinition or disclaimer and Dr. Almeroth has not identified any.

104. If one accepted Dr. Almeroth's incorrect analysis regarding disclaimer, then the requirements that Claim 18 have "a data networking engine implemented in a first circuit that includes at least one processor . . .;" "a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit . . .;" and "a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine," would seem to result in zero claim scope—if I understand what Dr. Almeroth is proposing. In other words, there could be no device that meets the elements of claim 18. This seems very unlikely to be the view of any POSITA.

105. It appears Dr. Almeroth reaches this conclusion based on a misunderstanding of the statements the Applicant made with respect to Brooks. The first time the Applicant addressed Brooks (in the May 19, 2009 office action response), the Applicant expressly stated that the "Office action does not identify what element of [Brooks] is being asserted as corresponding to Applicant's data networking engine," (Exhibit B at ENTROPIC_CHARTER_0005514) and continued to make this point when the Applicant was discussing Brooks.

106. Brooks discloses two programmable physical processors, 102 and 104, but as the Applicant pointed out, the functionality of these processors is ***not partitioned*** as required by the claims. Applicant reiterated this same problem throughout the dialogue with the Examiner concerning Brooks, specifically explaining that there is not a "data networking engine" in Brooks because processor 102 handles many cable modem functions, and processor 104 is described only

as providing operational system support and "may manage some message processing and scheduling." Exhibit B at ENTROPIC_CHARTER_0005582 (emphasis in original).

107. During prosecution, Applicant attempted to understand how the Examiner was attempting to map Brooks onto the claims. In this discussion, the Applicant again reiterated that Brooks ***does not disclose the claimed partitioning*** of the cable modem engine and data networking engine.

108. To properly frame the discussion, I first observe that a third component of Brooks was discussed, called the "CMAC/CPHY" component 224. As the Applicant explained in the April 5, 2010 office action response, "Figure 2 [of Brooks] makes clear that the cable modem functions are performed by CMAC unit 224 (*see, e.g.*, paragraph 0042)." *Id.* at ENTROPIC_CHARTER_0005557. I have included an annotated version of Brooks Figure 2 below, showing the CMAC unit and processors 102 and 104:

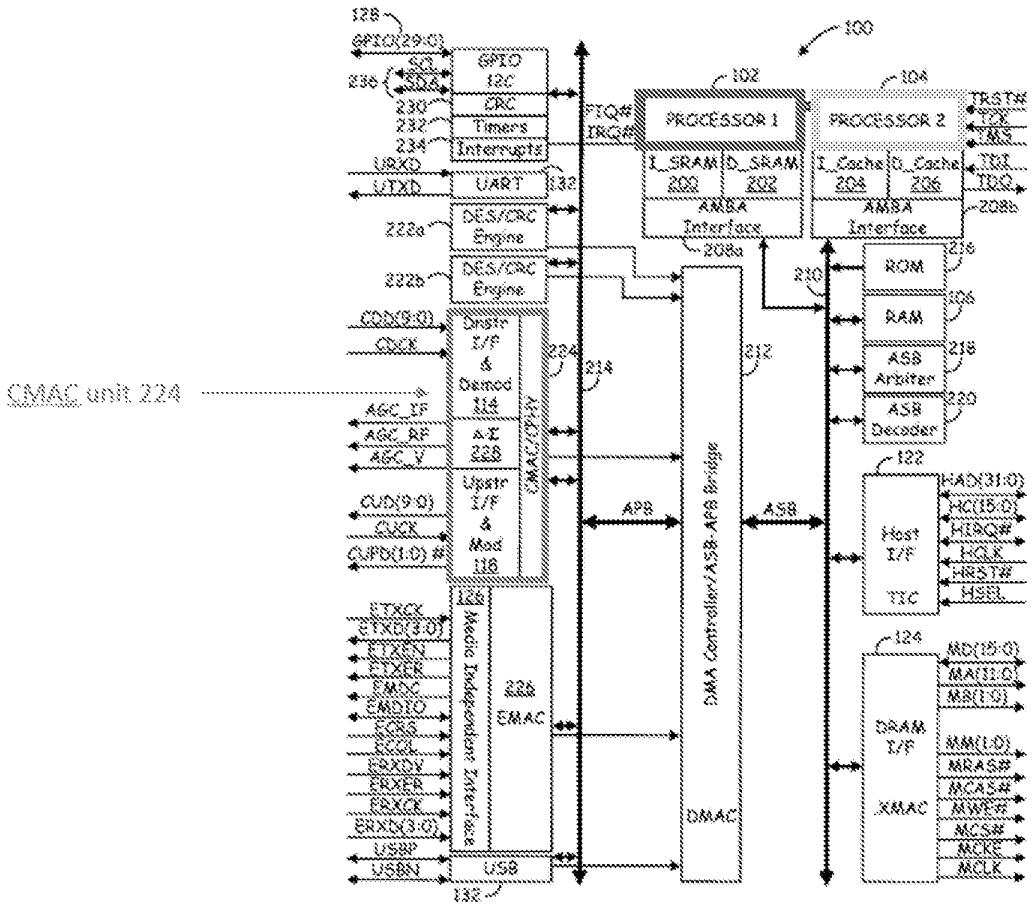


Fig. 2

Exhibit C, U.S. Pub. No. 2001/0039600 ("Brooks"), FIG. 2.

109. Applicant elaborated that CMAC 224 is responsible for, at least in part, the cable modem functions:

> [T]he Office Action make the conclusion statement [sic] that "the data networking engine and the cable modem engines are represented in Figure 1 and 2 of the [Brooks]" (*see, e.g.*, p. 8 of the Office action). However, Applicant is uncertain how any reasonable interpretation of these Figures can provide correspondence. For example, ***Figure 2 of [Brooks] discloses only two processors, each of which, therefore, must correspond to the claimed data-networking and cable-modem engines. However, the discussion of Figure 2 makes clear that the cable modem functions are performed by CMAC unit 224*** (*see, e.g.*, paragraph 0042). Therefore, in order for the cable modem engine to contain a processor and perform the CMAC functions as claimed, the cited cable modem engine must include circuitry to connect the processors with the CMAC unit. Because available connecting circuitry

> would be shared with the other processor, Applicant is uncertain how the asserted cable modem entire and home networking engine can be completely partitioned as claimed.

Exhibit B at ENTROPIC_CHARTER_0005557–0005558 (emphasis added); *see also* Exhibit C, [0042] ("a cable media access controller (CMAC) 224, including a System timer and interfaces to the cable downstream PHY circuitry 114 and cable upstream PHY circuitry 118, is provided to Support communications with a cable media 134").

110. The Applicant explained it was "uncertain how the asserted cable modem engine and home networking engine can be completely partitioned" because it appeared that the Examiner's assertion of Brooks would not make sense unless the Examiner was considering the "cable modem engine" to include ***one*** of the processors (102 or 104)—but ***not the other—plus the CMAC unit 224*** and the "available connecting circuitry [] shared with the other processor." Exhibit B at ENTROPIC_CHARTER_0005557–0005558.

111. However, the Applicant explained that in Brooks there is no indication that one processor and not the other would be a "completely partitioned" cable modem engine or data networking engine. *See id.* ("Because available connecting circuitry would be shared with the other processor, Applicant is uncertain how the asserted cable modem entire and home networking engine can be completely partitioned as claimed"). In other words, the Applicant was uncertain about how the Examiner was applying Brooks because there was no more of a reason to draw a box around the CMAC and processor 1 than there was to draw a box around the CMAC and processor 2, due to the specific layout of Brooks Figure 2.

112. In summary, Applicant's statements concerning Brooks focus on the point that there is no disclosure of ***partitioned*** engines (data networking and cable modem), with programmable processors. Everything from the file history that Dr. Almeroth focuses on simply reiterates this point in various ways. A POSITA would not understand the Applicant's statements

regarding Brooks to be a disclaimer of a data bus or other connection between the data networking engine and cable modem engine.

113. I also note an important point overlooked by Dr. Almeroth's position. The Applicant did not make any representations disclaiming a connection between the processors of a data networking engine and a cable modem engine because that connection in Brooks was not the subject of Applicant's statements.

114. The processors 102 and 104 of Brooks are connected directly, by a "system bus 108," in Figure 1, also known as "Advanced System Bus (ASB 210)" in Figure 2, highlighted below:

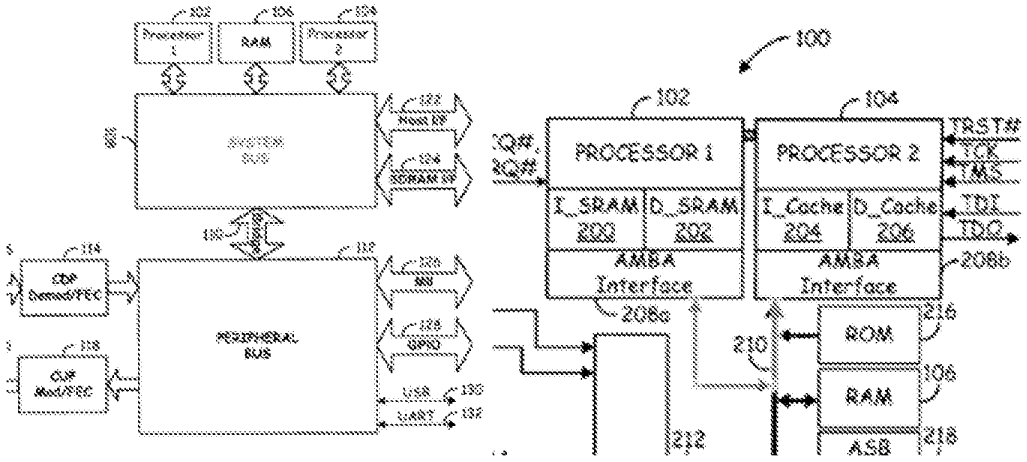


Exhibit C, FIGs. 1–2 (excerpt, annotated); *see also id.* at [0027] ("the first and second processors 102 and 104, are communicatively coupled to a system bus 108."), [0032] ("Advanced System Bus (ASB 210)"), [0034] ("The ASB210 is the bus on which the first and second processors 102 and 104, RAM memory 106, and other direct memory access (DMA) devices reside."). This connection was not referenced in the discussion with the Examiner that Dr. Almeroth relies upon.

115. What was referenced is a different connection. The Applicant pointed the Examiner to the connections between (1) each processor 102/104 and (2) a third component, *i.e.*, the CMAC

unit—***not*** the connection between processors 102 and 104 ***to each other***. Dr. Almeroth's annotation of Figure 2 illustrates the point. Dr. Almeroth highlights the shared connection between each of the two processors on the one hand, and the CMAC on the other (shown in yellow in Almeroth Decl. ¶ 62). But Dr. Almeroth does not highlight the direct connection between the processors—because that point is not the subject of the file history discussion.

116. To summarize, the issue of whether or not there can be a data path between the processor of a data networking engine and the processor of a cable modem engine was not at issue in the '775 Patent file history. A POSITA would not interpret Applicant's discussion of shared "connecting circuitry" or "data paths" as having been related to all "connecting circuitry" or "data paths," as Dr. Almeroth suggests, because clearly the Applicant and the Examiner knew that there was a connection between the processors.

117. Based on the above analysis, it is clear to me that the Applicant's statements regarding Brooks during the prosecution of the '775 Patent do not amount to any disavowal of claim scope, nor did the Applicant interpret the claims in any way that is inconsistent with the plain and ordinary meanings. Because Dr. Almeroth's opinion concerning indefiniteness relies on his misinterpretation of the prosecution history, it is my opinion that he has not shown any ambiguity in the claims scope.

118. A POSITA would be able to ascertain the scope of Claim 18 with reasonable certainty. A POSITA would understand that there is no ambiguity or conflict in having a "data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine" as claimed in Claim 18 of the '775 Patent.

VIII. '690 PATENT

A. Overview of the '690 Patent

119. The '690 Patent is titled "Receiver Determined Probe" and was filed on December 10, 2009, and issued on October 9, 2012. The '690 Patent claims priority to U.S. Provisional Application No. 61/122,687 dated December 15, 2008, and U.S. Provisional Application No. 61/179,454 filed on May 19, 2009. Accordingly, for my analysis herein, I have assumed the date of December 15, 2008 as the earliest possible priority date for the '690 Patent.

120. The '690 Patent is directed at aiding in the diagnosis of "*problems with subscriber services*." '690 Patent, 1:31–34 (emphasis added). The '690 Patent explains that there has been an "increase in the number of services and devices" offered through home networks which "increases the complexity of coordinating communication between the network nodes as each node may experience different access conditions along its portion of the network." *Id.* at 1:25–29. "This increase in complexity, further increases the likelihood that network problems may develop," and the content providers typically must "send[] a technician to the physical location of the home network to personally assess the network and diagnose the problem." *Id.* at 1:30–36. "[A]s the number of homes with subscriber services incorporated into their home networks increases, so does the amount of resources a service provider must devote to technical support and network maintenance." *Id.* at 36–40.

121. To help aid in the diagnosis of "problems with subscriber services" (*id.* at 1:31–34), the '690 Patent describes the use of probes to "characterize the communication channel over which data is to be sent between nodes in a network," including "various embodiments" in which "nodes on a network are programmed to generate a probe transmission in response to a request from the node that will be receiving the probe." *Id.* at Abstract, 1:41–43.

122. Exemplary "nodes" in a network are illustrated in Figure 1 of the '690 Patent, which I have annotated below. As shown below, these include nodes at the residence 101, as well as a Service Provider network node 112. *Id.* at FIG. 1, 4:10–24.

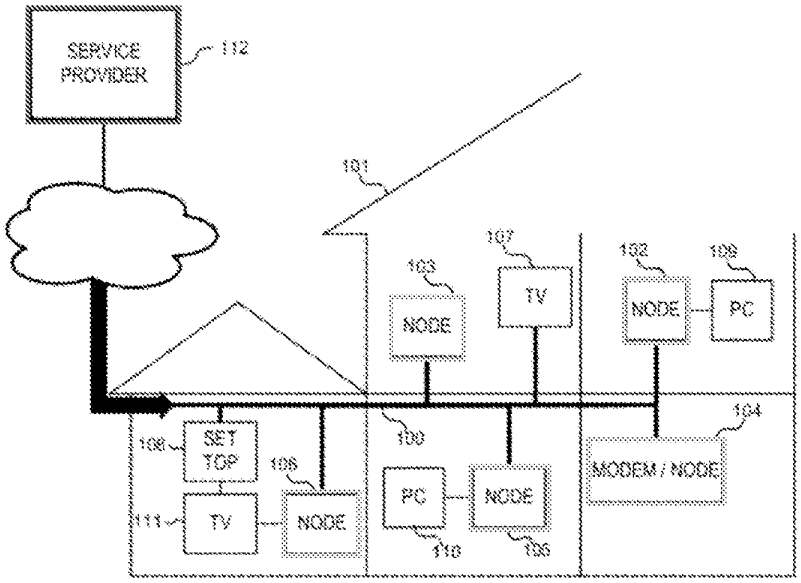


Fig. 1

'690 Patent, FIG. 1 (annotated).

123. According to various embodiments, nodes are "programmed to generate a probe transmission in response to a request from the nodes that will be receiving the probe." *Id.* at 1:66–2:3. The responsive "receiver determined probe" (also called simply a "probe") may comprise one or more of a plurality of parameters used for channel assessment, maintenance procedures, and/or off-site network diagnosis. *See id.* at 1:50–51, 4:25–27. *See also id.* at 2:20–27. An exemplary embodiment is shown in Figure 4, reproduced below.

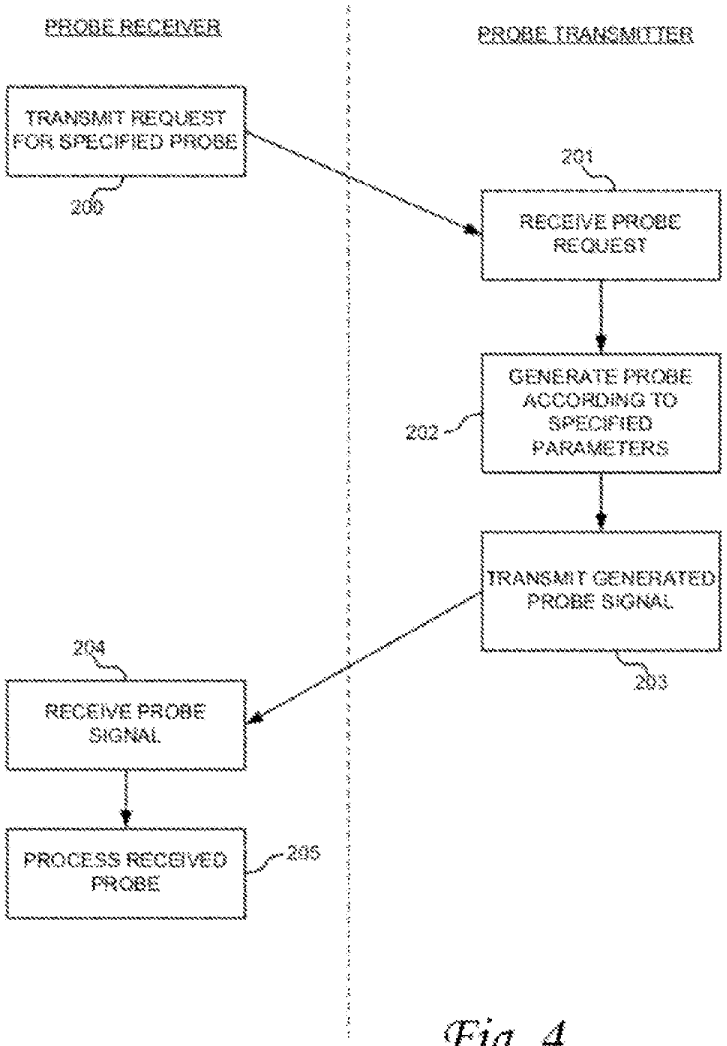


Fig. 4

'690 Patent, FIG. 4

124. The probe request may "specif[y] a plurality of parameters to be used . . . to generate a probe." *Id.* at 2:3–6. For example, in one embodiment, "at least one of the probe parameters indicates: a) a modulation profile for the probe; b) the payload content of the probe; c) the number of times to transmit the probe; d) the number of symbols for the payload of the probe; e) the preamble type for the probe; f) the cyclic-prefix length for the payload of the probe; g) the transmit power for the probe; and h) the transmit power scaling factor for the payload of the probe." *Id.* at

2:35–42. In addition, the probe request may specify a plurality of parameters that specify a form of the probe. *Id.* at 2:3–6.

B. Prosecution History of the '690 Patent

125. I have reviewed the prosecution history leading to the issuance of the '690 Patent. I note that Dr. Almeroth does not offer any summary or analysis of the '690 Patent's prosecution history in his Declaration.

126. Notably, during prosecution, the disputed terms discussed below and in Dr. Almeroth's declaration were understood by the Examiner and were not rejected as indefinite.

C. Disputed Terms of the '690 Patent

127. I understand that there is a dispute over one (1) claim term within Claim 1 and two (2) claim terms within Claim 9 of the '690 Patent. Below, I have reproduced Claims 1 and 9 of the in their entirety and have emphasized the terms that are in dispute.

1. A method comprising:

a) receiving in a first node, a probe request specifying a first plurality of parameters associated with the generation and transmission of a probe, wherein the first plurality of parameters at least specify content payload of the probe and a second node;

b) determining a second plurality of parameters associated with generation and transmission of the probe;

c) ***generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters***; and

d) transmitting the probe from the first node to the second node.

'690 Patent, Claim 1.

9. A method comprising:

a) a first node transmitting a probe request to a second node, the probe request specifying a first plurality of probe parameters for a physical layer probe, ***the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe***;

b) the first node receiving the probe from the second node, ***wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node***.

'690 Patent, Claim 9.

128. I understand Dr. Almeroth opines that the following terms in the '690 patent are indefinite:

- "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters" (Claim 1)
- "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" (Claim 9)
- "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe" (Claim 9)

Almeroth Decl. ¶ 30.

129. I disagree. As discussed further below, Dr. Almeroth misinterprets the plain and ordinary meaning of these phrases to manufacture an inconsistency that does not exist.

1. "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters" (Claim 1)

130. With respect to Claim 1, Dr. Almeroth opines that "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters" is indefinite because it is purportedly incompatible with the phrase "wherein the probe has a form dictated by the first plurality of parameters." *See* Almeroth Decl. ¶¶ 30, 83–84. This is because, according to Dr. Almeroth, "[b]y definition, the parameters define the form of a probe" and "[a] probe cannot be generated in accordance with 'the first plurality of parameters' and the 'second plurality of parameters,' but have its form dictated only by the 'first plurality of parameters' (as is

covered by the claim.)" Almeroth Decl. ¶ 30; *see also* ¶¶ 80–84. Dr. Almeroth's full statement from paragraph 30 is reproduced below:

> Claim 1 of the '690 Patent and its dependents are indefinite because "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters" is incompatible with "wherein the probe has a form dictated by the first plurality of parameters." By definition, the parameters define the form of a probe. A probe cannot be generated in accordance with the "first plurality of parameters" and the "second plurality of parameters," but have its form dictated only by the "first plurality of parameters" (as is covered by the claim.)

131. I disagree. Dr. Almeroth's reasoning is based on an incorrect interpretation of the claims. Dr. Almeroth manufactures a requirement that any and all "parameters" relating to the *generation* of the probe necessarily define the *form* of the probe. *See* Almeroth Decl. ¶ 30; *see also* ¶ 84 ("By definition, 'parameters' define the form of the probe that will be generated"). This is inconsistent with how a POSITA would read the specification and claims of the '690 Patent.

a. The claim language is clear on its face that not all parameters relate to the "form" of the probe

132. Beginning with the claims as a starting point, Claim 1 plainly recites that there is a first plurality of parameters and a second plurality of parameters "wherein the probe has a form dictated by the first plurality of parameters." Thus, the language of the claim on its face does not require ***all*** parameters to dictate the form of the probe.

133. A POSITA would understand that what the claim requires is that parameters are specified in the probe request, and at least one of these parameters (*i.e.*, the first plurality) dictates the form of the probe. A POSITA would understand that the other parameters (*i.e.*, the second plurality and any additional parameters) need not specify the form of the probe.

134. My findings are further supported by the claim language in Claim 9, wherein Claim 9 similarly recites a "first plurality of probe parameters" specified by the probe request and a "second plurality of parameters determined by the [node which generates the responsive probe]."

Only the first plurality of probe parameters is said to "compris[e] a form for the probe." *See* '690 Patent, Claim 9. A POSITA would therefore understand that the parameters "determined by the [node which generates the responsive probe]" need not comprise a form for the probe.

135. It should also be noted that both Claim 1 and Claim 9 make a distinction between parameters that are *specified* in the probe request (such as the first plurality) and parameters that are *determined* (the second plurality). In both cases, only parameters that are specified in the probe request are said to relate to the "form" for the probe.

b. The specification further confirms a POSITA's understanding that not all parameters relate to the "form" of the probe

136. The specification is consistent. For example, the specification recites:

> The receiving node may generate a probe request that specifies a plurality of parameters to be used in such a "receiver determined" probe to generate a probe having the "form" specified by these parameters.

'690 Patent, 2:3–6; *see also id.* at 2:17–19 ("the probe that is transmitted in response to the probe request will have a form dictated by the parameters specified in the probe request").

137. This confirms a POSITA's understanding of the plain claim language, that the probe request specifies parameters to be used in generating a probe, and the form of the probe is specified by at least one of these parameters (*i.e.*, the first plurality).

138. Furthermore, a POSITA would understand the point of the probe request is for a node to generate a probe containing responsive information—information which can be used, for example, for channel assessment, network maintenance procedures, or off-site network diagnosis. *See id.* at 1:48–52, 4:25–27. *See also id.* at 2:20–27. A POSITA would therefore understand the claimed "second plurality of parameters" could, for example, include such responsive information. This is made clear in Claim 9, which expressly recites "a second plurality of parameters *determined by the second node*." These second plurality of parameters may be the parameters that are, for

example, returned in the payload of the probe and which do not necessarily determine the "form" of the probe.

c. Dr. Almeroth fails to show support for his view that all parameters define the "form" of the probe

139. Dr. Almeroth asserts "[b]y definition, 'parameters' define the form of the probe that will be generated." Almeroth Decl. ¶ 84; *see also* ¶ 30. I disagree. The only support Dr. Almeroth cites for this conclusion is column 2, line 6, which reads in full context: "[t]he receiving node ***may*** generate a probe request that specifies a plurality of parameters to be used in such a 'receiver determined' probe to generate a probe having the 'form' specified by these parameters." '690 Patent, 2:3–6 (emphasis added).

140. Based on my review and understanding of the specification, there is nothing in the above-mentioned passage ('690 Patent 2:3–6), that a POSITA would understand as limiting the "form." The specification makes clear that "the receiving node ***may*** generate a probe request" wherein the responsive probe has a "'form' specified by" *e.g.*, according to the probe request's one or more parameters that "may" include a "form" parameter. For example, the phrase uses the term "may," which is permissive and indicates that an exemplary embodiment is being described. There is also no indication of the Applicant's express intent to define the term "form." The passage does not state that form "is" or "means" something. Furthermore, the passage refers only to "these parameters," as in the plurality of parameters specified in the probe request. The passage gives no indication that other parameters (such as those determined by the probe-generating node) must also specify the form of the probe. As such, nothing here is inconsistent with the plain language of Claims 1 and 9.

141. A POSITA would find no support for Dr. Almeroth's view that "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters" is incompatible with "the probe has a form dictated by the first plurality of parameters."

142. Based on the plain language of Claim 1, a POSITA could ascertain the scope of the claim with reasonable certainty. For example, a POSITA could ascertain, with reasonable certainty, whether a probe request specifies parameters, whether a probe is generated in accordance with those parameters, whether the probe is generated in accordance with a second plurality of parameters, and whether the probe has a form dictated by at least one of the parameters specified in the probe request.

143. For each of the reasons set forth above, it is my opinion that Dr. Almeroth has not shown that the scope of Claim 1 of the '690 Patent is not reasonably certain or is indefinite. *See also* ¶¶ 144–152, *infra*.

2. "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" (Claim 9) / "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe" (Claim 9)

144. According to Dr. Almeroth, Claim 9 is also indefinite for nearly the same reasons he opines that Claim 1 is indefinite. Dr. Almeroth's opinion, from paragraph 30 of his Declaration is reproduced below:

> Claim 9 of the '690 Patent and its dependents are indefinite because "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" is incompatible with "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe." By definition, the parameters define the form of a probe. A probe cannot be generated in accordance with the "first plurality of parameters" and the "second plurality of parameters," but have only the "first plurality of parameters" comprise its form (as is covered by the claim.)

145. I disagree. For the reasons discussed above, Dr. Almeroth is incorrect that "[b]y definition, the parameters define the form of a probe." *See e.g.*, ¶¶ 130–140, *supra*. A POSITA would not understand column 2, line 6 as defining or requiring all parameters to define the form of the probe. The language in that passage is permissive and exhibits no clear intent to define any term.

a. A POSITA would understand, in view of the intrinsic evidence, that not all parameters "compris[e] a form for the probe"

146. Further, the claim language makes clear that not all parameters must "compris[e] a form for the probe." Claim 9 recites "*the first plurality of probe parameters* comprising a form for the probe." A POSITA would understand the use of "comprising" to mean that other parameters can also be included in the "first plurality," in addition to the parameter(s) that specify a form for the probe. Dr. Almeroth's opinion improperly attempts to convert the open-ended "comprising" language to closed-ended "consisting of" language.

147. Dr. Almeroth also asserts that—because Claim 9 does not expressly recite the second plurality of parameters comprising a form for the probe—the claim (according to Dr. Almeroth) requires that *only* the first plurality of parameters determine the form. *See* Almeroth Decl. ¶ 84 ("the claims appear to cover the form of the probe being determined only by the parameters sent by the requesting node"). I disagree with his importation of the limitation "only." Claim 9 uses "comprising," indicating that the elements listed are necessary to satisfy the claim, but additional limitations can be added.

148. Thus a POSITA would not find it incompatible, based on the plain and ordinary meaning of the claim language, for a probe to be generated in accordance with the first and second plurality of parameters, wherein "the first plurality of probe parameters compris[es] a form for the probe."

149. In my opinion, a POSITA would be able to reasonably ascertain the scope of Claim 9 based on the plain and ordinary meaning of the claim language. For example, a POSITA would not have any difficulty ascertaining "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node." A POSITA would also not have any difficulty determining whether "the first plurality of probe parameters compris[es] a form for the probe including a modulation profile for the probe."

b. Among other things, Dr. Almeroth is incorrect that "both the requesting node and the transmitting node separately determine a 'plurality of parameters'" as if Claim 1 and Claim 9 are the same in this regard

150. I also note Dr. Almeroth asserts that Claims 1 and 9 require "both the requesting node and the transmitting node [to] separately ***determine*** a 'plurality of parameters associated with the generation' of the probe." Almeroth Decl. ¶ 83 (emphasis added). I disagree. Claim 1 recites a method comprising "determining a second plurality of parameters associated with the generation and transmission of the probe" not Claim 9. Further, Claim 1 does not specify which node determines these parameters.

151. In addition, the claims do not require the requesting node (*i.e.*, the node that transmits the probe request) to ***determine*** a plurality of parameters. Rather, Claims 1 and 9 both recite that the probe request ***specifies*** a plurality of parameters. Thus, Dr. Almeroth is simply incorrect about what the claims require.

152. Dr. Almeroth also asserts that the Claims 1 and 9 are somehow "unlike the disclosure." Almeroth Dec. ¶ 83. I disagree. This appears to be more akin to Dr. Almeroth providing an opinion related to the written description versus opining that a POSITA would not understand the claim terms with reasonable certainty. Regardless, as explained above, Dr.

Almeroth incorrectly interprets the claims, rendering his conclusion that the claims are unlike the disclosure also incorrect.

153. For each of the reasons set forth above, it is my opinion that Dr. Almeroth has not shown that the scope of Claim 9 of the '690 Patent is not reasonably certain or is indefinite.

IX. '682 PATENT

A. Overview of the '682 Patent

154. The '682 Patent is titled "Method And System For Service Group Management In a Cable Network" and was filed on January 9, 2018, and was issued on November 20, 2018. The '682 Patent claims priority to U.S. Application No. 15/434,673, filed on February 16, 2017 (now U.S. Patent No. 9,866,438), U.S. Application No. 15/228,703, filed on August 4, 2016 (now U.S. Patent No. 9,577,886), U.S. Application No. 13/948,444, filed on July 23, 2013 (now U.S. Patent No. 9,419,858), and U.S. Provisional Application No. 61/674,742, filed on July 23, 2012. Accordingly, for my analysis herein, I have assumed the date of July 23, 2012 as the earliest possible priority date for the '682 Patent.

155. The '682 Patent describes and claims a method and system for a "cable modem termination system (CMTS) [to] determine, for a plurality of cable modems served by the CMTS, a corresponding plurality of SNR-related metrics." '682 Patent, Abstract. The specification describes how the CMTS may assign cable modems ("CMs") into service groups based on the SNR-related metrics, where SNR means signal-to-noise ratio. In general, SNR is a ratio measurement of the (level of) signal to the (level of) noise with respect to the signal between the CMTS and CM. An exemplary system showing a CMTS and CMs is shown below in Figure 4A:

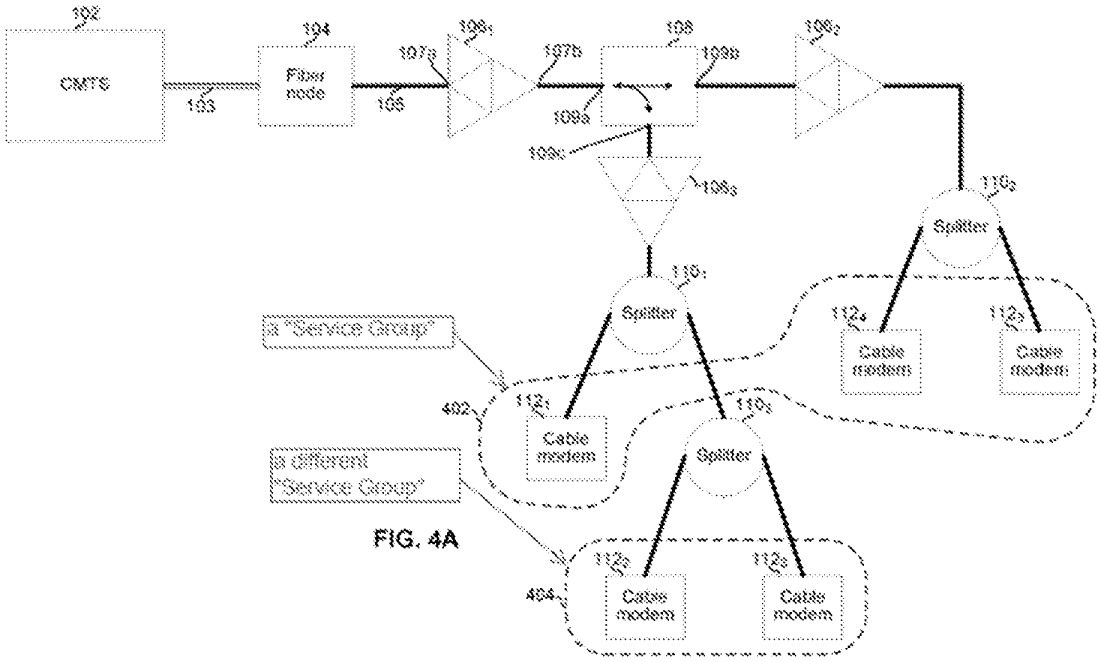


FIG. 4A

'682 Patent, FIG. 4A (annotated); *see also* 6:42–7:22, FIG. 4B.

156. Accordingly, the '682 Patent discloses that the CMTS builds a composite view of the various cable modems' SNR-related levels (*e.g.*, worst case SNR levels), wherein the '682 Patent calls these various SNR-related levels "SNR profiles." *Id.* at 3:53–58 ("SNR at a particular frequency or SNR over a range of frequencies (an SNR profile).").

157. The specification of the '682 Patent, as an example, describes that a plurality of CMs that share similar SNR-related metrics within a "service group" are said to have a "composite [worst-case] SNR profile for a [particular] service group." *Id.* at 4:14–17, 5:7–12.

B. Prosecution History of the '682 Patent

158. I have reviewed the prosecution history leading to the issuance of the '682 Patent. I note that Dr. Almeroth does not offer any summary or analysis of the '682 Patent's prosecution history in his Declaration.

159. Notably, during prosecution, the disputed terms discussed below and in Dr. Almeroth's declaration were understood by the Examiner and were not rejected as indefinite.

Furthermore, during prosecution, the Examiner not only understood the disputed terms and did not reject them as indefinite, but specifically cited to one of the disputed term as one of the reasons that this claim was allowable over prior art. *See* Exhibit D, 04/03/2018 Non-Final Rejection, 24–27 (ENTROPIC_CHARTER_0005329–0005332).

C. Disputed Terms of the '682 Patent

160. I understand that there is a dispute over two (2) claim terms within Claim 1 of the '682 Patent. Below I have reproduced Claim 1 in its entirety, and have emphasized the terms that are in dispute.

> 1. A method comprising:
>
> determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
>
> assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;
>
> generating, by said CMTS for each one of said plurality of service groups, ***a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups***;
>
> selecting, by said CMTS, one or more physical layer communication parameter to be used for ***communicating with said one of said plurality of service groups*** based on said composite SNR-related metric; and
>
> communicating, by said CMTS, with one or more cable modems ***corresponding to said one of said plurality of service groups*** using said selected one or more physical layer communication parameter.

'682 Patent, Claim 1.

1. "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics"

161. I understand that Charter asserts that the term "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" is indefinite because there is no way to determine what "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" means and has provided the expert opinion

of Dr. Almeroth in support of its position. I disagree and set forth my rebuttal herein. As discussed further below, it is my opinion that Dr. Almeroth has not identified any ambiguities or lack of reasonable certainty in the claims when considered in light of the intrinsic record.

a. I disagree that "worst case" and "composite worst case SNR" are the "same thing" in the context of Claim 1 or are otherwise indefinite

162. Dr. Almeroth begins by explaining his understanding of the disclosure of the '682 Patent. *See* Almeroth Decl. ¶¶ 85–91. He contends that the "composite worst-case SNR profile" for a service group is "the worst case SNR for [each] subcarrier among the CMs in that particular service group." *See* Almeroth Decl. ¶ 89 (quoting '682 Patent, 5:42–46).

163. Dr. Almeroth then provides an example of how he understands the "composite worst-case SNR profile" to be determined: "if there are 5 cable modems (CM[A] - CM[E]) in a hypothetical service group, the 'composite worst-case SNR profile' for that service group reflects the worst SNR of all the cable modems in the service group for each subcarrier . . . In this example, CM[A] has the worst SNR at subcarriers 2, 5 and 7, CM[B] has the worst SNR at subcarrier 1, CM[C] has the worst SNR at subcarrier 6, CM[D] has the worst SNR at subcarriers 3 and 8, and CM[E] has the worst SNR at subcarrier 4." Almeroth Decl. ¶ 90. Dr. Almeroth annotates Figure 2B to support his example:

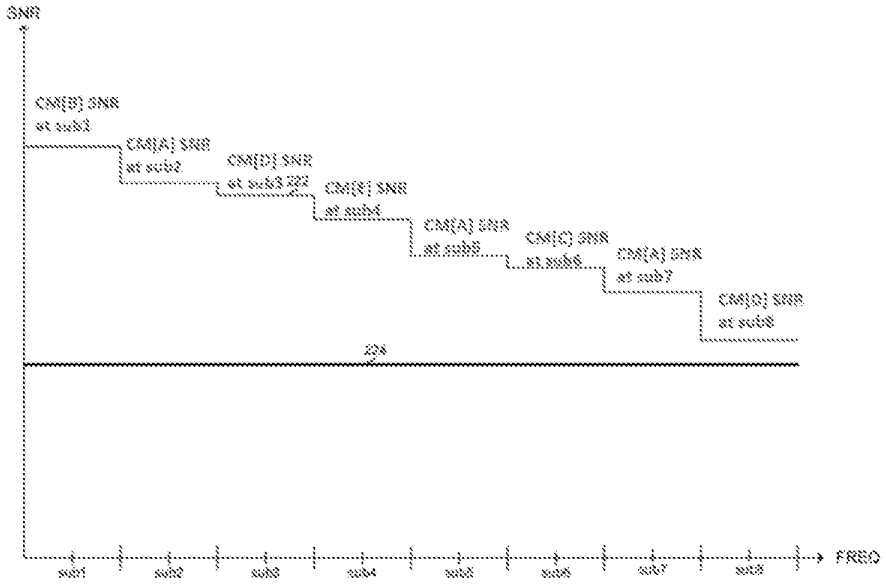


FIG. 2B

Almeroth Decl. ¶ 90.

164. Dr. Almeroth's example and annotations of Figure 2B misrepresent what the specification says about what is being described in Figure 2B. Specifically, Dr. Almeroth appears to be arguing that the steps each relate to a single CM's worst SNR, and that those worst SNRs are used to determine the "composite worst-case SNR profile." Almeroth Decl. ¶ 90.

165. However, the specification makes clear that "line 222 in FIG. 2B represents ***a composite*** worst-case SNR profile for one or more CM(s) in the HFC network to which the message 202 is destined." '682 Patent, 4:9–12 (emphasis added). The specification further explains that while the CMs report their SNR readings, only the CMTS can build a composite view of all reporting CMs based on the collective CM readings. *Id.* at 4:40–56. From that information, the CMTS assigns CMs into service groups. *Id.*

166. The specification further explains, that the exemplary profile line 222, is based on a "minimum desired headroom" "228" needed to reliably have a robust enough signal to overcome

the noise, the CMTS accordingly selects corresponding "physical layer [communication] parameters" to ensure reliable communications with each CM within a service group. '682 Patent, 5:13–20. A POSITA would understand that this means that the exemplary line 222 in Figures 2B and 2C shows the ceiling that the CMTS must transmit at for all CMs in the entire service group to reliably communicate. Below I reproduce Figure 2C of the '682 Patent for further clarification:

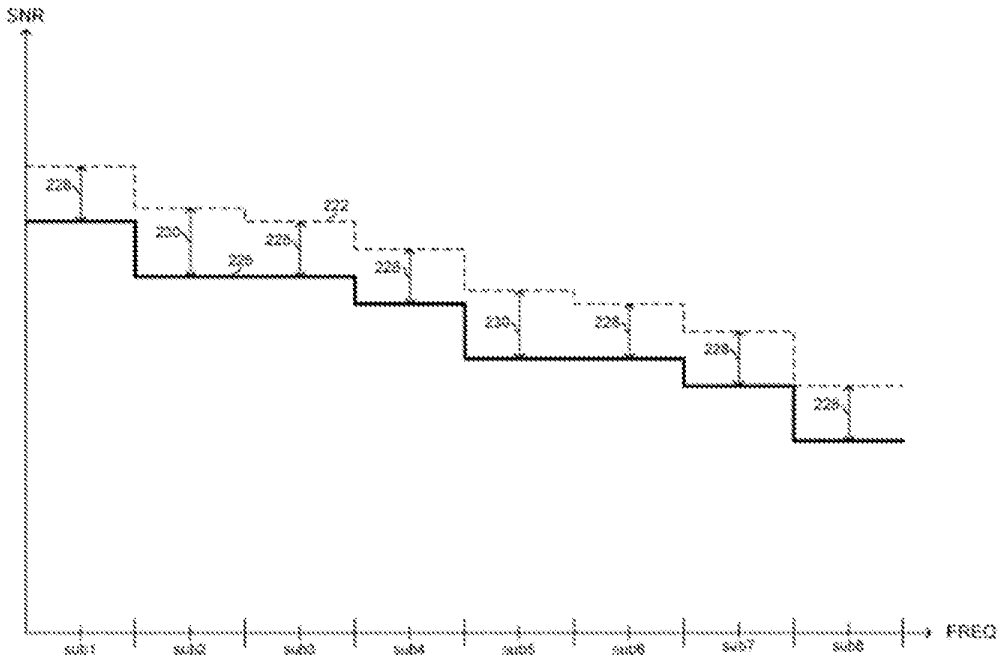


FIG. 2C

167. The rest of Dr. Almeroth's opinion focuses on how "composite worst-case SNR profile" does not have a plain and ordinary meaning. He concludes that"[t]here is no way to know how the 'composite SNR-related metric' can be 'based *at least in part on*' the 'worst-case SNR profile' since the two refer to the same thing." *See* Almeroth Decl. ¶ 96 (emphasis in original).

168. Dr. Almeroth's opinion mischaracterizes the difference between a "composite SNR-related metric" and a "worst-case SNR profile." The specification describes the "composite SNR-related metric" and "a worst-case SNR profile" as different things. While the specification describes how "worst-case SNR profile" must be a profile that in some way takes into account the

worst-case SNR of a cable modem or a service group, a "composite SNR-related metric" need not inherently involve worst-case SNR. '682 Patent, 4:3–20, 4:43–5:6, 5:7–20.

169. The '682 Patent discusses the *composite SNR-related metric* as being a composite of metrics in the context of worst-case SNR because that is part of the disclosed invention: in one embodiment, using the worst-case SNR in this way could allow for more efficient utilization of an HFC network to improve its overall data throughput and better overall data throughput for the cable modems in that network. '682 Patent, 5:40–57; *see also id.* at 4:25–28. Accordingly, the *composite SNR-related metric* could also include the ***best-case*** SNR, an ***average*** SNR, or some other SNR-related metric entirely. Claim 1 of the '682 Patent discloses and the specification teaches that a *composite SNR-related metric* need only be based "at least in part on a worst-case SNR profile." '682 Patent Claim 1, 4:25–28, 5:42–46. The *composite SNR-related metric* could also be based in part on other SNR profiles or SNR-related metrics. *Id.*

b. I disagree with Dr. Almeroth's opinion that "worst case" SNR is unintelligible or always 0 in the context of Claim 1

170. Dr. Almeroth similarly misconstrues what "worst-case" means. *See* Almeroth Decl. ¶ 94. Dr. Almeroth contends, without any explanation, that the "worst case" SNR will always be an SNR of 0, and thus a "worst-case SNR profile" would contain only 0s and consequently be unintelligible. His position seems to be that because an SNR profile of only 0s is nonsensical, a "worst-case SNR profile" must actually be referring to a "composite worst-case SNR profile." Almeroth Decl. ¶ 94. Dr. Almeroth's position would require one to assume (erroneously so) that SNR is a static value unrelated to data throughput. Even so, neither the '682 Patent specification nor the claims requires that a "worst case" SNR always be zero.

171. Taken together, Dr. Almeroth's mischaracterization of the individual terms making up the claim term "a composite SNR-related metric based at least in part on a worst-case SNR

profile of said SNR-related metrics" is an attempt to create ambiguity and indefiniteness where there is none.

172. Thus, it is my opinion that there is no ambiguity regarding how to determine "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics." The specification clearly teaches that the purpose of the composite SNR is to group modems, at least in part, by composite SNR performance such that one modem with a lower performance does not reduce the potential throughput of every modem in a group. As discussed above, a POSITA would understand that the intrinsic record supports the plain and ordinary meaning such that a *composite SNR-related metric* need only be based at least in part on *a worst-case SNR profile*.

2. "[communicating with/corresponding to] said one of said plurality of service groups"

a. Among other things, Dr. Ameroth is wrong that there is no antecedent basis

173. I understand that Charter asserts that the term "[communicating with/corresponding to] said one of said plurality of service groups" is indefinite because there is no identified or antecedent "one of said plurality of service groups" to which "said one of said plurality of service groups" refers and has provided the expert opinion of Dr. Almeroth in support of its position. I disagree and set forth my rebuttal herein.

174. Dr. Almeroth's opinion misses the clear antecedent basis in Claim 1

175. In my opinion, the claim term(s) "[communicating with/corresponding to] said one of said plurality of service groups" should be construed according to its plain and ordinary meaning because 1) Dr. Almeroth's fails to identify the antecedent clearly listed in the prior element of Claim 1, and 2) the meaning of the words as they are read in the content of the full claim are abundantly clear. Dr. Almeroth appears to only write a single paragraph of merely three sentences

and two citations for the proposition that this claim term is indefinite. *See* Almeroth Decl. ¶ 97. Dr. Almeroth's ultimate opinion as to this claim term is that "[t]here is no antecedent in the claim for 'said one of said plurality of service groups,' and there is no way to know which service group among the 'plurality of service groups' is being referred to." *Id.*

176. However, the antecedent basis is clearly contained in the prior claim element. I have emphasized the relevant portions of the claim here to demonstrate that Dr. Almeroth ignores that there are two steps of antecedent basis that the elements rely on:

> 1. A method comprising:
>
> determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
>
> assigning, by said CMTS, each cable modem among a **plurality of service groups** based on a respective corresponding SNR-related metric;
>
> generating, by said CMTS for each one of said **plurality of service groups**, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics *corresponding to said* one of said plurality of service groups;
>
> selecting, by said CMTS, one or more physical layer communication parameter to be used for *communicating with said* one of said plurality of service groups based on said composite SNR-related metric; and
>
> communicating, by said CMTS, with one or more cable modems *corresponding to said* one of said plurality of service groups using said selected one or more physical layer communication parameter.

'682 Patent, Claim 1 (emphasis added).

177. When the claim language is viewed in total, it is clear that there is not only an antecedent basis, but that a POSITA would be able to follow each element of Claim 1 and understand the invention. The specification identifies that an advantageous embodiment would be to perform Claim 1 for as many service groups in the plurality of service groups as preferred in order to achieve superior cable modem performance in the network. '682 Patent, Abstract, 5:40–57.

178. A POSITA would further understand that a composite SNR-related metric generated for service group A, for example, would be the same composite SNR-related metric and same service group in the selecting and communicating elements of Claim 1. Nonetheless, the claimed invention only ***requires*** communicating with a single service group of the plurality of service groups in the selecting and communicating elements of Claim 1. As such, Dr. Almeroth's assertion that one cannot determine which service group is being referred to does not create any indefiniteness, and the claim term should be construed according to its plain and ordinary meaning.

179. For each of the reasons set forth above, it is my opinion that Dr. Almeroth has not shown that the scope of Claim 1 of the '682 Patent is not reasonably certain or is indefinite.

X. ADDITIONAL REMARKS

180. I currently hold the opinions expressed in this Declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations. Additionally, it is my understanding that discovery is ongoing in this matter. I reserve the right to rely on additional discovery that occurs after this Declaration is submitted. To the extent that additional information becomes available relevant to the opinions expressed in this Declaration, I will update my opinions as appropriate.

181. I also reserve the right to respond to any additional arguments or opinions raised by Charter or Charter's expert(s). I further reserve the right to respond to any new positions raised by Charter or respond to any further expert declaration provided by Charter regarding claim construction issues.

I hereby declare that all statements made are of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this proceeding.

Dated: April 14, 2023

By: Richard A. Kramer Ph.D.
Richard A. Kramer Ph.D.
Salem, Oregon

EXHIBIT A

RICHARD A. KRAMER, PH.D.
Phone: (541) 602-2271
email: Richard.Kramer@SISDevelopment.com

EXECUTIVE SUMMARY

Industry technical expert with 30+ years of solid industry experience as a top-technology leader combined with academic excellence. Top-technology leader in the introduction of new technologies in the areas of: video, video compression/encoding, multimedia, streaming media, network communications, wireless communications, wireless networks, artificial intelligence, machine learning, cryptography, encryption, authentication, digital rights, physical security (video surveillance, cameras, digital video recorders, burglar alarm systems, intelligent locks, monitoring software), Internet / web-based client-server /cloud architectures, advanced software, and data security.

PROFESSIONAL EXPERIENCE

SIS DEVELOPMENT INC. — 2006-PRESENT

President

- Leader of SIS Development, Inc. ("SIS") / Security Industry Services Inc. SIS is an engineering and technical services company that serves leading product and software companies.
- Called upon and served as a technical expert for numerous reputable companies/organizations including Sony, Apple, Netflix, Canon, FLIR Systems, ASUS Computer, American Express, US-Department of Justice, and the like.
- Formed a formidable team of leaders, core competency, and technical resources domestically and internationally. Formed strategic partnerships to form a profitable "win-win".

GENERAL ELECTRIC, GE-SECURITY — 2003 - 2007

General Manager – Technology / Vice President, Engineering

Leader of progressive 300+ person technology and engineering organization: 16 organizations in 11 geographically dispersed locations. Responsible for technology development for $500M+/year in products worldwide for General Electric's Video Systems Group (VSG) and other advanced Enterprise/Commercial/Residential solutions: video surveillance (IP network video products and software, DVRs, cameras), burglar alarm systems (ITI, CADDX and other lines), burglar alarm monitoring software (MAS), and life-safety markets (access control systems, real-estate mobile keys, smoke detectors, etc.).

- Execution and Innovation - Developed leading-edge new customer solutions, successfully launching 20+ major new products/platforms per year, resulting in double-digit organic market growth.
- Held leading industry market share (90 %+) position in key vertical and unique markets with technically innovative products and software in a wide variety of security applications.

- Strategy Leader of GE FY2005 "Session 2" strategy creation and multiple technical M&A due-diligence teams for numerous acquisition targets. Leader of negotiations: closed numerous key strategic partnerships/agreements. 2005 OM (Operating Margin) +50% above plan.
- High-Performance - Advanced with increasing levels of responsibilities from $120M to $500M+ in revenue/year accountability; rated as "Top-20%" talent and nominate/attended executive leadership training at GE's legendary Jack Welch Executive Training Center.

GM/VP/C-LEVEL ROLES, NEW VENTURES, AND DIVESTITURES 1998-2003

VP Engineering /GM/Officer for start-ups and corporate sponsored diversification ventures

- Ivex Corporation – Launched/Pioneered first IP network video surveillance solution for the security industry (partnered with Loronix, now Verint): Developed an online video monitoring software service and the revolutionary IP network video appliance. Successfully acquired by a public entity. Stock went from $3.60 to $8.60 within 30 days.
- Home Wireless Networks - Built team/leader of R&D for world's first combined voice plus data wireless home gateway. Products "Bell" approved. Launched under BellSouth and MCI brands. Launched first low-cost 802.11 access point by Telenor in Europe. Acquired.
- Miraxis; parent EMS TECHNOLOGIES, $309M (Acquired by Honeywell); corporate technology diversification new business based on new network and wireless Ka-band combined 2-way wireless WAN/Internet/video connectivity and DTH/DBS video distribution satellite technology.

SCIENTIFIC-ATLANTA, BROADBAND COMMUNICATIONS DIVISION ($2.5B) 1995 – 1998

(Acquired by CISCO SYSTEMS)

Project Director, Advanced Video Systems (AVS) 1997-1998
Engineering Manager, Home Communications Terminals 1996-1997
Engineering Manager, 8600x 1995-1996

Led director-level cross-functional team developing next generation interactive TV (iTV) 2-way video cable set-top boxes to replace $400M/year Advanced Video Systems (AVS) broadband products. Built engineering department and provided daily direction to multi-disciplined engineering department responsible for S-A's highest revenue earning product, the 8600x cable set-top. Direct engineering management responsibility for AVS high-volume domestic set-tops, remote controls and third-party partnerships.

- Engineering manager for consumer iTV video products – the company's highest revenue-earning product lines ($200M/year) with volumes over 1M+/year (8600x, 8600, etc.).
- Reversed 10-year legacy of re-branding Panasonic set-tops by successfully building new engineering organization and launching the company's first successful

internally designed high-volume, low-cost product. Volumes reached 80K/month. Reduced COGS (Cost of Goods Sold) by 40%, from $154 to $78.

- Spearheaded the launch of the company's first high-volume product to be built in a new company owned factory in Mexico. Proactively developed processes and infrastructure.
- Led the introduction of new development processes and successfully completed business plans, product definitions, ROI (Return on Investment) analysis, forecasts, and resource plans for next-generation set-top products to replace the existing $400M/year broadband AVS products.
- Managed daily design engineering activities and contract manufacturing support with international third-party partners: Panasonic, WKK and others.

SCHLUMBERGER INDUSTRIES, EMNA ($14B, NYSE: SLB) **1987 – 1995**
(Acquired by ITRON)

Engineering Manager, Residential and Commercial Metering **1994-1995**
Hardware Manager, Recorders, and Translation Systems **1990-1994**
Senior Electronic Design Engineer **1989-1990**
Electronic Design Engineer **1987-1989**

Engineering manager for Schlumberger's Electricity Management, North America (EMNA) division. Managed supervisors, multi-disciplined developers and Quality Assurance/Software Quality Assurance personnel developing high-volume electronic communication products, meter reading, modems and power monitoring equipment used by the electric utility industry to monitor and control power on the power grid.

- Designed working ASIC (Application Specific Integrated Circuit) on first pass. Granted two patents.
- As a hands-on developer, primary designer for division's top two highest priced products (Gross Margin: 55%, Average Sales Price: $2,000).
- Managed R&D organization for residential and commercial product lines, obtaining over $60M/year in revenue with product line volumes ranging from 10Ks/year to 100Ks/year.
- Promoted, dynamically improved, and launched division's highest revenue product (the "Vectron") after a two-year delay within another R&D organization.
- As hardware manager, launched new product lines that spawned new services business.
- Annually selected to participate in the "Best Program" for high potential managers.

BABCOCK & WILCOX, NUCLEAR POWER DIVISION **1984 - 1987**
Electronic Design Engineer / Sr. Electronics Design Engineer

As part of the "Special Products and Integrated Field Services" team, I was a designer and developer of electronic inspection systems and robotic repair systems for nuclear power plant components inside the nuclear containment building.

- Provided system, circuit and software design for advanced video/CCTV, ultrasound, and other imaging solutions to inspect radioactive components inside the nuclear containment building.
- Board level designer of electronic hardware using a multitude of CPU/MPUs, high-speed communication interfaces, control circuits, and complex test/measurement ADC circuits.
- Software programmer using high-level software programming languages and assembly code firmware for robotic/automation repair and inspection equipment.

EDUCATION

Ph.D. in Electrical and Computer Engineering, GPA: 4.0 **2022**

Oregon State University Corvallis, Oregon

Research areas and interests include: video, video streaming technologies, video compression (encoding / decoding), optimization of video streaming content transmission, network coding, wireless communications, artificial intelligence / machine learning / reinforcement learning (including algorithms, classifiers, prediction, video analytics), security (including cryptography, encryption, data security, physical security).

Dissertation: "Machine Learning Bandwidth Optimization of Interactive Live Free-Viewpoint Multiview Video for Sporting Events," Oregon State University.

Graduated Top of Class (4.0 GPA)

Master of Science in Electrical and Computer Engineering, GPA: 4.0 **2017**

Oregon State University Corvallis, Oregon

Research areas and interests include video, video compression (encoding/decoding), optimization of video streaming content transport, network coding, video streaming, wireless communications, cryptography, encryption, and data security.

Thesis: "Optimization of Interactive Live Free Viewpoint Multiview Video Streaming Bandwidth," Oregon State University.

Graduated Top of Class (4.0 GPA)

Bachelor of Science in Electrical Engineering, Magna cum laude **1984**

The University of Toledo Toledo, Ohio

Member Tau Beta Pi Engineering Honor Society

Executive MBA, 12 Credit Hours **Attended 2003**

Emory University, Goizueta Business School Atlanta, Georgia

The executive business program was ranked in the top 10 globally by Business Week and The Financial Times.

CERTIFICATIONS, AFFILIATIONS & OTHER TRAINING

Proficient trained software/source code programmer using the following software languages/systems: MATLAB, Object Oriented, C, C++, Java, FORTRAN, MIRCL ("Multiprecision Integer and Rational Arithmetic C/C++ Library" which is a software library used for developing encryption and authentication algorithms), and numerous assembly languages for both RISC (Reduced Instruction Set Computer) and CISC (Complex Instruction Set Computer) processors.

Member, IEEE (Institute of Electrical and Electronic Engineers).

Member Phi Kappa Phi Honor Society – Lifetime Member

Java 2, Sun Certified Programmer.

GE Six Sigma, Black Belt Training Certified.

Additional post-graduate studies and/or certificates: DSP (Digital Signal Processing) and computer architecture, finance, project management, leadership training.

PATENTS

U.S. Patent No. 5,701,253 - Isolated Current Shunt Transducer; December 23, 1997.

U.S. Patent No. 5,422,939 - Parallel Off-Hook Detection for Both Line Available and Phone Pick-up Detection, June 6, 1995.

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1. Richard A. Kramer, Dissertation: "Machine Learning Bandwidth Optimization of Interactive Live Free-Viewpoint Multiview Video for Sporting Events," Oregon State University, May 17, 2022 (presented, June 15, 2022).

2. Richard A. Kramer, Thinh Nguyen, "Optimization of Interactive Live Free Viewpoint Multiview Video Streaming Bandwidth", Proceedings of SAI Intelligent Systems

Conference, IntelliSys 2018: Intelligent Systems and Applications pp. 641-657 (presented, September 6, 2018, London, UK).

3. Richard A. Kramer, Jin Phoy Rhee, "The Need, Advances and Challenges Related to Wireless Body Area Network Communications Technology", Oregon State University, June 6, 2017 (presented, June 8, 2017).

4. Richard A. Kramer, Aashutosh Y. Taikar, Warit Paweenbampen, Haya Alorayj, Surabhi Tushar Godambe, "The Challenges and Advances in Mixed Reality Video Technology", Oregon State University, June 7, 2017 (presented, June 7, 2017).

5. Michael Foster, Richard Kramer, "A Low-Power, Low-Noise, High-Gain Differential Operational Amplifier", June 8, 2017

6. Richard A. Kramer, Thesis: "Optimization of Interactive Live Free Viewpoint Multiview Video Streaming Bandwidth", Oregon State University, April 10, 2017 (presented April 10, 2017).

7. Richard A. Kramer, Mathias Elmlinger, Abhishek Ramamurthy, Siva Pranav Kumar Timmireddy, "A Comprehensive Review of the Challenges and Opportunities Confronting Cache Memory System Performance", Oregon State University, March 13, 2017 (presented March 16, 2017).

8. Richard A. Kramer, Presentation/Lecture: "ESIGN and Other RSA Alternative Signature Schemes", Oregon State University, February 8, 2017.

9. Richard A. Kramer, ESIGN, ECDSA, ED25519 Cryptographic Signature Software Code, January 16, 2017.

10. Richard A. Kramer, "A Survey of ESIGN: State of the Art and Proof of Security" (re-issue with full implementation, performance testing and data analysis), Oregon State University, January 16, 2017.

11. Richard A. Kramer, "The Insecurity of Libcrypts's PRG", Oregon State University, February 9, 2017.

12. Richard A. Kramer, "A Survey of ESIGN: State of the Art and Proof of Security", Oregon State University, November 7, 2016.

13. Richard A. Kramer, Presentation/Lecture: "Secure Audit Logging Systems with Privacy Preservation", Oregon State University, October 25, 2016.

14. Richard A. Kramer, "Efficient Multimedia Distribution in Source Constraint Networks", Oregon State University, November 3, 2015.

15. Richard A. Kramer, "An Analysis of Dynamic Flow Scheduling for Data Center Networks", Oregon State University, August 27, 2015.

Exhibit 7 (Corrected)

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ENTROPIC COMMUNICATIONS, LLC, Plaintiff, v. CHARTER COMMUNICATIONS, INC., Defendant.	Civil Action No. 2:22-cv-00125-JRG

REBUTTAL EXPERT DECLARATION OF RICHARD A. KRAMER PH.D.
REGARDING CLAIM CONSTRUCTION

TABLE OF CONTENTS

Page

I. Introduction 1
II. Qualifications 3
III. Compensation 10
IV. Materials Considered 10
V. Legal Standards 11
VI. Level of Skill in the Art 13
VII. '775 Patent 15
A. Overview of the '775 Patent 15
B. Summary of The '775 Patent File History 17
C. Disputed Terms of the '775 Patent 28
1. "a data networking engine implemented in a first circuit . . ." and "a cable modem engine implemented in a second circuit . . ." (Claim 18) 29
a. Among other things, Dr. Almeroth's opinions assume a POSITA would ignore "circuit" as used in the plain claim language 29
2. "DOCSIS MAC processor" / "DOCSIS controller" (Claim 18) 32
a. A POSITA would understand the meaning of "DOCSIS MAC processor" and "DOCSIS controller" 32
b. Dr. Almeroth misconstrues "DOCSIS MAC processor" and "DOCSIS controller" by requiring them to be implemented on separate, specific physical processors 33
3. "data bus" (Claim 18) 36
VIII. '690 Patent 43
A. Overview of the '690 Patent 43
B. Prosecution History of the '690 Patent 46
C. Disputed Terms of the '690 Patent 46
1. "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters" (Claim 1) 47
a. The claim language is clear on its face that not all parameters relate to the "form" of the probe 48
b. The specification further confirms a POSITA's understanding that not all parameters relate to the "form" of the probe 49
c. Dr. Almeroth fails to show support for his view that all parameters define the "form" of the probe 50

2. "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" (Claim 9) / "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe" (Claim 9) 51

a. A POSITA would understand, in view of the intrinsic evidence, that not all parameters "compris[e] a form for the probe" 52

b. Among other things, Dr. Almeroth is incorrect that "both the requesting node and the transmitting node separately determine a 'plurality of parameters'" as if Claim 1 and Claim 9 are the same in this regard 53

IX. '682 Patent 54

A. Overview of the '682 Patent 54

B. Prosecution History of the '682 Patent 55

C. Disputed Terms of the '682 Patent 56

1. "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" 56

a. I disagree that "worst case" and "composite worst case SNR" are the "same thing" in the context of Claim 1 or are otherwise indefinite 57

b. I disagree with Dr. Almeroth's opinion that "worst case" SNR is unintelligible or always 0 in the context of Claim 1 60

2. "[communicating with/corresponding to] said one of said plurality of service groups" 61

a. Among other things, Dr. Ameroth is wrong that there is no antecedent basis 61

X. Additional Remarks 63

I, Richard A. Kramer, declare as follows:

I. INTRODUCTION

1. I am over the age of 18 and am competent to make this Rebuttal Declaration ("Declaration"). I have personal knowledge, or have developed knowledge of these technologies based upon education, training, or experience, of the matters set forth herein. If called upon to do so, I would testify competently thereto.

2. I have been retained by counsel for Entropic Communications, LLC ("Entropic") in the above-captioned action as an independent consultant to offer opinions regarding how a person of ordinary skill in the art would understand certain claim terms in U.S. U.S. Patent No. 8,223,775 (the "'775 Patent"); U.S. Patent No. 8,284,690 (the "'690 Patent"); and U.S. Patent No. 10,135,682 (the "'682 Patent"), (collectively, the "Patents at Issue"). Specifically, I am submitting this Declaration to address the meaning and construction of certain disputed terms in response to the Expert Declaration of Dr. Kevin Almeroth Regarding Claim Construction. For the purposes of this Declaration, I have not been asked to opine on the meaning of any other disputed terms not addressed below.

3. In forming my opinions, I understand that the claims should be interpreted as they would be understood by a person of ordinary skill in the art ("POSITA") of the patent at the time its application was filed. I understand that the claims are to be construed with reference to the patent's specification, the claims, and the prosecution history, in light of the plain meaning of the terms used in the claims, and with reference to other sources of information, such as dictionaries, textbooks, and literature or other patents in the same or related fields.

4. My opinions are based on my years of education, research and experience, as well as my investigation and study of relevant materials, including those identified in this Declaration.

5. I may rely upon these materials, my knowledge and experience, and/or additional materials in forming any necessary opinions. Further, I may also consider additional documents and information to rebut arguments raised by the Defendants. I reserve any right that I may have to supplement this Declaration if further information becomes available or if I am asked to consider additional information. Furthermore, I reserve any right that I may have to consider and comment on any additional expert statements or testimony of Defendant's expert(s) in this matter.

6. My analysis of the materials produced in this investigation is ongoing and I will continue to review any new material as it is provided. This Declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

7. If requested, I am prepared to explain at a technology tutorial or claim construction hearing the technology disclosed in the Patents at Issue, including the state of the art around the filing dates of this patent. This may include, among other things, background information on communication systems, broadband communications systems / cable systems (*e.g.,* cable TV systems, HFC (Hybrid Fiber Coax) cable systems, etc.), satellite communication systems, RF (Radio Frequency)[1] systems, including systems architectures, components, and applications thereof for these types of systems. Any explanations that I may provide with respect to a technology tutorial or claim construction hearing may also include the use of visual aids or other demonstrations. I am also prepared to rebut, as necessary, matters raised by the expert(s) of

[1] "RF," which means "Radio Frequency," is a term and technology that not only applies to wireless systems, but also applies to terrestrial systems such as, for example, cable systems (including cable and/or HFC systems) and related devices. This was likewise true well before the earliest possible priority dates of the Patents at Issue.

Defendant Charter Communications, Inc. ("Charter")—whether in declarations, reports, depositions, or hearings—and to address related matters raised in the course of claim construction.

II. QUALIFICATIONS

8. In this section, I provide a summary of my educational background, employment background, and other relevant qualifications. A more detailed statement of my professional qualifications, including education, publications, honors and awards, professional activities, consulting engagements, and other relevant experience is included in my curriculum vitae, attached as Exhibit A to this Declaration, and is incorporated by reference herein.

9. I have 30 plus years of in-depth industry experience developing and deploying successful communication systems, broadband communications systems / cable systems (*e.g.*, cable TV systems, HFC (Hybrid Fiber Coax) cable systems, etc.), satellite communication systems, and RF systems, including systems architectures, components, and applications thereof for these types of systems—to name a few.

10. From 2007 to present, I currently serve as President of SIS Development, Inc. / Security Industry Services, Inc., an engineering and technical services company specializing in the technical areas of, for example, communication systems (including cable TV/broadband systems), video systems, wireless networking, Internet technologies, and client-server systems. Exemplary technical services that I have provided include assisting companies in the cable TV and communications industry. For example, I assisted a company in the development an SoC (System on a Chip) for a cable TV set-top box.

11. From 2003 to 2007, I served as the Vice President-Engineering and General Manager-Technology at GE-Security, a division of General Electric (GE) which is now owned by United Technologies Corporation (UTC). At GE, I was the lead engineer for the world-wide "Video Systems Group" that developed video products, multimedia communications systems and

products, and HFC based systems and products. At GE, I was also the lead engineer for residential and commercial security systems engineering and development for North America.

12. From 1998 to early 2003, I was the top technology leader at a number of high-tech start-up companies. Those high-tech start-up companies included Miraxis Corporation (a division of EMS Technologies, Inc., now Honeywell, Inc.). At Miraxis, I was the Vice President of Product Development from late 2001 to early 2003, developing IP network and digital video solutions in the satellite TV industry (*e.g.,* a DTH (Direct to Home) / DBS (Direct Broadcast Satellite) solution). As the Vice President of Product Development, I was responsible for all aspects of the system architecture and components to provide both multimedia content and two-way modem communications.

13. In 2000, I joined Ivex Corporation ("Ivex"), where I served as the Vice President of Engineering and led all technology development. At Ivex I led the development of video surveillance solutions including a product called the VSA (Video Streaming Appliance) and an Internet/network system/software solution called ViewOps. Our solutions allowed retail chains like Ace Hardware, Finish Line, and Eddie Bauer to remotely view their sites and facilities using servers. Further, the user could log into the ViewOps system to obtain pre-recorded events that were triggered by a wide variety of sensor inputs.

14. In 1998, I joined Home Wireless Networks, Inc., where I was promoted to Vice President of Engineering. At Home Wireless Networks, I led all engineering in the development of leading-edge wireless products, including 900 MHz RF circuits, antennas, and transceivers. Home Wireless Networks' products—which included the first integrated voice and low-cost IEEE 802.11 WiFi access point—were launched under the British Telecom and Telenor brands in Europe and the BellSouth and MCI brands in the United States. At the time we used well known

IC (Integrated Circuit) design methods and SoC (System on a Chip) design methods. For example, as Vice President of Engineering at Home Wireless Networks, I was responsible for the development of an SoC (System on a Chip) that integrated an ARM processor. The ARM processor core was provided to us in the form of a hardware library (*e.g.*, in the form of HDL (Hardware Description Language)) that we then integrated into our SoC as a whole. We then had an outside semiconductor foundry manufacture our SoC.

15. From 1995 to 1998, I was the engineering/technology leader for multimedia cable TV set-top boxes in North America for Scientific-Atlanta, Inc. (prior to being acquired by Cisco Systems, Inc.) within the Advanced Video Systems (AVS) Division. My group developed and successfully launched Scientific-Atlanta's first internally designed cable TV set-top box (also called an HCT which means Home Communication Terminal). The development of the cable TV set-top boxes that I led engineering for included responsibility for RF, analog, and digital design for the finished products.

16. At Scientific-Atlanta, in addition to my leadership in the development of cable TV products, I was also responsible for testing the products for our entire division as a whole. Subsequently, I directly managed the construction and operation of our own complete cable TV Head End (HE) system. When we designed products, we evaluated the performance of our products within the entire cable TV system including within the cable TV HE that we operated. Such evaluations of performance included the measurement and monitoring of a whole host of system impairments related to cable TV system two-way communications including those measurements related to SNR (Signal to Noise Ratio) and other modulation impairments.

17. At Scientific-Atlanta I was later promoted and served as the top technology leader on the Strategic Planning Team for the AVS Division, working on the next generation advanced

video products including the overall system design, software and HCTs. In this role, each of the functional technology areas including firmware, hardware, system software and cable system communication headend equipment reported to me in a dotted line matrix/cross-functional organizational structure for the development of our next generation of products and solutions.

18. As part of my responsibilities at Scientific-Atlanta, I stayed current with industry standards that we implemented into our systems such as, for example, the DOCSIS (Data Over Cable Service Interface Specification) standard, the MPEG (Motion Pictures Expert Group) standard, and various Internet/networking standards such as the SNMP (Simple Network Management Protocol) standard. Moreover, the products and solutions that I led the development of at Scientific-Atlanta included a plethora of technologies that included, for example, the development of cable TV communication circuits and systems and RF circuit design.

19. From 1987 to 1995, I held a number of technology positions at Schlumberger Industries, Electricity Management North America. From 1987 until 1989, I was an Electronic Design Engineer at Schlumberger. As an Electronic Design Engineer, I designed circuitry and firmware for solid-state electronic electric meters including the design of a PLC (Programmable Logic Controller) which was an IC that did not include a processor. I also designed an Application Specific Integrated Circuit (ASIC). The use of ASICs and PLCs were well known technologies at the time. I worked on many aspects of design for our core metering products including the design of AMR (Automatic Meter Reading) electronics. The electricity meters that I designed further employed a wide array of sensors to measure electric power consumption, low battery conditions, tamper detection, and the like.

20. In 1989, I was promoted to Senior Electronic Design Engineer at Schlumberger. In 1990, I was promoted to Hardware Manager of the Recorders and Translation Systems where I led

the development of data interfaces between electricity meters and a utility's remote central office. In 1994, I was promoted to Engineering Manager, Residential and Commercial Metering.

21. As Engineering Manager, Residential and Commercial Metering for Schlumberger, I oversaw product development of residential and commercial solid-state electronic electric meters for North America. For example, I was responsible for the engineering design of the "MACS" (Metering And Communications System) that was used to remotely read and control electricity meters installed within multi-tenant buildings using the existing power lines. We called this PLC (Power Line Carrier) communication technology. In fact, PLC was one of the first communication methods used for "Smart Homes" which at that time was in its early infancy. PLC was seen as a means to communicate between various appliances and the utility meter within a home. As part of my R&D (Research and Development) duties, I extensively researched Smart Home technology and PLC technology and as a result I attended a Parks Associates Smart Home workshop in or around 1994.

22. In 1984, I began work as an Electronic Design Engineer in the Nuclear Power Division at Babcock & Wilcox. I was later promoted to Senior Electronics Design Engineer.

23. In the Special Products and Integrated Field Services team at Babcock & Wilcox, my work involved designing and developing both: (a) monitoring systems to monitor the operation of the nuclear power plant equipment, and (b) inspection/robotic repair systems to inspect and repair nuclear power plant components inside the nuclear containment buildings. My work required me to implement a wide variety of sensor technologies into the control room monitoring and robotic systems that I designed.

24. Related to monitoring systems at Babcock & Wilcox, as just one example, I helped redesign portions of a Safety Parameter Display System (SPDS). The SPDS was a system used in

the control room of nuclear power plants to allow the operators to monitor the plethora of equipment and related sensors within a nuclear power plant. For example, such sensors determined temperature, the state of valves and other equipment (closed / not closed), water levels, pressure, and radiation levels to name a few.

25. Related to inspection/robotic repair systems at Babcock & Wilcox, I was one of the key designers of the electronics, software, and firmware (for measurement, control, and communications) for a robot called "ROGER" (Remotely Operated Generator Exam and Repair). My work in designing ROGER required me to work with a plethora of sensor technologies including cameras (to monitor activities and position of the robot), temperature sensors (for monitoring equipment health) and motion sensors (that enabled us to detect and control ROGER's position and movement within a nuclear power plant steam generator). My developments further implemented of cable TV systems to enable the visual inspection within that containment building and other high-radiation areas. ROGER was also outfitted with various exchangeable "tools" that allowed us to perform different types of inspections and repairs on nuclear steam generators which utilized a wide variety of sensor technologies to monitor remote equipment. The sensor states and parameters, including temperature and switch positions, were sent back via a dedicated serial communications network channel called "SDLC," to remote systems operated by personnel far away from the highly radioactive steam generator.

26. In 1984, I received a Bachelor of Science in Electrical Engineering, magna cum laude, from the University of Toledo.

27. In 2017, I received a Master of Science in Electrical and Computer Engineering from Oregon State University, where I graduated with a 4.0 GPA (Grade Point Average). My thesis, entitled "Optimization of Interactive Live Free Viewpoint Multiview Video Streaming

Bandwidth," was based on my own research in streaming multiview video over the Internet using peer-to-peer networks and wireless broadcast transmissions.

28. In 2022, I received a Ph.D. in Electrical and Computer Engineering from Oregon State University based on my academic research that I started in 2015. I graduated with a 4.0 GPA (Grade Point Average). My dissertation, entitled "Machine Learning Bandwidth Optimization of Interactive Live Free-Viewpoint Multiview Video for Sporting Events," was based on my own research combined with my applied industry knowledge in the fields of artificial intelligence, machine learning, classifiers, video / video detection / video analytics / video content prediction, and communication systems (including cable/HFC and satellite systems). The heart of my dissertation was to intelligently predict and then optimally communicate multimedia data over two-way DVB (Direct Video Broadcast) terrestrial systems (which include two-way DVB cable TV systems and DVB IPTV (Internet Protocol TV) systems)), two-way DVB satellite systems, and P2P (Peer-to-Peer) systems.

29. I am a member of the Institute of Electrical and Electronics Engineers (IEEE).

30. I am a lifetime member of the honor society of Phi Kappa Phi.

31. In 2003, I further attended Emory University's, Goizueta Business School and took numerous MBA (Master of Business Administration) courses. Emory's business school program at the time was ranked in the top 10 globally by Business Week and The Financial Times.

32. I have received two U.S. patents: (a) U.S. Patent No. 5,701,253, entitled "Isolated Current Shunt Transducer," which describes and at the time new transducer sensor design for measuring electricity, and (b) U.S. Patent No. and 5,422,939, entitled "Parallel Off-Hook Detection for Both Line-Available and Phone Pick-Up Detection," which describes an at the time new device for sensing the state of telephone lines.

III. COMPENSATION

33. I am being compensated for my services in this matter at my standard consulting rate of $725 per hour. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study, the substance of my opinions, or the outcome of any proceeding involving the challenged claims. I have no financial interest in the outcome of this matter.

IV. MATERIALS CONSIDERED

34. In preparing this declaration, I reviewed and considered the following materials, and any others referenced in the body of my declaration:

1) the Patents at Issue and their file histories, as well as the patents and file histories for the applications identified as Related U.S. Applications on the face of the Patents at Issue;

2) the parties' proposed claim constructions;

3) the Declaration of Dr. Kevin Almeroth Regarding Claim Construction ("Almeroth Declaration"); and

4) the extrinsic evidence cited herein.

35. I may use these documents and information, or other information obtained during the course of this or related proceedings, as well as representative charts, graphs, schematics and diagrams, animations, and models based on those documents and information, to support and to explain my testimony. I am informed that discovery in this action is ongoing and I reserve the right to modify or supplement my opinions, this declaration, and/or to submit additional declarations to address any information obtained, or positions taken, as discovery continues.

36. My opinions are based in part on a review and analysis of the above-mentioned documents and materials. The materials relied upon within this Declaration are of the type that an expert in my field would have reasonably relied upon in forming opinions. I have also drawn on

my education, experience, and knowledge of basic engineering principles for communication systems, broadband communications systems / cable systems (*e.g.*, cable TV systems, HFC (Hybrid Fiber Coax) cable systems, etc.), satellite communication systems, RF systems, including systems architectures, components, and applications thereof, that were already in use prior to, and within the timeframe of the earliest priority dates for the claimed subject matter in the Patents at Issue.

V. LEGAL STANDARDS

37. I am not an attorney or a patent attorney, and I offer no opinions on the law. I have, however, been informed by counsel regarding various legal standards that may apply to this case, and I have applied those standards where necessary in arriving at my conclusions.

38. I understand that patent claims are construed from the viewpoint of a person of ordinary skill in the art ("POSITA") at the time of the invention. I understand that this hypothetical POSITA is considered to have the normal skills and knowledge of a person in the applicable technical field. The factors that may be considered in determining the level of ordinary skill include: i) the education level of the inventor; ii) the types of problems encountered in the art; iii) the prior art solutions to those problems; iv) the rapidity with which innovations are made; v) the sophistication of the technology; and vi) the education level of active workers in the field.

39. I understand that the most important evidence to consider in construing the claims is the "intrinsic" evidence, which I understand includes the claim language, the patent specification, and the prosecution history, including *inter partes* review ("IPR") and other post-grant proceedings with the United States Patent and Trademark Office's ("USPTO") Patent Trial and Appeal Board ("PTAB").

40. I further understand that a POSITA must read the claim terms in the context of the claim itself, as well as in the context of the entire patent specification. I understand that in the

specification and/or prosecution history, the patentee may specifically define a claim term in a way that differs from the plain and ordinary meaning of the term. I understand that the prosecution history of the patent is a record of the proceedings before the USPTO and may contain explicit representations or definitions made during prosecution that affect the scope of the patent claims. I understand that an Applicant may, during the course of prosecuting the patent application, limit the scope of the claims to overcome prior art or to overcome an Examiner's rejection, by clearly and unambiguously arguing to overcome or distinguish a prior art reference or by clearly and unambiguously disclaiming claim coverage.

41. In interpreting the meaning of the claim language, I understand that a POSITA may also consider "extrinsic" evidence, which consists of all evidence external to the patent and prosecution history, including expert and inventor testimony, positions taken by the patent owner in other litigations, dictionaries, and learned treatises. I understand that extrinsic evidence may not be relied on if it contradicts or varies the meaning of the claim language provided by the intrinsic evidence, particularly if the Applicant has explicitly defined a term in the extrinsic record.

42. I also understand that patent claim may not be interpreted one way to avoid invalidity and another way to find infringement. In other words, a claim must be read the same way for validity as for infringement.

43. I understand that Section 112 of the Patent Laws requires that a patent claim particularly point out and distinctly claim the subject matter that the Applicant regards as his or her invention. I understand that a patent claim is invalid for indefiniteness if it fails to inform, with reasonable certainty, a person of ordinary skill in the art about the scope and bounds of the invention claimed. I understand a claim is indefinite if its scope is not clear enough that a POSITA could have determined with reasonable certainty whether a particular embodiment infringes the

claim. I also understand that when considering whether a claim is indefinite, a POSITA may consider both the intrinsic and extrinsic evidence.

44. I understand that a term may be found to be indefinite when the claim language is facially subjective or ambiguous and the meaning of a term and/or scope of the claims is not "reasonably certain" to one skilled in the art.

45. I understand that failure to provide explicit antecedent basis for a term does not always render a claim indefinite. If the scope of a claim would be reasonably ascertainable by those skilled in the art, then the claim is not indefinite.

46. I understand there are instances where inherent components of elements recited have an antecedent basis in the recitation of the components themselves. For example, the limitation "the outer surface of said sphere" would not require an antecedent recitation that the sphere has an outer surface.

VI. LEVEL OF SKILL IN THE ART

47. In rendering the opinions set forth in this Declaration, I was asked to consider the patent claims and the prior art through the eyes of a person of ordinary skill in the art ("POSITA"). The "art" is the field of technology to which a patent is related. In my Declaration, I use the term POSITA to refer to the same hypothetical person of ordinary skill in the art. I considered factors such as the educational level and years of experience of those working in the pertinent art, patents and publications of other persons or companies, the sophistication of the technology, the types of problems encountered in the art, the prior art solutions to those problems, and the speed at which innovations are made. I understand that a POSITA is not a specific real individual but rather a hypothetical individual having the qualities reflected by the factors discussed above.

48. The Patents at Issue relate to communication systems such as broadband communications systems / cable systems (*e.g.*, cable TV systems, HFC (Hybrid Fiber Coax) cable

systems, etc.), satellite communication systems, and RF systems, including systems architectures, components, and applications. I note that each of the Patents at Issue relate to these types of systems as I further discuss below. These types of technologies were typically designed by Electrical, Firmware, and Software Engineers that had experience working with these types of communication systems. I have performed such development myself, and I have further worked with and directly managed these types of Engineers in the industry. I am therefore very familiar with the common skill sets required for this type of work.

49. Taking these factors into consideration and based on my experience in the industry at the time of the earliest priority dates of the Patents at Issue, it is my opinion that a POSITA at the time of the earliest possible priority date of each of the Patents at Issue would have been an Engineer with at least a Bachelor's Degree in Electrical Engineering (or equivalent), with at least two years of experience developing broadband/cable TV/satellite communication systems and solutions.

50. I understand Charter's expert Dr. Almeroth has proposed that the level of ordinary skill would be a person having at least i) a bachelor-level degree in electrical engineering or a related subject and three or more years of experience working in the field of cable television signal processing and communication systems; ii) a master's-level degree in electrical engineering or a related subject and one or more years of experience working in the field of cable television signal processing and communication systems; or iii) a Ph.D.-level degree in electrical engineering or a related subject and at least some experience working in the field of cable television signal processing and/or communication systems. *See* Almeroth Decl. ¶ 27.

51. I am qualified to provide opinions concerning what a POSITA would have known and understood at that time, and my analysis and conclusions herein are from the perspective of a POSITA as of that date and would apply under either party's proposed set of qualifications.

52. As of approximately 2003, I was at least as qualified as the POSITA identified above. Thus, I understand the perspective of a POSITA as of at least as early as 2003, the earliest priority date of any of the Patents at Issue.

VII. '775 PATENT

A. Overview of the '775 Patent

53. The '775 Patent is titled "Architecture For A Flexible And High-Performance Gateway Cable Modem," was filed on September 30, 2003, and issued on July 17, 2012. Accordingly, for my analysis herein, I have assumed the date of September 30, 2003 as the earliest possible priority date for the '775 Patent.

54. The '775 Patent is directed towards a novel architecture for cable modems. As the '775 Patent explains "[t]he future gateway cable modem (CM) will provide a wide range of data networking and VoIP service" and "[t]he major challenge in designing such a gateway cable modem is integration of these services with the basic cable modem functionality in an efficient and cost effective [way]." '775 Patent, 1:13–18.

55. The '775 Patent discloses various embodiments providing a "highly flexible, high performance system capable of handling multiple cable modem voice, data and networking services" where a cable modem engine is "completely partitioned" from the data networking engine. *Id.* at 1:61–2:4. In the disclosed embodiments, complete partitioning is accomplished, for example, by "localizing data networking functions in the data networking engine processor and localizing cable modem functions in the cable modem engine processor." *Id.* at 4:16–19.

56. Figure 1 illustrates an exemplary cable modem system architecture 100 according to the '775 Patent. I have annotated Figure 1 below.

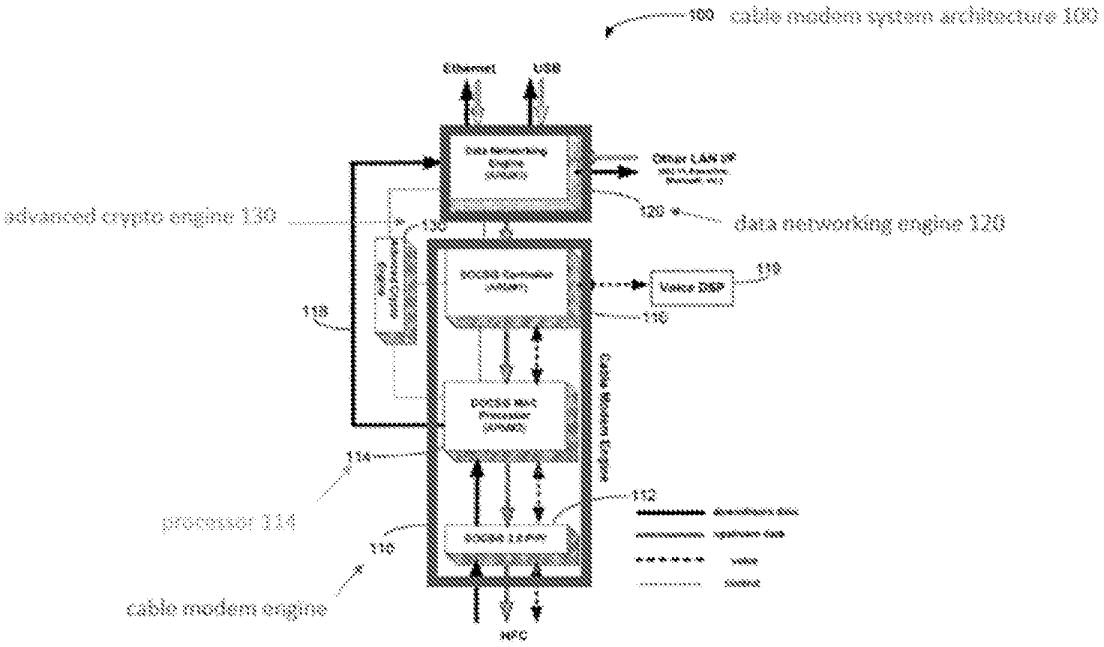


Figure 1

57. System 100 includes three major subsystems: cable modem engine 110, data networking engine 120, and advanced crypto engine 130. *Id.* at 2:49–52. Cable modem engine 110 implements DOCSIS cable modem functions. *Id.* at 2:55–56. The data networking engine 120 implements data networking functions. *Id.* at 3:49–53. "Advanced crypto engine 130 provides hardware support for crypto functions." *Id.* at 4:4–5.

58. In the embodiment of Figure 1, the cable modem engine includes a "processor 114," and the data networking engine also includes a processor such as, for example, an ARM processor. *See id.* at FIG. 1.

59. At least one data bus is implemented at, for example, path 118. This allows communication between the "Data Networking Engine" "120" and the "Cable Modem Engine" "110" while still retaining functional partitioning. *See id.*

B. Summary of The '775 Patent File History

60. I have reviewed the prosecution history leading to the issuance of the '775 Patent. A copy of the file history is attached as Exhibit B.

61. On September 30, 2003, the Applicant filed the application leading to the '775 Patent. The originally filed claims are reproduced below:

1. A cable modem system comprising:

a data networking engine that performs data networking functions; and

a cable modem engine that performs all other cable modem functions; the cable modem engine being completely partitioned from the data networking engine.

2. A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine that performs all crypto functions.

5. A cable modem system as claimed in claim 1, wherein the cable modem engine comprises:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller.

6. A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer comprises a hardware transmitter and receiver.

7. A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor processes downstream PDU packets and forwards the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. A cable modem system as claimed in claim 5, wherein the data networking engine is responsible for all data networking processing including advanced multi-port briding/routing with NAT/firewall and VPN, and home networking applications.

11. A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. A cable modem architecture comprising:

a cable modem engine comprising:

a DOCSIS PHY layer comprising a transmitter and receiver;

a DOCSIS MAC processor that implements real-time critical MAC functions for both upstream and downstream communications; and

a DOCSIS controller implementing VoIP functionality; and

a data networking engine implementing all data networking processing and home networking applications, wherein the data networking engine is completely decoupled from the cable modem engine.

13. A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller provides VoIP functionality in accordance with the PacketCable specification, and wherein the data networking engine provides the embedded portal services functionality of the CableHome specification, wherein the CableHome functionality is provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

> 15. A method for providing a flexible and partitioned cable modem gateway comprising:
>
> providing data and home networking functionality in a data networking engine;
>
> providing DOCSIS and VoIP functionality in a cable modem engine; and
>
> partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

Exhibit B at ENTROPIC_CHARTER_0005459–0005462.

62. On February 19, 2009, the Examiner issued a non-final rejection. Among other things, the Examiner rejected originally filed Claims 1–15 as being anticipated by Brooks (U.S. Publication No. 2001/0039600). By way of example, at the time, Claim 1 recited the following:

> 1. A cable modem system comprising:
>
> a data networking engine that performs data networking functions; and
>
> a cable modem engine that performs all other cable modem functions; the cable modem engine being completely partitioned from the data networking engine.

Id. at ENTROPIC_CHARTER_0005459.

63. The Examiner asserted:

> As per claim 1, Brooks teaches a cable modem system comprising: a data networking engine that performs data networking functions (Abstract; paragraphs 0013-0016); and a cable modem engine that performs all other cable modem functions (Abstract; paragraphs 0013-0016); the cable modem engine being completely partitioned from the data networking engine (Abstract; paragraphs 0013-0016).

Id. at ENTROPIC_CHARTER_0005497.

64. On May 19, 2009, the Applicant responded to the February 19, 2009 rejection. The Applicant amended the claims, including Claim 1, as shown below.

> 1. (Currently Amended) A cable modem system comprising:
>
> a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform ~~that performs~~ home ~~data~~ networking functions including interfacing with customer provided equipment; ~~and~~
>
> a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable mode engine to perform ~~that performs all other~~ cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and
>
> a data bus that connects the data networking engine to the cable modem engine,
>
> wherein the cable modem functions performed by the cable modem engine are ~~being~~ completely partitioned from the home networking functions performed by the data networking engine.

Id. at ENTROPIC_CHARTER_0005510.

65. The Applicant also traversed the rejection "because the cited portions of [Brooks] ***do not correspond to aspects of the claimed invention*** *directed to the data networking functions performed by a data networking engine being* ***completely partitioned/decoupled*** *from the other cable modem functions performed by a cable engine*." *Id.* at ENTROPIC_CHARTER_0005514 (emphasis added).

66. The Applicant further explained that the office action created uncertainty as to how the Examiner was interpreting and applying the disclosures of Brooks to the claims at issue. Specifically, the Applicant stated:

> [T]he Office action does not identify what element of [Brooks] is being asserted as ***corresponding to Applicant's data networking engine***.

Id. at ENTROPIC_CHARTER_0005514 (emphasis added).

67. On February 5, 2010, the Examiner issued a final rejection. Among other things, the Examiner again issued a rejection of the claims as anticipated by Brooks. The Examiner stated the following with respect to Claim 1:

> As per claim 1, Brooks teaches a cable modem system comprising: a data networking engine implemented in a first circuit that includes at least one processor (Figure 2), the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment (Abstract; paragraphs 0014, 0026, 0037, 0066-0068); a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine (paragraphs 0026, 0037, 0042-0046, 0050-0052); a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine (0042-0046).

Id. at ENTROPIC_CHARTER_0005540.

68. The Examiner also provided the following response to the Applicant's remarks:

> The data networking engine and cable modem engines are represented in figures 1 and 2 of the Brooks reference, including buses carrying out separate networking functions. For example, the data networking engine interfaces with the peripheral devices and employs operating system functions, and the cable modem engine implements DOCSIS functionality. These entities are completely partitioned from each other, as discussed in the cited sections.
>
> Paragraphs 0036-0042 discuss the transfer of packets between the cable modem and data networking engines. Therefore, examiner respectfully disagrees with the assertion that there is no data networking engine, and it is respectfully submitted that the Brooks invention fully teaches the limitations of claim 7. Further, paragraph 0010 discusses the inclusion of various CableLabs standards. Because PacketCable and CableHome specifications constitute these standards, Brooks fully teaches the claim limitations.

Id. at ENTROPIC_CHARTER_0005544.

69. On April 5, 2010, the Applicant responded to the February 5 office action. The Applicant again traversed the rejection and explained the Applicant's continued uncertainty as to how the Examiner was interpreting and applying the disclosures of Brooks to the claims at issue. Specifically, the Applicant stated the following:

> For example, ***Applicant is uncertain how [Brooks] discloses aspects of the claimed invention directed to data networking functions performed by a data networking engine being completely partitioned/decoupled from the other cable modem functions performed by a cable modem engine***. The Examiner has repeatedly failed to identify elements of [Brooks] corresponding to these aspects as requested. In contrast, the Office Action make the conclusion statement [sic] that "the data networking engine and the cable modem engines are represented in Figures 1 and 2 of [Brooks]" (*see, e.g.*, p. 8 of the Office action). However, Applicant is uncertain how any reasonable interpretation of these Figures can provide correspondence. For example, ***Figure 2 of [Brooks] discloses only two processors, each of which, therefore, must correspond to the claimed data-networking and cable-modem engines. However, the discussion of Figure 2 makes clear that the cable modem functions are performed by CMAC unit 224*** (*see, e.g.*, paragraph 0042). Therefore, in order for the cable modem engine to contain a processor and perform the CMAC functions as claimed, the cited cable modem engine must include circuitry to connect the processors with the CMAC unit. Because available connecting circuitry would be shared with the other processor, Applicant is uncertain how the asserted

> cable modem engine and home networking engine can be completely partitioned as claimed. Because the Office Action has not identified these clamed aspects in [Brooks], a *prime facie* case has not been presented and Applicant requests that the rejection of claims 1-16 be withdrawn.

Id. at ENTROPIC_CHARTER_0005557–0005558 (emphasis added).

70. The Applicant further confirmed its uncertainty of the Examiner's application of Brooks by stating, for example: "Applicant submits that the Examiner's failure to identify corresponding elements as requested in Applicant's response constitutes an incomplete answer under M.P.E.P. § 707.07 and, therefore, makes the finality of the Office Action improper." *Id.* at ENTROPIC_CHARTER_0005558. The Applicant further explained, "[i]n order to comply with 35 U.S.C. § 132, sufficient detail must be provided by the Examiner regarding the alleged correspondence between the claimed invention and the cited reference to enable Applicant to adequately respond to the rejections." *Id.*

71. On May 11, 2010, the Examiner issued an Advisory Action, in which the Examiner withdrew some rejections but continued the finality of the rejection of Claims 1–16 associated with the Brooks '006 disclosure. The Examiner explained the following:

> Brooks' abstract, for example, discloses bifurcated processing architecture. The first processor processes information flowing to and from cable media interface circuitry. This constitutes the data networking engine, which performs the interacting with equipment as claimed. The second processor performs the management of some message processing and scheduling, which constitutes cable modem functions other than those of the data networking engine (please see paragraph 0026). This then constitutes the cable modem engine, as claimed. Claim 9 of the Brooks reference further teaches partitioned processors, where the co-processor supports the processing of cable media and performs data transfer, and the first processor performs a plurality of other processing functions.

Id. at ENTROPIC_CHARTER_0005572.

72. On June 7, 2010, the Applicant submitted a request for continued examination along with an amendment to the claims and remarks. Among other things, the Applicant explained its continued requests for the Examiner to explain the application of the Brooks reference because

"it was pointed out that there was continued uncertainty as to how the Examiner was interpreting and applying the disclosures of Brooks '600 to the claims at issue." *Id.* at ENTROPIC_CHARTER_0005580. In particular, the Applicant explained the continued uncertainty as follows:

> [I]t was pointed out that in Brooks '600, only two processors were disclosed. Therefore, from the Examiner's position that "the data networking engine and cable modem engines are represented in figures 1 and 2" (Office Action, p. 8), it would follow that one of the two processors corresponded to the networking engine, and the other of the two processors corresponded to the cable modem engine. ***It was further pointed out that while the discussion concerning Figure 2 in Brooks '600 paragraph 0042 makes clear that cable modem functions are performed by CMAC unit 224***, if the cable modem engine is to contain a processor and perform CMAC functions as claimed, the cited cable modem engine must include circuitry to connect one of the processors with the CMAC unit. It was noted, however, that because available connecting circuitry would be shared by both the one processor and the other processor, the asserted cable modem engine and home networking engine could not be completely partitioned as claimed.

Id. at ENTROPIC_CHARTER_0005580–0005581 (emphasis added).

73. In other words, as the Applicant explained, processor 102, which the Examiner had designated as the data networking engine, handles many cable modem functions:

> [I]t appears that the Examiner may be asserting that the cable modem processor includes second processor 104, that the data networking engine is first processor 102 (see Fig. 2), and that the CMAC/CPHY block (114, 118, 224 and 228) is also a part of the cable modem engine. However, processor 102 handles many cable modem functions (see Fig. 4, paragraphs 0053 to 0062), and is explicitly described as "programmed to implement the desired MAC functionality" (paragraph 0026). Paragraph 0025 states "in the case of DOCSIS, typical MAC functionality includes MPEG and MCNS decoding and frame synchronization." On the other hand, processor 104 is described only as providing operating system support and that it "may manage some message processing and scheduling" (paragraph 0026, emphasis added). Thus, the Examiner's designation of the first processor as the "data networking engine" is at odds with the Brooks '600 description of processor 102 as being "programmed to implement the desired MAC functionality."

Id. at ENTROPIC_CHARTER_0005582 (emphasis in original).

74. The Applicant further explained that the specific architecture of Brooks, in which the CMAC/CPHY block (114, 118, 224, and 228) communicates with both processors 102 and

104 by sharing the same data paths and sharing the same direct memory access controller, did not "square" with certain features in Claim 1 and Claim 15:

> The Examiner's apparent designation of the first processor 102 in Brooks '600 as the "data networking engine," and the second processor 104 and the CMAC/CPHY block (114, 118, 224 and 228) as the "cable modem engine," further does not square with the claim 1 feature that "the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine," and the claim 15 feature of "partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VOIP functionality." This is because the CMAC/CPHY block (114, 118, 224 and 228) communicates with both the processors 102 and 104 by sharing the same data paths and sharing the same direct memory access controller. (See peripheral bus 112 – bridge 110 – system bus 108 in Fig. 1 and APB 214 – DMA Controller/ASB-APB Bridge 212 – ASB 210 in Fig. 2, and paragraphs 0034 and 0035.)

Id. at ENTROPIC_CHARTER_0005582.

75. On September 2, 2011, the Examiner issued a non-final rejection for Claims 1–16. The Examiner did not include Brooks as a basis for the rejection. *See id.* at ENTROPIC_CHARTER_0005592–0005602.

76. On March 2, 2012, the Applicant amended the claims and added the now-asserted Claim 18 (as Claim 20). Claim 20 is reproduced below:

20. (**New**) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a DOCSIS controller and a DOCSIS MAC processor, the DOCSIS MAC processor configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput; and

a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

Id. at ENTROPIC_CHARTER_0005619.

77. On March 19, 2012, the Examiner allowed the claims. *See id.* at ENTROPIC_CHARTER_0005628–0005632. Claim 20 was unchanged and issued as Claim 18.

C. Disputed Terms of the '775 Patent

78. I understand that there is a dispute over five (5) claim terms within Claim 18 of the '775 Patent. Below I have reproduced Claim 18 of the '775 Patent in its entirety and have emphasized the terms that are in dispute.

18. A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when

executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a ***DOCSIS controller*** and a ***DOCSIS MAC processor***, the ***DOCSIS MAC processor*** configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the ***DOCSIS controller*** in order to boost downstream throughput; and

a ***data bus*** that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

'775 Patent, Claim 18.

79. Dr. Almeroth concludes that these terms are indefinite;[2] however, his analysis is flawed on numerous levels. For the reasons I outline below, a POSITA would not interpret the claims as Dr. Almeroth does and would not find Claim 18 indefinite.

1. "a data networking engine implemented in a first circuit . . ." and "a cable modem engine implemented in a second circuit . . ." (Claim 18)

a. Among other things, Dr. Almeroth's opinions assume a POSITA would ignore "circuit" as used in the plain claim language

80. I understand that the dispute centers around the following claim language:[3]

[2] Including "indefinite" for claim terms "DOCSIS MAC processor" and "DOCSIS controller" if not interpreted as Dr. Almeroth requires (*i.e.*, "[i]f … does not mean …"). Almeroth Decl. ¶ 29.

[3] I note that I have done my analysis considering not only the below claim language but also the claim terms as a whole and Claim 18 as a whole.

- "a data networking engine implemented in a first circuit that includes at least one processor" (Claim 18)
- "a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit" (Claim 18)

81. Dr. Almeroth opines that these terms are ambiguous because:

> [T]here is no way to determine what "circuit" means in the claims or how many circuits a particular cable modem contains. Nor is there a way to determine where one circuit begins and another ends. It is therefore impossible to determine if any particular cable modem contains "a first circuit" and "a second circuit' as claimed, or if the "second circuit" is "separate from the first circuit."

Almeroth Decl. ¶ 29; *see also id.* at ¶¶ 64–75.

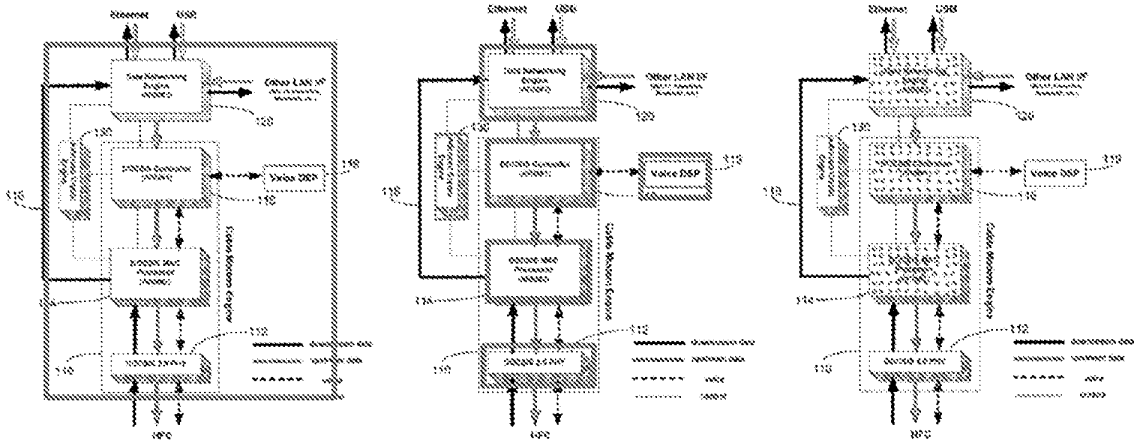
82. I disagree. The '775 Patent does not claim a first and second "circuit" in a vacuum. Rather, Claim 18 recites "a data networking engine implemented in a first circuit that includes at least one processor" and "a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit."

83. A POSITA has no difficulty understanding that circuits, such as those of the data networking engine, are delineated from other circuits, such as those of the cable modem engine. This is extremely common. The definition of "circuit" Dr. Almeroth cites confirms this point: "circuit" "A combination of electrical components interconnected to perform a particular task. At one level a computer consists of a single circuit; at another, it consists of hundreds of interconnected circuits." Almeroth Decl. ¶ 65 (citing Appx. C, at 99).

84. This is further true of the specific context of the '775 Patent. As of the priority date, a POSITA would have been familiar with systems-on-a-chip (SoCs) and application-specific integrated circuits (ASICs) (*i.e.*, a "chip"). *See, e.g.*, '775 Patent, 4:58–62. Furthermore, a POSITA would have been familiar with data networking functions (*e.g.*, web server, CableHome, etc.) and cable modem functions (*e.g.*, DOCSIS). *See, e.g., id.* at Abstract. Therefore, a POSITA would

readily appreciate that Claim 18 claims separate data networking and cable modem engines, wherein each is implemented on a circuit that includes at least one processor.

85. Dr. Almeroth attempts to create ambiguity by looking at circuits in the abstract while ignoring the plain language of Claim 18, the specification, and the embodiments depicted in Figures 1 and 2. Dr. Almeroth draws boxes around the physical parts depicted in Figure 1:



Almeroth Decl. ¶¶ 67, 69, 71.

86. Dr. Almeroth concludes that the claim is indefinite because none of the above illustrations show "[a] data networking engine implemented in a first circuit [and] a cable modem engine implemented in a second circuit." *See id.* at ¶¶ 67–72.

87. Dr. Almeroth's physical boxes ignore that the specification describes these components as the portions of physical circuits that embody the functionalities of the cable modem shown:

> System 100 comprises three major ***subsystems***: ***cable modem engine 110; data networking engine 120***; and advanced crypto engine 130. The ***functional sub-components*** of these three-subsystems are illustrated in greater detail in FIG. 2.

'775 Patent, 2: 50–54 (emphasis added).

88. This is consistent with Dr. Almeroth's dictionary definition, which speaks in terms of division based on function: "[a] combination of electrical components interconnected to perform

a particular task." Almeroth Decl. ¶ 65 (citing Appx. C at 99). A POSITA would have recognized at the time, as I experienced firsthand, the combination of electrical components interconnected to perform a particular task included integrated circuits, wherein an SoC comprised one or more integrated circuits. *See* '775 Patent, 4:25–28; *see also id.* at 4:58–62.

89. The specification provides an exemplary embodiment where the data networking engine and cable modem engine may be implemented on a single chip having two processors, *i.e.*, one for the data networking engine and one for the cable modem engine. *See* '775 Patent, 4:58–62 ("***A chip*** implementing cable modem system 100 will have only a small incremental hardware cost/functional increase over current stand-alone cable modem chips. The major cost difference relative to current chips is the addition of another ARM940-type processor to the chip."). In such an embodiment, the cable modem engine and data networking engine would be implemented on the same circuit board (if not the same die).

90. A POSITA would therefore not discard their prior experience and plain understanding of separate circuits where the separation is in terms of function. Thus, a POSITA would not understand "separate" to mean "separate circuit boards."

2. "DOCSIS MAC processor" / "DOCSIS controller" (Claim 18)

a. A POSITA would understand the meaning of "DOCSIS MAC processor" and "DOCSIS controller"

91. Dr. Almeroth opines that the term DOCSIS MAC processor must mean "the DOCSIS MAC processor as described in the patent specification (*see, e.g.*, '775 Patent, 3:1–20; 4:41–54; *id.* at Figures 1 & 2)." Almeroth Decl. ¶ 29; *see also id.* ¶¶ 76–77. Dr. Almeroth also opines that the term DOCSIS controller must "mean the DOCSIS controller as described in the patent specification (*see, e.g.*, '775 Patent, 3:21–48; 4:41–57; *id.* at Figures 1 & 2)." Almeroth

Decl. ¶ 29. According to Dr. Almeroth, this is because these terms do not have a plain and ordinary meaning to a POSITA. Almeroth Decl. ¶¶ 76–77.

92. I disagree. Consistent with the plain meaning of the terms, a POSITA reading the claims and specification would understand that the DOCSIS MAC processor and the DOCSIS controller are portions of the cable modem engine corresponding to the functions of MAC processing for DOCSIS, and controlling the DOCSIS functions, respectively. '775 Patent, 2:55–59; *see also* ¶¶ 57, 87, *supra*.

93. This plain understanding is confirmed by the specification, which describes these blocks and their corresponding functions in detail. For example, "DOCSIS MAC processor" 114 "implements real-time critical MAC functions for both upstream (US) and downstream (DS) communications." '775 Patent, 3:1–3. These MAC functions can include "US and DS synchronization, DS MAC address filtering, DS protocol filtering, US and DS PHS, concatenation, fragmentation, MAP processing, US transmission scheduling, as well as DOCSIS link-layer DES encryption and decryption." *Id.* at 3:3–7. Similarly, the specification describes how "DOCSIS controller" 116 implements DOCSIS functions such as MAC management message (MMM) processing, IGMP, MAC address learning, classification, US protocol filtering, CM IP stack and software downloading, cable modem IP/UDP functions, SNMP, DHCP, TFTP, and TOD functionality, and cable modem provisioning. '775 Patent, 3:27–38.

b. Dr. Almeroth misconstrues "DOCSIS MAC processor" and "DOCSIS controller" by requiring them to be implemented on separate, specific physical processors

94. Dr. Almeroth opines that Claim 18 is indefinite because the cable modem engine is implemented in a circuit "that includes at least one processor." Almeroth Decl. ¶ 78. Specifically, he opines:

> [T]his would cover a cable modem engine that includes only one processor. However, the claim also expressly requires that the cable modem engine contain a DOCSIS MAC processor and a DOCSIS controller, both of which are ARM processors.

Almeroth Decl. ¶ 78 (parentheticals omitted).

95. In my opinion there are two errors here. First, Dr. Almeroth misinterprets "DOCSIS MAC processor" and "DOCSIS controller" as being physical processors with some physical separateness. Second, Dr. Almeroth contends that they must be the specific brand/architecture of physical processors (ARM processors) identified as exemplary in the specification. A POSITA would find no support for any of these contentions.

96. There is an *exemplary* embodiment depicted in Figure 1 where "the processing-intensive functions of the cable modem and data networking are rationally distributed among three different [physical] processors." '775 Patent, 4:43–49. In this exemplary embodiment, there are two different physical processors in the cable modem engine, and the "DOCSIS MAC processor" functionality is assigned to one processor core while the "DOCSIS controller" functionality is assigned to the second processor core. But in another example embodiment, Claim 18 does not require that the functions of the "DOCSIS MAC processor" and the "DOCSIS controller" be embodied or implemented in separate physical processors. *See id.* at 4:16–19 ("This is accomplished by localizing data networking functions in the data networking engine processor [singular] and localizing cable modem functions in the cable modem engine processor [singular]") (annotation added). Thus, Claim 18 simply requires that the cable modem engine "includes at least ***one*** processor."

97. Moreover, a POSITA would find Dr. Almeroth's interpretation inconsistent with other description in the specification. The '775 Patent discloses that "A chip implementing cable modem system 100 will have only a small incremental hardware cost/functional increase over

current stand-alone cable modem chips. The major cost difference relative to current chips is the addition of ***another ARM940-type processor to the chip***." *Id.* at 4:58–62 (emphasis added). That means the cable modem engine itself may be implemented on a single processor core (the data networking engine embodied in the other). In fact, the '775 Patent clearly states "[t]his is accomplished by localizing data networking functions in the ***data networking engine processor*** [singular] and localizing cable modem functions in the ***cable modem engine processor*** [singular]". *See id.* at 4:16–19 (annotation and emphasis added). This is consistent with the claim language for the "cable modem engine [] second circuit" requiring "at least ***one***" processor (the "data networking engine [] first circuit" requiring the other). In light of this disclosure, a POSITA would not conclude that the claimed "DOCSIS MAC processor" and "DOCSIS controller" must be implemented on separate processors.

98. A POSITA would further understand that, although ARM processors are common processors, there are many other types of processors that were readily available at the time of the invention and there would be no reason to exclude other kinds of processors from the scope of the claims. The specification similarly makes this clear by explaining that Figure 1 is a non-limiting "embodiment." *See* '775 Patent, 3:17–19 ("***In one implementation***, processor 114 is an ARM9TDMI-based RISC processor") (emphasis added); 3:24–25 ("***In one implementation***, controller 116 is an ARM940-based RISC processor") (emphasis added).

99. Thus, in my opinion, a POSITA would be able to ascertain the scope of Claim 18 with reasonable certainty and would not misinterpret the "DOCSIS MAC processor" and "DOCSIS controller" functional blocks as limited to separate, specific physical processors.

3. "data bus" (Claim 18)

100. Dr. Almeroth opines that "data bus" is indefinite because of a purported disclaimer during prosecution of the '775 Patent related to the scope of the term "completely partitioned." Specifically, he states:

> The claim limitation requiring "a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine" renders Claim 18 and its dependents indefinite. The applicants successfully argued during prosecution that a "data networking engine" and a "cable modem engine" are not "completely partitioned" if they share "connecting circuitry" or "data paths." The "data bus" as claimed would be shared "connecting circuitry" and a shared "data path," meaning the cable modem engine and the data networking engine cannot be "completely partitioned" as claimed.

Almeroth Decl. ¶ 29; *see also* ¶ 79.

101. I disagree. Both terms "data bus" and "completely partitioned" appear in the '775 Patent claims, including Claim 18, and, as a result, no POSITA would consider there to be a disclaimer in the scope of the term "completely partitioned" to exclude a data bus. In addition, the Examiner understood the claim scope during prosecution and did not find a "data bus" incompatible with "completely partitioned."

102. A POSITA would <u>not</u> understand that the presence of a data bus between the data networking engine and the cable modem engine destroys their separate nature. *See, e.g.*, ¶¶ 82–84, 89, 90, *supra*. The '775 Patent confirms the standard understanding of a POSITA that two processors with complete separation of their functions remain completely separated even with a data bus in between allowing information exchange. *See, e.g.*, ¶¶ 82–84, 89, 90, *supra*; *see also*, '775 Patent, Fig 1, 3:14–17, 3:22–24.

103. Moreover, during prosecution, the Applicant never limited "completely partitioned" to exclude "any circuitry" or any shared "data path" as Dr. Almeroth asserts. *See*

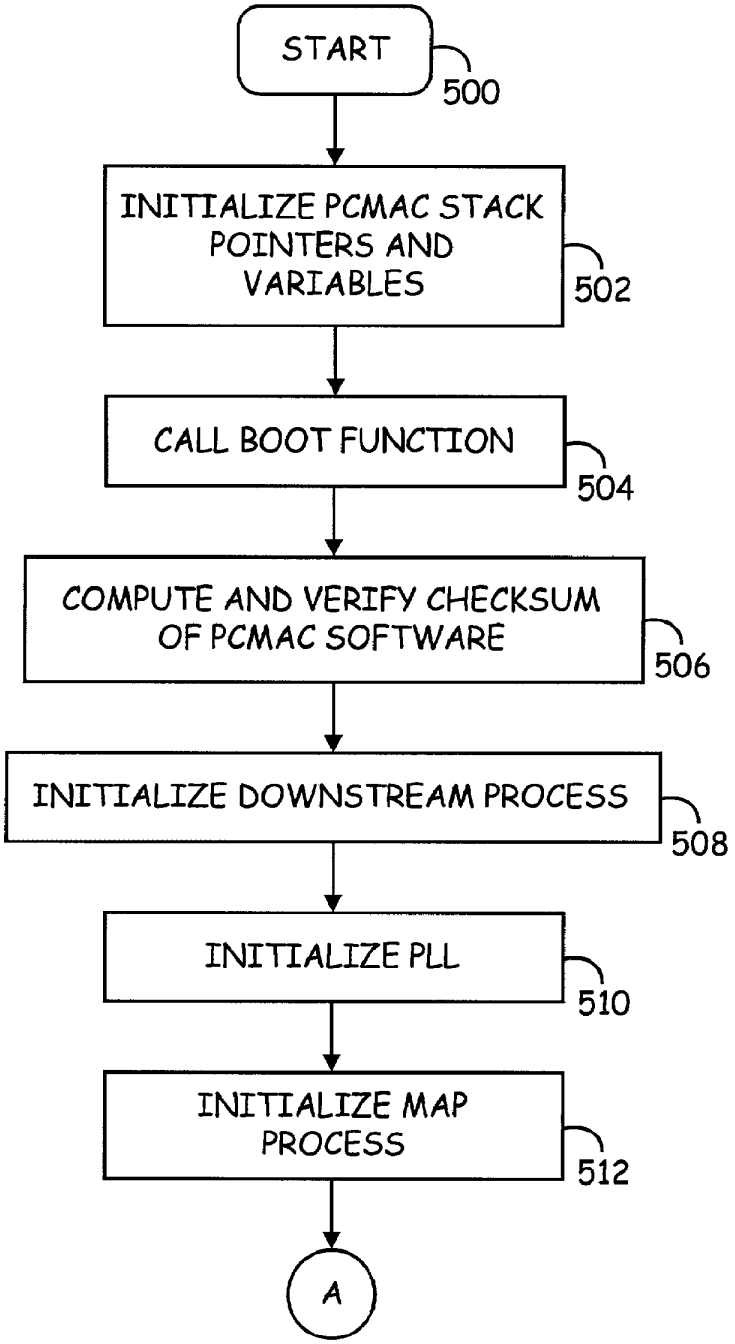

START
500
INITIALIZE PCMAC STACK POINTERS AND VARIABLES
502
CALL BOOT FUNCTION
504
COMPUTE AND VERIFY CHECKSUM OF PCMAC SOFTWARE
506
INITIALIZE DOWNSTREAM PROCESS
508
INITIALIZE PLL
510
INITIALIZE MAP PROCESS
512
A

Fig. 5A

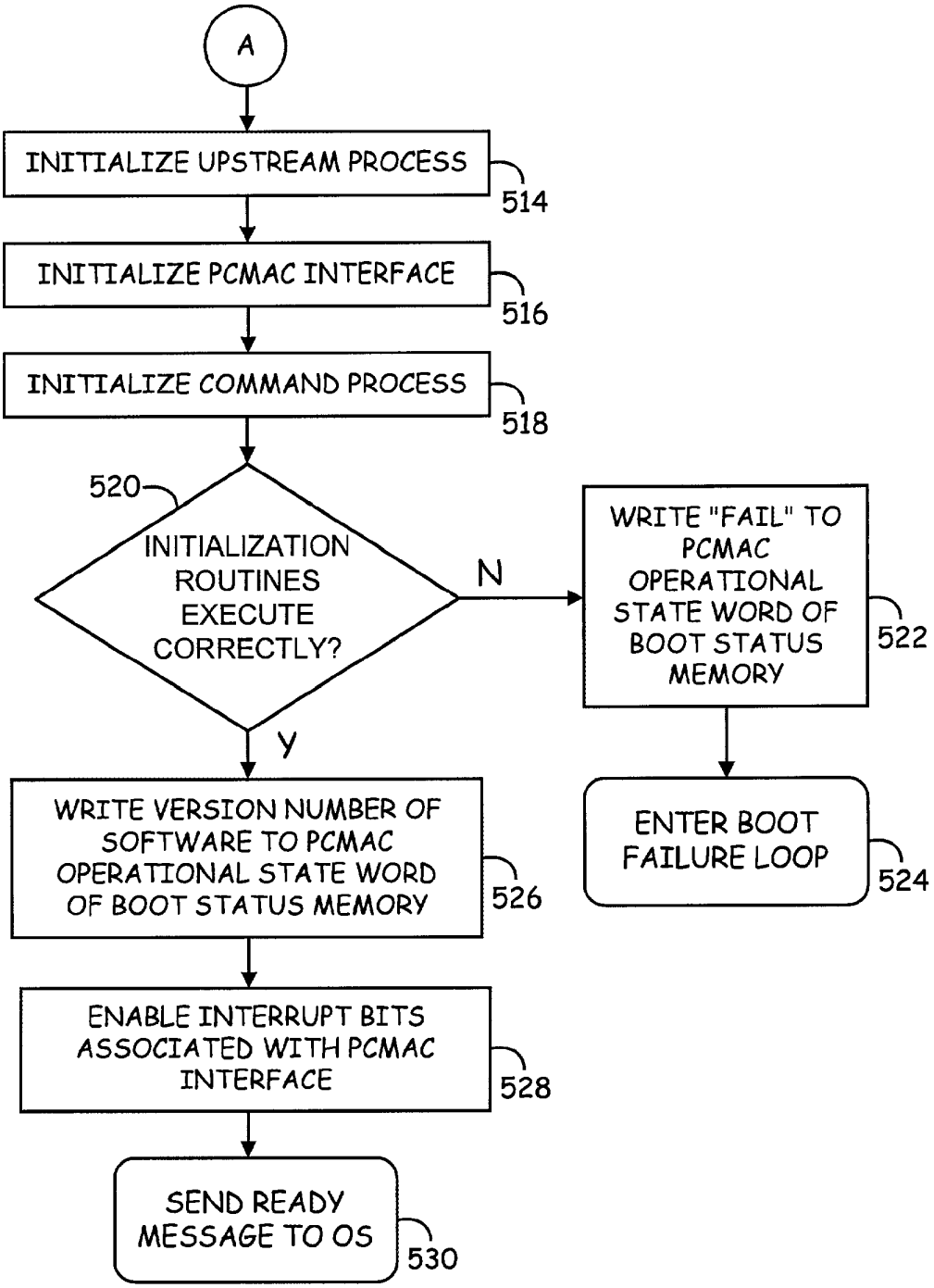

A
INITIALIZE UPSTREAM PROCESS
514
INITIALIZE PCMAC INTERFACE
516
INITIALIZE COMMAND PROCESS
518
520
INITIALIZATION ROUTINES EXECUTE CORRECTLY?
N
WRITE "FAIL" TO PCMAC OPERATIONAL STATE WORD OF BOOT STATUS MEMORY
522
Y
WRITE VERSION NUMBER OF SOFTWARE TO PCMAC OPERATIONAL STATE WORD OF BOOT STATUS MEMORY
526
ENTER BOOT FAILURE LOOP
524
ENABLE INTERRUPT BITS ASSOCIATED WITH PCMAC INTERFACE
528
SEND READY MESSAGE TO OS
530

Fig. 5B

CABLE MODEM HAVING A PROGRAMMABLE MEDIA ACCESS CONTROLLER

BACKGROUND

[0001] 1. Technical Field

[0002] The present invention relates generally to a cable modem; and, more particularly, it relates to a cable modem having a programmable media access controller.

[0003] 2. Related Art

[0004] In recent years, cable television networks have become more widespread. A typical cable TV system can carry many television stations, and is effectively a high bandwidth system. Because of the increasing availability of cable television infrastructure, the use of television cables as the medium for computer data networks has the potential for giving users high bandwidth at a reasonable cost. A cable TV system, however, requires several enhancements in order to function as a data network.

[0005] In its classic form, a cable TV system carries information in only one direction—from the cable system headend to the individual user. The user interface to the system generally comprises a receiver such as a television or a stereo. The headend transmits television or stereo channels simultaneously. In general, the user has no influence on what is transmitted and can only choose among the channels the headend is transmitting.

[0006] In contrast, a data network carries data from the headend to the user (the downstream path) and from the user to the headend (the upstream path). The individual user requires equipment, such as a cable modem, that can both receive from the headend and transmit to it. A cable data network must be able to handle many individual users simultaneously, each of whom have control over what they receive and transmit.

[0007] Cable modems offer greatly improved bandwidth capable of delivering services hundreds, or even thousands, of times faster than conventional modems. Cable modems can achieve data-transfer rates of up to 40 Mbits/s by connecting directly to coaxial lines as opposed to dial-in modems, that use twisted-pair copper telephone lines.

[0008] In order for a cable TV network to operate as a data network, it requires a headend capable of both transmitting and receiving data. To ensure that each user receives the data they require, a network protocol must be implemented to allow independent users of the network to utilize the shared headend and the distribution network without interference from or receiving the data of other users.

[0009] The network protocol places requirements on both the headend and the user end. Generally, the headend serves as the network controller, and the user's cable modem must be able to respond to commands from the headend. In cable modems adhering to the well-known OSI reference model, the lowest layer is the Physical layer (PHY), while the next layer up is the Data Link layer. The Data Link layer is segmented into two parts, the Medium Access Controller (MAC), which interfaces with the PHY, and the Logical Link Control (LLC), which interfaces to the MAC and to higher layers. In general, the MAC and LLC provide the following Data Link functionality: transmit and receive data encapsulation, including framing (frame boundary delimitation, frame synchronization), addressing (management of source and destination address), and error detection (detection of physical medium transmission errors); and media access management, including collision avoidance and handling. A physical address or MAC address is a unique Data Link layer address that is assigned to every port or device that connects to a network. Other devices in the network use these addresses to locate specific ports in the network and to create and update routing tables and data structures.

[0010] In an effort to coordinate the development of multimedia high-speed data services and the interoperability of network devices, cable operators have formed the Multimedia Cable Network Systems (MCNS) Group in cooperation with the industry research and development consortium CableLabs. The MCNS group has promulgated the Data Over Cable Service Interface Specification (DOCSIS). Other standards, such as DAVIC/DVB have likewise been created. Such standards continue to evolve over time, with the frequent inclusion of additional feature sets.

[0011] Previously, integrated cable modem devices have only included physical-layer functions and a fixed-function MAC. These devices are generally compliant with a single specification or a version of a specification. Thus, any changes to the underlying specification require hardware modifications for the MAC to be compliant, resulting in lengthy and expensive product development cycles.

[0012] Further limitations and disadvantages of conventional and traditional systems will become apparent to one of skill in the art through comparison of such systems with the present invention as set forth in the remainder of the present application with reference to the drawings.

SUMMARY OF THE INVENTION

[0013] Briefly, the present invention relates to a cable modem having a programmable media access controller (MAC). In one embodiment of the invention, a single cable modem device is provided that includes all necessary MAC functions. The cable modem device advantageously allows the MAC functions to be programmed to support evolving standards (e.g., DOCSIS) without requiring expensive hardware upgrades. The cable modem device may also include data-conversion components, a complete PHY that is compliant with both United States and European standards, an Ethernet MAC, a Universal Serial Bus (USB) transceiver, an encryption engine(s), key memory components and other peripheral functions.

[0014] The cable modem device of a disclosed embodiment of the invention utilizes a bifurcated microprocessor architecture in which first processing circuitry (e.g., an embedded processor core) is programmed to implement the desired MAC functionality for processing information flowing to and from cable media interface circuits. A second embedded processor core or host system processor provides operating system functionality and controls the boot process for the first embedded processor core. In a further embodiment, separate processor cores are provided for implementing MAC functionality for the downstream and upstream data paths, respectively. The embedded microprocessor cores may be Advanced RISC Machines (ARM) microprocessors or any other suitable microprocessor cores.

[0015] In a disclosed embodiment of the invention, cable media interface circuitry, as well as other peripheral cir-

cuitry, are coupled to a peripheral bus. The peripheral bus is linked by a bridge circuit to a system bus. The processing circuitry of the programmable MAC is communicatively coupled to the system bus. A novel centralized DMA controller is provided to direct transfer of data between the peripheral bus and the system bus as determined, at least in part, by the programmable MAC.

[0016] A cable modem device having a programmable MAC according to the present invention provides a software upgrade path to permit support for new versions of standards as they are adapted. Further, the programmable nature of the cable modem device permits individual manufacturers to differentiate products at the MAC layer without having to modify or replace hardware.

[0017] Other aspects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] A better understanding of the present invention can be obtained when the following detailed description of various exemplary embodiments is considered in conjunction with the following drawings:

[0019] **FIG. 1** is a block diagram of an exemplary cable modem device having a programmable cable media access controller according to the present invention;

[0020] **FIG. 2** is a schematic block diagram providing exemplary details of the cable modem device of **FIG. 1**;

[0021] **FIG. 3** is a schematic block diagram providing exemplary details of processing circuitry of **FIG. 1** capable of being programmed to implement media access controller functionality in accordance with the present invention;

[0022] **FIG. 4** is a state diagram providing details of an exemplary programmable cable media access controller software architecture implemented by the cable modem device of **FIG. 1**; and

[0023] **FIGS. 5A and 5B** are flow diagrams of an exemplary boot process for a programmable cable media access controller according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0024] **FIG. 1** is a block diagram of an exemplary cable modem device **100** having a programmable cable media access controller (hereinafter referred to as a programmable MAC) in accordance with the present invention. The cable modem device **100** permits MAC functions to be programmed to support evolving standards, such as DOCSIS, without concomitant hardware upgrades. The disclosed circuitry may be part of a single integrated circuit, or a combination of integrated circuits. Alternatively, host system circuitry may be leveraged to perform certain of the functions described below.

[0025] The cable modem device **100** can be implemented in a variety of products, including external or internal cable modems with Ethernet and/or USB connections, multifunction home-networking products, interactive set-top-box solutions, digital satellite receivers, wireless networking devices having antennas, Small Office/Home Office (SOHO) equipment and Internet Protocol (IP) telephony products. Accordingly, various embodiments of the invention may interface with non-traditional "cable" media (e.g., any type of media capable of transporting MPEG packets), and the precise nature of the data transmission media is not considered critical to the invention. The cable modem device **100** may be compliant with any of a number of standards, including but not limited to, DOCSIS, DAVIC/DVB (Digital Video Broadcasting) and Voice Over IP (VOIP) standards. In the case of DOCSIS, typical MAC functionality includes MPEG and MCNS decoding and frame synchronization.

[0026] In the cable modem device **100** of **FIG. 1, a** first processor **102** is programmed to implement the desired MAC functionality, while a second processor **104** provides operating system support. The first processor **102** of the disclosed embodiment is designed for high performance data processing. In addition to executing an operating system, the second processor **104** may manage some message processing and scheduling. The second processor **104** preferably utilizes a real-time operating system, such as VxWorks®.

[0027] Data passed between the first and second processors **102** and **104** and other components of the cable modem device **100** may be stored in random access memory (RAM) **106**. The RAM **106**, as well as the first and second processors **102** and **104**, are communicatively coupled to a system bus **108**. The system bus **108** is linked to a peripheral bus **112** via a bridge **110**.

[0028] Bi-directional communication between the cable modem device **100** and cable media **134** is conducted by physical layer devices coupled to the peripheral bus **112**. More particularly, downstream data communicated from the cable media **134** is received by analog-to-digital conversion circuitry **116**. The digital output of the analog-to-digital circuitry **116** is provided to a cable downstream PHY circuitry **114** that performs demodulation and forward error correction functions. The output of the cable downstream PHY circuitry **114** is provided to peripheral bus **112** for processing by the programmable MAC.

[0029] Upstream data to be communicated to the cable media **134** is provided from the peripheral bus **112** to cable upstream PHY circuitry **118** that modulates the upstream data, and may also perform error correction operations. The output of the cable upstream PHY circuitry **118** is communicated to a digital-to-analog converter **120** for provision to the cable media **134**.

[0030] The cable modem device **100** of **FIG. 1** may also include a number of optional interfaces for communicating with a host system or external devices. For example, a host interface **122** and expansion memory interface **124** may be coupled to the system bus **108**. Likewise, the peripheral bus **112** may support a Media Independent Interface (MII) **126**, a General Purpose Input/Output (GPIO) interface **128**, a USB port **130**, and a UART port **132**. As will be appreciated, many other types of interfaces may be provided, and the precise nature of supported devices is not considered critical to the invention.

[0031] Various alternate embodiments of the cable modem device **100** are contemplated. For example, the programmable MAC could be implemented by a pair of processors, with the upstream code handled by one processor and the

downstream code handled by another processor. Such a configuration may provide advantages in terms of software partitioning.

[0032] **FIG. 2** is a schematic block diagram providing exemplary details of the cable modem device **100** of **FIG. 1**. In this embodiment of the invention, the cable modem device **100** utilizes the Advanced System Bus (ASB **210**) and Advanced Peripheral Bus (APB **214**) protocol and bus architecture as specified in the Advanced Microcontroller Bus Architecture (AMBA) specification. The AMBA specification defines an on-chip communication standard for designing high-performance embedded microcontrollers. The ASB **210** is generally utilized for high-performance system modules, supporting the efficient connection of processors, on-chip memories, and off-chip external memory interfaces with low-power peripheral/macrocell functions. The APB **214** is generally utilized with low-power peripherals, and is optimized for minimal power consumption and reduced interface complexity in supporting peripheral fuuctions.

[0033] Another bus defined by the AMBA specification is the Advanced High-Performance Bus (AHB). The AHB is generally utilized with high-performance, high-frequency system modules. The AHB may act as the high-performance system backbone bus, and supports the efficient connection of processors, on-chip memories, and off-chip external memory interfaces with low-power peripheral macrocell functions.

[0034] In the disclosed embodiment of the invention, the ASB **210** is utilized as the system bus **108**, although it is contemplated that other buses such as the AHB may also be used. The ASB **210** is the bus on which the first and second processors **102** and **104**, RAM memory **106**, and other direct memory access (DMA) devices reside. The ASB **210** provides a high-bandwidth interface between the system elements that are involved in the majority of data transfers. An ASB-APB bridge/centralized DMA controller **212** is provided for linking the ASB **210** to the lower bandwidth APB **214**, where most of the peripheral devices in the cable modem device **100** are located. As discussed in greater detail below, the ASB-APB bridge/centralized DMA controller **212** is both an ASB **210** master and an APB **214** master, and utilizes burst transfers and pipelining of data to optimize bus efficiency.

[0035] The APB **214** provides the basic peripheral macrocell communications infrastructure. Such peripherals typically have interfaces which are memory-mapped registers, have few high-bandwidth interfaces, and are accessed under program control (such as the programmable MAC). In the disclosed embodiment of the invention, certain performance enhancements have been made to the APB and ASB, as well as the device interfaces to these buses, as set forth in greater detail in previously incorporated patent applications entitled, "System and Method for Providing an Improved Synchronous Operation of an Advanced Peripheral Bus with Backward Compatibility", and "Asochronous Centralized Multi-Channel DMA Controller".

[0036] Although the disclosed cable modem device **100** utilizes the AMBA bus architecture, in a broader implementation the programmable MAC may be configured to operate with a wide variety of buses and interface with any type of peripheral device. For example, in a host processor-based implementation, the ASB **210** may be replaced with a PCI bus or other type of bus typically found in computer systems.

[0037] In this embodiment of the invention, the first processor **102** includes a microprocessor macrocell providing a high-performance integer core RISC engine that utilizes an instruction memory **200** and a data memory **202**. The second processor **104** of this embodiment is a cached microprocessor macrocell (e.g., an ARM940T macrocell by Advanced RISC Machines) providing a high-performance integer core RISC engine. The second processor **104** has a separate instruction cache **204** and data cache **206**, as well as a memory configuration and protection unit. The instruction and data caches **204** and **206** of the second processor **104** support concurrent processing. In addition, the second processor **104** is capable of performing random read/write ASB accesses and cache line fills, as well as buffered burst writes. The first processor **102** and second processor **104** communicate with the ASB **210** via an AMBA Interface **208***a* and **208***b*, respectively.

[0038] The first processor **102** and second processor **104** each have two interrupt inputs FIQ# and IRQ# that are active-low level-sensitive. In the disclosed embodiment of the invention, the FIQ# interrupt is of higher priority than the IRQ# interrupt and is serviced first when both interrupts are asserted in unison. Servicing an FIQ# interrupt disables an IRQ# interrupt until the FIQ# interrupt handler exits or re-enables the IRQ# interrupt.

[0039] In addition to RAM **106**, a read only memory (ROM) **216** may be provided on the ASB **210**. Further, an ASB arbiter **218** is coupled to the ASB **210**. The ASB arbiter **218** determines which ASB master has access to the ASB **210**. In this embodiment, there are four ASB masters capable of requesting the ASB **210**: the first processor **102**, the second processor **104**, the host interface **122**, and the DMA controller **212**. The arbitration scheme utilized by the ASB arbiter **218** is based on priority. The DMA controller **212** has the highest priority in order to minimize system latency and data buffering for certain peripherals. The host interface **122** has second priority since its access may be less frequent. The first processor **102** has next priority since its accesses may be generally more time critical than those of the second processor **104**. Of course, other arbitration schemes may be utilized.

[0040] The host interface **122** may also function as a test interface controller (TIC) that provides a parallel test access port to the first and second processor **102** and **104**, as well as the ASB **210**. The TIC allows externally applied test vectors to be converted into internal bus transfers. More than one host interface **122** may be maintained by the cable modem device **100**. For example, in addition to the host interface **122**, a PCI or similar interface may added for communicating to a host system, while the host interface **122** communicates with other peripherals such as voice attachments. The host interface **122** supports a slave mode which provides an external host processor access to its internal memory, as well as memory-mapped register set. The host interface **112** also supports a master mode which allows control signals to access external slave devices such as flash memory or data peripherals.

[0041] An ASB decoder **220** is also coupled to the ASB **210**. The ASB decoder **220** decodes addresses on the ASB

210, and provides selection signals to each ASB slave. The expansion memory interface **124** includes an expansion memory access controller (XMAC) that provides an interface to support external memory. In the disclosed embodiment of the invention, the expansion memory interface **124** is a 16-bit synchronous interface, although many variations are possible.

[**0042**] As previously mentioned, a number of physical interfaces to external data sources are coupled to the APB **214**. In particular, a cable media access controller (CMAC) **224**, including a system timer and interfaces to the cable downstream PHY circuitry **114** and cable upstream PHY circuitry **118**, is provided to support communications with a cable media **134**. The CMAC **224** hardware and firmware combine to support a desired specification (e.g., a DOCSIS feature set for the MAC sub-layer of an MCNS cable modem). In general, CMAC **224** aligns incoming packets and prepends a time stamp and appends a pattern recognition trailer structure to form word packets to be delivered to memory by the DMA controller **212**. The CMAC **224** is also responsible for requesting data from the DMA controller **212** at the appropriate time, calculating checksums, and encrypting all or part of the upstream data and bursting the data to the upstream cable upstream PHY circuitry **118**. Exemplary details of the later operation are provided in the previously-incorporated patent application entitled "Method and Apparatus for Upstream Burst Transmission Synchronization in Cable Modems." Delta sigma converter circuitry **228** is also coupled to the CMAC **224** to provide automatic gain control and other functionality for the cable PHY layer.

[**0043**] A pair of DES/CRC engines **222***a* and **222***b* are provided as peripherals to the APB **214**. The DES/CRC engines **222***a* and **222***b* are capable of performing DES encryption or decryption, and/or cyclic-redundancy-checks on a stream of data supplied by the DMA controller **212**. Providing more than one DES/CRC engine **222** permits a plurality of data flow threads to be processed simultaneously.

[**0044**] An Ethernet external datalink is also coupled to the APB **214**, and is comprised of an Ethernet media access controller (EMAC) **226** and the MII **126**. In the disclosed embodiment of the invention, the EMAC **226** supports the MAC sublayer of the IEEE 802.3 specification and allows it to be connected to an IEEE 802.3 10/100 Mbps (100Base-T and 10Base-T) MII compatible EPHY device or seven-wire HomeLan PHY device. The MII **126** provides a port to transmit and receive data that is media independent, multi-vendor interoperable, and supports all data rates and physical standards. The port consists of datapaths that are generally four bits wide in each direction, as well as control and management signals. The MII **126** can be configured as a glueless connection to support Ethernet or HomeLan serial mode.

[**0045**] A USB interface **132** is also coupled to the APB **214**. The USB interface **132** can couple to any of a number of compliant external devices. In the disclosed embodiment of the invention, the USB interface **132** supports receive and transmit signaling of 12-Mb/s.

[**0046**] A number of other miscellaneous peripherals may also be coupled to the APB **214**. For example, a UART **132** may be provided to receive and transmit data, for example, over a telephone line. In addition, a CRC engine **230** is provided to perform single-cycle computations on input data up to 32 bits at a time. This CRC engine **230** is intended to provide high-performance Header Check Sequence (HCS) calculations, as used in both downstream and upstream CMAC operations.

[**0047**] Programmable timer circuitry **232** is also coupled to the APB **214**, and may perform a number of functions. For example, the programmable timer circuitry **232** may generate real-time interrupts, as well as perform system "watchdog" operations. The programmable timer circuitry **232** may also be used as an external event counter.

[**0048**] A pair of interrupt controllers **234** may be provided, one for each of the first processor **102** and second processor **104**. All peripheral interrupt sources are routed through the interrupt controllers **234**, and reduced to two active low inputs to the first and second processors **102** and **104**—FIQ# and IRQ#—which are asserted in response to specified data operations. Software control interrupts may also be provided.

[**0049**] A general purpose I/O bus **128** and I^2C serial bus **236** are also coupled to the APB **214**. It is contemplated that two of the I/O pins of the general purpose I/O bus **128** may be enabled for software controlled I^2C operations via a control register. Pins of the general purpose I/O bus **128** can also serve as external interrupt inputs.

[**0050**] **FIG. 3** is a schematic block diagram providing exemplary details of the first processor **102** of **FIG. 1**. Again, the first processor **102** is capable of being programmed to implement MAC functionality in accordance with the present invention.

[**0051**] As discussed generally above, the first processor **102** comprises a processor core **300**, an instruction memory **200**, and a data memory **202**. Each of these elements communicates with the ASB **210** via the AMBA interface **208***a*. In one contemplated embodiment of the invention, the processor core **300** is a high-performance integer core such as that used in the ARM940T processor macrocell. In one embodiment of the invention, the instruction memory **200** comprises a 20K×32 SRAM coupled to the instruction address and data busses IA and ID. The data memory **202** of the this embodiment comprises a 12K×32 SRAM coupled to the data and address buses DD and DA.

[**0052**] Inputs to the processor core **300** include a JTAG test bus, a clock signal CLK, and the interrupts FIQ# and IRQ#. The processor core **300** also interfaces with an instruction memory control bus and data memory control bus coupled to the AMBA interface **208***a*. In accordance with the ASB specification, a number of control, address and data signals are communicated between the AMBA interface **208** and the ASB **210**.

[**0053**] **FIG. 4** is a state diagram providing details of an exemplary programmable MAC **400** software architecture implemented by the cable modem device **100** of **FIG. 1**. The programmable MAC **400** software of this embodiment of the invention is composed of several software processes that perform various tasks and functions. A number of the programmable MAC **400** processes communicate with each other via shared memory regions, functions, or subroutines. Other programmable MAC **400** processes communicate with the operating system via a programmable MAC interface. The programmable MAC interface may be imple-

mented as a reserved region of data memory or message queues, an interrupt controller, and predefined messages to pass data, configuration parameters, and status information across the interfaces. The programmable MAC **400** processes may span one or more processor contexts. Transitions between programmable MAC **400** processes may occur via external hardware interrupts (IRQ or FIQ), or via a software interrupt causing a change of context. In general, a process executing within a given context will execute linearly until completion or until another context switch occurs.

[0054] The exemplary programmable MAC **400** software of **FIG. 4** comprises six (6) major process: a message router process **401**, a command processor **402**, a downstream process **404**, a PLL process **406**, an upstream process **408**, and a map and upstream (MUP) process **410**. These processes are provided by way of example, and it is contemplated that a greater number or a fewer number of processes could be implemented without departing from the spirit or scope of the invention.

[0055] The message router **401** is primarily responsible for managing the flow of information into and out of the programmable MAC. This includes placing programmable MAC downstream data (protocol data units (PDU) and MAC management messages (MMM)) and status messages in the programmable MAC output message FIFO **414**. The message router **401** is also responsible for retrieving programmable MAC upstream data and configuration messages from the programmable MAC input message FIFO **412**. Messages retrieved by the message router **401** are then routed to the appropriate programmable MAC **400** process. The message router **401** is further responsible for managing programmable MAC status interrupts.

[0056] The message router **401** also interacts with a command processor that receives and processes MCNS and other commands. Commands directed to the command processor **402** are placed in the command input message queue **416**, while a command output message queue **418** is used to store output messages from the command processor **402**.

[0057] The downstream process **404** manages and monitors the flow of downstream data. More particularly, the downstream process **404** of the disclosed embodiment of the invention is responsible for: MPEG synchronization, MPEG frame header verification, MCNS frame header verification, extraction of MCNS extended header information, SID perfect filtering, MAC address perfect filtering, imperfect multi-cast address filtering, information element filter, DES decryption, CRC validation, downstream data transfer to the appropriate destination (PLL, MAP processor, or programmable MAC external interface), and downstream statistics.

[0058] Messages from the message router **401** to the downstream process **404** are placed in a downstream process input message queue **424**, while messages from the downstream process **404** to the message router **401** are placed in a downstream process output message queue **426**. The downstream process **404** communicates with a downstream PHY **440** via a downstream interface **446** and MPEG buffers **448**. The downstream process **404** further utilizes a downstream DES/CRC engine **442** to provide decryption and validation functionality.

[0059] The PLL process **406** functions to provide a local clock reference that is phase-locked to a CMTS clock. The PLL process **406** further provides conversion functions to convert between system time and the local hardwire time. In addition, the PLL process **406** communicates status information to the second processor **104** and the other programmable MAC processes. Messages from the message router **401** to the PLL process **406** are placed in a PLL input message queue **428**. Messages from the PLL process **406** to the message router **401** may be placed in a PLL output message queue **430**.

[0060] The upstream process **408** manages the transmission of upstream data. More particularly, the upstream process **408** handles: concatenation/fragmentation of upstream frames, checksum or CRC computation, DES encryption, programming the upstream physical layer or PHY **436**, and ensuring time-to-send requirements are met. The upstream process **408** utilizes an upstream DES/CRC function **432** to coordinate encryption and validation of upstream data. The upstream process **408** further communicates with an upstream interface **438**, and receives linked list data **434** from the MUP process **410**.

[0061] The MUP process **410** handles the processing of downstream MAP frames, manages the scheduling of upstream frame transmission, and handles the ranging process used to optimize communications with a cable headend. The MUP process **410** of the disclosed embodiment of the invention has two entry points: a MUP input message queue **422** that is called by the message router **401** when a new input message is available in the queue, and a MAP queue **440** that is called by the downstream process **404** when new MAP is available. MUP output message queue **420** is also provided for passing data to the message router **401**.

[0062] It is contemplated that additional functions may be added to the exemplary programmable MAC **400** software architecture of **FIG. 4**, and that other functions may be implemented in hardware.

[0063] **FIGS. 5A and 5B** are flow diagrams of an exemplary boot process for a programmable MAC according to the present invention. The boot process of the disclosed embodiment of the invention maintains a boot status memory area at a fixed address in memory to allow the second processor **104** to monitor the boot status of the programmable MAC. The boot status memory region preferably resides at a fixed, word-line address in the processor data memory. The programmable MAC updates words in the boot status region with non-zero values as it proceeds through the boot process. The boot process may be conducted by the second processor **104**, by a host system via a host system interface **122**, or by other circuitry of the cable modem device **100**.

[0064] Following commencement of the boot process at step **500**, the programmable MAC stack pointers and variables are initialized at step **502**. The programmable MAC can maintain separate stacks for each of the separate contexts or operating modes of the processor **102**. These stacks, as well as processor data memory variables, are initialized in this step.

[0065] Next, in step **504**, the boot process calls a boot function to perform the remainder of the disclosed programmable MAC boot process. The boot function of the boot process proceeds to step **506**, where a checksum is performed on the programmable MAC software loaded into the

processor instruction memory. The computed checksum is then compared to a value stored in a global memory variable. Next, beginning with step **508**, all programmable MAC software processes are initialized via initialization routines called by the boot process. The downstream process is first initialized in step **508**, followed by initialization of PLL in step **510**. The MAP process is next initialized in step **512**.

[**0066**] The boot process continues at step **514** (**FIG. 5B**) where the upstream process is initialized. The programmable MAC interface is next initialized in step **516**, followed by initialization of the command process in step **518**.

[**0067**] Following initialization of the programmable MAC software processes, the boot process determines if the initialization routines executed correctly. If not, the boot process writes a "fail" value to the operating state word of the boot status memory. Next, a boot failure loop is entered in step **524**, although it is contemplated that step **522** may be performed upon entry into the boot failure loop. In addition, if the boot process fails, a power-on reset may be applied by the second processor **104**.

[**0068**] If the initialization routines executed correctly as determined in step **520**, the boot process proceeds to step **526** and a version number of the programmable MAC software is written to the operating state word of the boot state status memory. Next, in step **528**, the boot process enable interrupt bits associated with the programmable MAC interface or message router **401**. Finally, the boot process sends a message to the operating system indicating that the power on processes is complete and the programmable MAC is ready for operation.

[**0069**] Thus, a cable modem having a programmable MAC has been described. The programmable MAC features of the cable modem provide a software upgrade path to permit support for new versions and variations of cable modem standards, thereby reducing or eliminating hardware development costs.

[**0070**] In view of the above detailed description of the present invention and associated drawings, other modifications and variations will now become apparent to those skilled in the art. It should also be apparent that such other modifications and variations may be effected without departing from the spirit and scope of the present invention.

What is claimed is:

1. A cable modem having a programmable media access controller, comprising:

a system bus;

a plurality of processors, each of the plurality of processors is communicatively coupled to the system bus, that perform a plurality of processing functions, the plurality of processing functions are partitioned, at least in part, between at least two of the plurality of processors;

a peripheral bus that is operable to perform transfer of cable media;

a bridge that communicatively couples the system bus and the peripheral bus; and

a peripheral processing device, communicatively coupled to the peripheral bus, that is operable to perform processing of a selectively off-loaded portion of the cable media.

2. The cable modem of claim 1, wherein one of the plurality of processors supports upstream data transfer of cable media received by the cable modem; and

at least one other of the plurality of processors supports downstream data transfer of the cable media transmitted by the cable modem.

3. The cable modem of claim 1, wherein one of the plurality of processors is operable to perform at least one of message processing and scheduling.

4. The cable modem of claim 1, wherein the bridge comprises a direct memory access controller that is operable selectively to provide a portion of the cable media to one of the plurality of processors and to provide the off-loaded portion of the cable media to the peripheral processing device.

5. The cable modem of claim 1, further comprising at least one additional peripheral processing device, communicatively coupled to the peripheral bus, that is operable to perform processing of at least one additional selectively off-loaded portion of the cable media.

6. The cable modem of claim 1, wherein the plurality of processing functions comprises operating system functionality.

7. The cable modem of claim 1, wherein the plurality of processing functions comprises media access control functionality.

8. The cable modem of claim 1, wherein one of the plurality of processors employs embedded code to support media access control functionality.

9. A cable modem device, comprising:

a bifurcated bus structure comprising a first bus and a second bus;

a partitioned processor structure, communicatively coupled to the first bus, comprising a plurality of processors, that is operable to perform a plurality of processing functions;

a co-processor, communicatively coupled to the second bus, that is operable to support processing of cable media that is selectively off-loaded from at least one of the plurality of processors;

an input/output interface, communicatively coupled to the second bus, that is operable to perform data transfer of a plurality of data to the second bus; and

a direct memory access controller that communicatively couples the first bus and the second bus and that is operable to support off-loading of at least one function of the plurality of functions to the co-processor.

10. The cable modem device of claim 9, further comprising at least one additional coprocessor, communicatively coupled to the second bus, that is also operable to support processing of cable media that is selectively off-loaded from at least one of the plurality of processors.

11. The cable modem device of claim 9, wherein the first bus employs an Advanced System Bus protocol; and

the second bus employs an Advanced Peripheral Bus protocol.

12. The cable modem device of claim 9, wherein one of the plurality of processors supports upstream data transfer of cable media received by the cable modem; and

at least one other of the plurality of processors supports downstream data transfer of the cable media transmitted by the cable modem.

13. The cable modem device of claim 9, wherein the co-processor is operable to perform at least one of DES encryption and DES decryption.

14. The cable modem device of claim 9, wherein the plurality of processing functions comprises operating system functionality and media access control functionality.

15. The cable modem device of claim 9, wherein the second bus operates consuming power at a rate lower than a rate at which the first bus consumes power.

16. The cable modem device of claim 9 manufactured as an integrated circuit.

17. A method to perform processing within a cable modem, the method comprising:

performing cable media processing using a plurality of processors, the cable media processing is partitioned, at least in part, between at least two of the plurality of processors;

selectively off-loading a portion of the cable media from at least one of the plurality of processors to a co-processor; and

processing the off-loaded portion of the cable media using the co-processor.

18. The method of claim 17, wherein the method is performed within an integrated circuit.

19. The method of claim 17, wherein at least one of the plurality of processors comprises embedded code that is substantially operable for media access control functionality.

20. The method of claim 17, further comprising directing upstream and downstream communications of cable media using at least two of the plurality of processors.

* * * * *

Appendix G

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D	9980

65913 7590 02/19/2009

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EXAMINER	
HOSSAIN, TANIM M	
ART UNIT	**PAPER NUMBER**
2445	

NOTIFICATION DATE	DELIVERY MODE
02/19/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ip.department.us@nxp.com

Office Action Summary	Application No.	Applicant(s)	
	10/675,566	LI ET AL.	
	Examiner	Art Unit	
	Tanim Hossain	2445	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 September 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *30 September 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-15 are rejected under 35 U.S.C. 102(e) as being anticipated by Brooks (U.S. 2001/0039600)

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

As per claim 1, Brooks teaches a cable modem system comprising: a data networking engine that performs data networking functions (Abstract; paragraphs 0013-0016); and a cable modem engine that performs all other cable modem functions (Abstract; paragraphs 0013-0016); the cable modem engine being completely partitioned from the data networking engine (Abstract; paragraphs 0013-0016).

As per claim 2, Brooks teaches a cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine (0024-0026).

As per claim 3, Brooks teaches a cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine (0024-0026).

As per claim 4, Brooks teaches a cable modem system as claimed in claim 1, and further comprising an advanced crypto engine that performs all crypto functions (0013).

As per claim 5, Brooks teaches a cable modem system as claimed in claim 1, wherein the cable modem engine comprises: a DOCSIS PHY layer (0024-0026); a DOCSIS MAC processor (0024-0026); and a DOCSIS controller (0024-0026).

As per claim 6, Brooks teaches a cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer comprises a hardware transmitter and receiver (0024-0026).

As per claim 7, Brooks teaches a cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor processes downstream PDU packets and forwards the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput (0024-0026).

As per claim 8, Brooks teaches a cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller (0024-0026).

As per claim 9, Brooks teaches a cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification (0024-0026).

As per claim 10, Brooks teaches a cable modem system as claimed in claim 5, wherein the data networking engine is responsible for all data networking processing including advanced

multi-port briding/routing with NAT/firewall and VPN, and home networking applications (0024-0026).

As per claim 11, Brooks teaches a cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification (0024-0026).

As per claim 12, Brooks teaches a cable modem architecture comprising: a cable modem engine comprising: a DOCSIS PHY layer comprising a transmitter and receiver (0024-0026); a DOCSIS MAC processor that implements real-time critical MAC functions for both upstream and downstream communications (0024-0026); and a DOCSIS controller implementing VoIP functionality (0024-0026); and a data networking engine implementing all data networking processing and home networking applications, wherein the data networking engine is completely decoupled from the cable modem engine (0024-0026).

As per claim 13, Brooks teaches a cable modem architecture as claimed in claim 12, wherein the DOCSIS controller provides VoIP functionality in accordance with the PacketCable specification, and wherein the data networking engine provides the embedded portal services functionality of the CableHome specification, wherein the CableHome functionality is provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine (0013-0016, 0024-0026).

As per claim 14, Brooks teaches a cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor (0013-0016, 0024-0026).

As per claim 15, Brooks teaches a method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VolP functionality in a cable modem engine (0013-0016, 0024-0026); and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VolP functionality (0013-0016, 0024-0026).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tanim Hossain whose telephone number is (571)272-3881. The examiner can normally be reached on 8:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenton Burgess can be reached on 571/272-3949. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Tanim Hossain
Patent Examiner
Art Unit 2445
/Larry D Donaghue/
Primary Examiner, Art Unit 2454

Confirmation No. 9980

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	LI *et al.*	Examiner:	Hossain, Tanim
Serial No.:	10/675,566	Group Art Unit:	2445
Filed:	September 30, 2003	Docket No.:	81373818US01 (NXPS.615PA)
Title:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM		

AMENDMENT AND RESPONSE TO OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Customer No.
65913

Dear Sir:

In acknowledgement of the non-final Office Action dated February 19, 2009, please reconsider the application in view of the following amendments and remarks.

A complete listing of the claims, including any amendments, and Remarks/Arguments follow.

In the Claims:

Please amend the claims as indicated below.

1. (Currently Amended) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform ~~that performs~~ home ~~data~~ networking functions including interfacing with customer provided equipment; ~~and~~

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable mode engine to perform ~~that performs all other~~ cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and

a data bus that connects the data networking engine to the cable modem engine,

wherein the cable modem functions performed by the cable modem engine are ~~being~~ completely partitioned from the home networking functions performed by the data networking engine.

2. (Original) A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. (Original) A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. (Currently Amended) A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine configured to perform ~~that performs~~ all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem

engine.

5. (Currently Amended) A cable modem system as claimed in claim 1, wherein the cable modem engine includes ~~comprises~~:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller, and

wherein the at least one processor of the data networking engine is a RISC processor.

6. (Currently Amended) A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer includes ~~comprises~~ a hardware transmitter and receiver.

7. (Currently Amended) A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor is configured to process ~~processes~~ downstream PDU packets and forward ~~forwards~~ the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. (Original) A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. (Original) A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. (Currently Amended) A cable modem system as claimed in claim 5, wherein the data networking engine is configured to perform ~~responsible for~~ all data networking processing including advanced multi-port bridging ~~briding~~/routing with NAT/firewall and VPN, and home networking applications.

11. (Original) A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. (Currently Amended) A cable modem architecture comprising:

a cable modem engine that includes ~~comprises~~:

a DOCSIS PHY layer comprising a transmitter and receiver;

a DOCSIS MAC processor configured to implement ~~that implements~~ real-time critical MAC functions for both upstream and downstream communications; and

a DOCSIS controller configured to implement ~~implementing~~ VoIP functionality; and

a data networking engine that includes a RISC processor configured to implement ~~implementing~~ all data networking processing and home networking applications, wherein the implementation of the data networking processing and home networking applications by the data networking engine is completely decoupled from the implementation of the MAC functions and the VoIP functionality by the cable modem engine.

13. (Currently Amended) A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller is configured to provide ~~provides~~ VoIP functionality in accordance with the PacketCable specification, ~~and~~ wherein the data networking engine is configured to provide ~~provides~~ the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality ~~is~~ provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. (Original) A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. (Original) A method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VoIP functionality in a cable modem engine; and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

16. (New) A cable modem system as claimed in claim 5, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

Remarks

In the non-final Office Action dated February 19, 2009, the following grounds of rejection are presented: claims 1-15 stand rejected under 35 U.S.C. § 102(e) over Brooks (U.S. Patent Pub. 2001/0039600). In the following discussion, Applicant does not acquiesce in any regard to averments in this Office Action (unless Applicant expressly indicates otherwise).

Applicant respectfully traverses the § 102(e) rejection of claims 1-15 because the cited portions of the '600 reference do not correspond to aspects of the claimed invention directed to the data networking functions performed by a data networking engine being completely partitioned/decoupled from the other cable modem functions performed by a cable modem engine. The cited portions of the '600 reference teach a cable modem device 100 that includes two separate processors 102 and 104 (*see, e.g.,* Figure 1 and paragraphs 0024-0026, which are apparently being asserted as corresponding to the DOCSIS MAC processor and the DOCSIS controller of Applicant's cable modem engine (*see, e.g.,* claims 5-14). Applicant submits that the '600 reference does not teach a separate data networking engine (as claimed) that implements certain functionality in a manner that is completely partitioned/decoupled from the functionality performed by processors 102 and 104 of cable modem device 100. Specifically, the '600 reference teaches that the home-networking functionality is implemented by the same processors that implement the DOCSIS and VoIP functionality, instead of implementing these functionalities in a partitioned manner in separate engines, as claimed. Thus, the cited portions of the '600 reference do not correspond to the claimed invention.

Applicant notes that the Office Action does not identify what element of the '600 reference is being asserted as corresponding to Applicant's data networking engine. In fact, the Office Action fails to provide any explanation regarding which specific elements of the '600 reference (*e.g.,* processors 102 and 104) are alleged to correspond to any element of the claimed invention (*e.g.,* Applicant's data networking engine, cable modem engine, DOCSIS MAC processor and the DOCSIS controller). In order to comply with 35 U.S.C. § 132, sufficient detail must be provided by the Examiner regarding the alleged correspondence between the claimed invention and the cited reference to enable Applicant to adequately respond to the rejections. *See, also,* 37 CFR 1.104 ("The pertinence of each reference, if not apparent, must be clearly explained and each rejected

claim specified.") and M.P.E.P. § 706.02(j), ("It is important for an Examiner to properly communicate the basis for a rejection so that the issues can be identified early and the applicant can be given fair opportunity to reply."). As such, should any rejection based on the '600 reference be maintained, Applicant respectfully requests that the Examiner specifically identify which element of the '600 reference is being alleged to correspond to each element of the claimed invention.

In view of the above, the § 102(c) rejection of claims 1-15 is improper and Applicant requests that it be withdrawn.

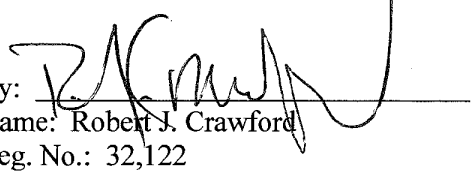
Applicant further traverses the § 102(e) rejection of various dependent claims because the Office Action fails to adequately address these claims. Regarding claim 7, the '600 reference does not teach that processor 102 (taught by the '600 reference to implement MAC functionality) processes PDU packets and forwards these packets to an apparently nonexistent data networking engine (as claimed) without the involvement of some other processor, which is not identified by the Office Action. Regarding claims 9, 11 and 13-14, the '600 reference does not teach that cable modem device 100 implements functionality of the PacketCable specification or functionality of the CableHome specification. In fact, the '600 reference does not make any mention of either the PacketCable specification or the CableHome specification. Accordingly, the § 102(e) rejection of claims 7, 9, 11 and 13-14 is improper and Applicant requests that it be withdrawn.

In view of the above, Applicant believes that each of the rejections is improper and should be withdrawn and that the application is in condition for allowance. Should there be any remaining issues that could be readily addressed over the telephone, the Examiner is asked to contact the agent overseeing the application file, David Cordeiro, of NXP Corporation at (408) 474-9063 (or the undersigned).

Please direct all correspondence to:

Corporate Patent Counsel
NXP Intellectual Property & Standards
1109 McKay Drive; Mail Stop SJ41
San Jose, CA 95131

CUSTOMER NO. 65913

By: 
Name: Robert J. Crawford
Reg. No.: 32,122
651-686-6633
(NXPS.615PA)

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D	9980

65913 7590 09/03/2009

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EXAMINER	
HOSSAIN, TANIM M	
ART UNIT	**PAPER NUMBER**
2445	

NOTIFICATION DATE	DELIVERY MODE
09/03/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ip.department.us@nxp.com

Office Action Summary	Application No.	Applicant(s)	
	10/675,566	LI ET AL.	
	Examiner	Art Unit	
	Tanim Hossain	2445	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 1 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *5/19/09*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) _____ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-16* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-11 and 16, drawn to computer software upgrading, classified in class 717, subclass 168.

II. Claims 12-15, drawn to network protocol implementation, classified in class 709, subclass 230.

Inventions I and II are related as subcombinations as usable together in a single combination. The subcombinations are distinct from each other if they are shown to be separately usable. In the instant case, Invention I discloses the upgrading of software for the system in an independent fashion. This specific upgrading concept is classified in class 717, subclass 168. On the other hand, Invention II includes the implementation and use of various protocols to employ different network functionalities, and is thus classified accordingly, in class 709, subclass 230. Both inventions may be implemented separately from one another.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classifications, restriction for examination purposes as indicated is proper.

Applicant is advised that the reply to this requirement to be complete must include an election of the invention to be examined even though the requirement be traversed (37 CFR 1.143).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tanim Hossain whose telephone number is (571)272-3881. The examiner can normally be reached on 8:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vivek Srivastava can be reached on 571/272-7304. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Tanim Hossain
Patent Examiner
Art Unit 2445

/VIVEK SRIVASTAVA/

Supervisory Patent Examiner, Art Unit 2445

Confirmation No. 9980

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	LI *et al.*	Examiner:	Hossain, Tanim
Serial No.:	10/675,566	Group Art Unit:	2445
Filed:	September 30, 2003	Docket No.:	81373818US01 (NXPS.615PA)
Title:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM		

RESPONSE TO ELECTION/RESTRICTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Customer No.
65913

Dear Sir:

This communication is in reply to the Office Action dated September 3, 2009 in which a restriction/election requirement was presented.

A complete listing of the Claims, to include any amendments thereto, and the Remarks follow.

App. Serial No. 10/675,566
Docket No.: 81373818US01

In the Claims:

1. (Previously presented) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable mode engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and

a data bus that connects the data networking engine to the cable modem engine,

wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

2. (Original) A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. (Original) A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. (Previously presented) A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine configured to perform all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem engine.

5. (Previously presented) A cable modem system as claimed in claim 1, wherein the cable modem engine includes:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller, and

wherein the at least one processor of the data networking engine is a RISC processor.

6. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer includes a hardware transmitter and receiver.

7. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor is configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. (Original) A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. (Original) A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine is configured to perform all data networking processing including advanced multi-port bridging routing with NAT/firewall and VPN, and home networking applications.

11. (Original) A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. (Currently amended) A cable modem <u>system as claimed in claim 5, wherein the</u> ~~architecture comprising: a~~ cable modem engine ~~that~~ includes:

the [[a]] DOCSIS PHY layer includes ~~comprising~~ a transmitter and receiver;

the [[a]] DOCSIS MAC processor is configured to implement real-time ~~critical~~ MAC functions for both upstream and downstream communications; and

the [[a]] DOCSIS controller is configured to implement VoIP functionality; and wherein

the [[a]] data networking engine ~~that~~ includes a RISC processor configured to implement substantially all data networking processing and home networking applications~~, wherein the implementation of the data networking processing and home networking applications by the data networking engine is completely~~ decoupled from the implementation of the MAC functions and the VoIP functionality of ~~by~~ the cable modem engine.

13. (Previously presented) A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, wherein the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. (Original) A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. (Original) A method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VoIP functionality in a cable modem engine; and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

16. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

Remarks

In the Office Action dated September 3, 2009, a Restriction/Election was made, requesting that Applicant elect either Group I (consisting of claims 1-11 and 16) or Group II (consisting of claims 12-15). Applicant elects the claims identified under Group I (claims 1-11, 12-14 as amended and 16) with traverse. Applicant respectfully submits that the rationale used in support of the restrictions does not comply with the rules and guidelines set forth in the M.P.E.P. Applicant submits that the restrictions should be withdrawn.

The Office Action asserts that the inventions of Groups I and II are related as subcombinations as usable together in a single combination and that both inventions may be implemented separately from one another. Specifically, the Office Action asserts that the invention of Group I "discloses the upgrading of software for the system in an independent fashion" and the invention of Group II "includes the implementation and use of various protocols to employ different network functionalities."

Applicant traverses for lack of compliance with the restriction guidelines in the M.P.E.P. and because no basis has been provided to support the separate use conclusion in the Office Action.

Notwithstanding, Applicant has amended claim 12 to comport to the scope presented in the Office Action.

Accordingly, Applicants respectfully requests that the Examiner withdraw the present restriction requirement(s) for examination of all the claims.

App. Serial No. 10/675,566
Docket No.: 81373818US01

In view of the above, Applicant believes that each of the rejections is improper and should be withdrawn and that the application is in condition for allowance. Should there be any remaining issues that could be readily addressed over the telephone, the Examiner is asked to contact the agent overseeing the application file, Peter Zawilski, of NXP Corporation at (408) 474-9063 (or the undersigned).

Please direct all correspondence to:

Corporate Patent Counsel
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San Jose, CA 95131

CUSTOMER NO. 65913

By: _____
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Reg. No.: 32,122
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D	9980

65913 7590 02/05/2010

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EXAMINER	
HOSSAIN, TANIM M	
ART UNIT	**PAPER NUMBER**
2445	

NOTIFICATION DATE	DELIVERY MODE
02/05/2010	ELECTRONIC

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The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ip.department.us@nxp.com

Office Action Summary	Application No.	Applicant(s)	
	10/675,566	LI ET AL.	
	Examiner	Art Unit	
	Tanim Hossain	2445	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 October 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

Claim 1 is objected to because of the following informalities: The term, "the cable mode engine" in line 9 appears to be a typographical error. Appropriate correction is required.

Election/Restriction

The restriction requirement filed on September 3, 2009 is hereby withdrawn.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 12 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 12 discloses that the data networking engine includes a RISC processor, which is not supported by the specification.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 12 -14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 12 contains the term "substantially" The term is not defined in the specification rendering the claim indefinite. Other claims are dependent from claim 12.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-16 are rejected under 35 U.S.C. 102(e) as being anticipated by Brooks (U.S. 2001/0039600).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

As per claim 1, Brooks teaches a cable modem system comprising: a data networking engine implemented in a first circuit that includes at least one processor (Figure 2), the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment (Abstract; paragraphs 0014, 0026, 0037, 0066-0068); a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine (paragraphs 0026, 0037, 0042-0046, 0050-0052); a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine (0042-0046).

As per claim 2, Brooks teaches a cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine (0024-0026).

As per claim 3, Brooks teaches a cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine (0024-0026).

As per claim 4, Brooks teaches a cable modem system as claimed in claim 1, and further comprising an advanced crypto engine that performs all crypto functions (0013).

As per claim 5, Brooks teaches a cable modem system as claimed in claim 1, wherein the cable modem engine comprises: a DOCSIS PHY layer (0024-0026); a DOCSIS MAC processor (0024-0026); and a DOCSIS controller (0024-0026).

As per claim 6, Brooks teaches a cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer comprises a hardware transmitter and receiver (0013, 0024-0026).

As per claim 7, Brooks teaches a cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor processes downstream PDU packets and forwards the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput (0024-0026, 0028).

As per claim 8, Brooks teaches a cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller (0024-0026).

As per claim 9, Brooks teaches a cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification (0024-0026).

As per claim 10, Brooks teaches a cable modem system as claimed in claim 5, wherein the data networking engine is responsible for all data networking processing including advanced

multi-port bridging/routing with NAT/firewall and VPN, and home networking applications (0024-0026, 0030).

As per claim 11, Brooks teaches a cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification (0024-0026).

As per claim 12, Brooks teaches a cable modem as claimed in claim 5, wherein the cable modem engine includes: the DOCSIS PHY layer includes a transmitter and receiver (0030); the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications (0053-0054); the DOCSIS controller is configured to implement VoIP functionality (0025); and wherein the data networking engine includes a RISC processor configured to implement all data networking processing and home networking applications, decoupled from the implementation of the MAC functions and the VoIP functionality of the cable modem engine (0037, 0043-0045).

As per claim 13, Brooks teaches a cable modem architecture as claimed in claim 12, wherein the DOCSIS controller provides VoIP functionality in accordance with the PacketCable specification, and wherein the data networking engine provides the embedded portal services functionality of the CableHome specification, wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine (0013-0016, 0024-0026).

As per claim 14, Brooks teaches a cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor (0013-0016, 0024-0026, 0037).

As per claim 15, Brooks teaches a method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VoIP functionality in a cable modem engine (0013-0016, 0024-0026); and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality (0013-0016, 0024-0026).

As per claim 16, Brooks teaches a cable modem system as claimed in claim 5, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine (0044-0045).

Response to Remarks

Applicant's remarks filed on May 19, 2009 have fully been considered.

The data networking engine and cable modem engines are represented in figures 1 and 2 of the Brooks reference, including buses carrying out separate networking functions. For example, the data networking engine interfaces with the peripheral devices and employs operating system functions, and the cable modem engine implements DOCSIS functionality. These entities are completely partitioned from each other, as discussed in the cited sections.

Paragraphs 0036-0042 discuss the transfer of packets between the cable modem and data networking engines. Therefore, examiner respectfully disagrees with the assertion that there is no data networking engine, and it is respectfully submitted that the Brooks invention fully teaches the limitations of claim 7. Further, paragraph 0010 discusses the inclusion of various CableLabs standards. Because PacketCable and CableHome specifications constitute these standards, Brooks fully teaches the claim limitations.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tanim Hossain whose telephone number is (571)272-3881. The examiner can normally be reached on 8:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vivek Srivastava can be reached on 571/272-7304. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Tanim Hossain
Patent Examiner
Art Unit 2445

/Nabil El-Hady/
Supervisory Patent Examiner, Art Unit 4191

Reply under 37 C.F.R. 1.116
Expedited Procedure
Technology Center 2445

Confirmation No. 9980

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	LI *et al.*	Examiner:	Hossain, Tanim
Serial No.:	10/675,566	Group Art Unit:	2445
Filed:	September 30, 2003	Docket No.:	81373818US01 (NXPS.615PA)
Title:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM		

REQUEST TO WITHDRAW FINALITY AND RESPONSE TO FINAL OFFICE ACTION

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Customer No. 65913

Dear Sir:

In acknowledgement of the Final Office Action dated February 5, 2010, please reconsider the application in view of the following amendments and remarks.

A complete listing of the claims, including any amendments, and Remarks/Arguments follow.

Authorization is given to charge/credit **Deposit Account 50-4019 (81373818US01)** all required fees/overages to enter this paper.

App. Serial No. 10/675,566
Docket No.: 81373818US01

In the Claims:

1. (Currently amended) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem ~~mode~~ engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and

a data bus that connects the data networking engine to the cable modem engine,

wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

2. (Original) A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. (Original) A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. (Previously presented) A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine configured to perform all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem engine.

5. (Previously presented) A cable modem system as claimed in claim 1, wherein the cable modem engine includes:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller, and

wherein the at least one processor of the data networking engine is a RISC processor.

6. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer includes a hardware transmitter and receiver.

7. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor is configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. (Original) A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. (Original) A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine is configured to perform all data networking processing including advanced multi-port bridging routing with NAT/firewall and VPN, and home networking applications.

11. (Original) A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. (Currently Amended) A cable modem system as claimed in claim 5, wherein the cable modem engine includes:

the DOCSIS PHY layer includes a transmitter and receiver;

the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications; and

the DOCSIS controller is configured to implement VoIP functionality; and wherein

the data networking engine ~~that~~ includes a RISC processor configured to implement ~~substantially all~~ a majority of data networking processing and home networking applications decoupled from the implementation of the MAC functions and the VoIP functionality of the cable modem engine.

13. (Previously presented) A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, wherein the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. (Original) A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. (Original) A method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VoIP functionality in a cable modem engine; and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

16. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

Remarks

In the non-final Office Action dated February 5, 2010, the following grounds of rejection are presented: claim 1 is objected to as to informalities; claim 12 is rejected under 35 U.S.C § 112, first paragraph as failing to comply with the written description requirement; claims 12-14 are rejected under 35 U.S.C § 112, second paragraph as being indefinite; claims 1-16 stand rejected under 35 U.S.C. § 102(e) over Brooks (U.S. Patent Pub. 2001/0039600). In the following discussion, Applicant does not acquiesce in any regard to averments in this Office Action (unless Applicant expressly indicates otherwise).

Applicant has amended claim 1 to correct a typographical error, and requests that the objection be removed.

Applicant respectfully traverses the § 102(e) rejection of claims 1-16 because the cited portions of the '600 reference do not correspond to aspects of the claimed invention. For example, Applicant is uncertain how the '600 reference discloses aspects of the claimed invention directed to data networking functions performed by a data networking engine being completely partitioned/decoupled from the other cable modem functions performed by a cable modem engine. The Examiner has repeatedly failed to identify elements of the '600 reference corresponding to these aspects as requested. In contrast, the Office Action make the conclusion statement that "the data networking engine and cable modem engines are represented in Figures 1 and 2 of the ['600] reference" (*see, e.g.*, p. 8 of the Office Action). However, Applicant is uncertain how any reasonable interpretation of these Figures can provide correspondence. For example, Figure 2 of the '600 reference discloses only two processors, each of which, therefore, must correspond to the claimed data-networking and cable-modem engines. However, the discussion of Figure 2 makes clear that the cable modem functions are performed by CMAC unit 224 (*see, e.g.*, paragraph 0042). Therefore, in order for the cable modem engine to contain a processor and perform the CMAC functions as claimed, the cited cable modem engine must include circuitry to connect the processors with the CMAC unit. Because available connecting circuitry would be shared with the other processor, Applicant is uncertain how the asserted cable modem engine and home networking engine can be completely

partitioned as claimed. Because the Office Action has not identified these claimed aspects in the '600 reference, a *prima facie* case has not been presented and Applicant requests that the rejection of claims 1-16 be withdrawn.

Applicant submits that the Examiner's failure to identify corresponding elements as requested in Applicant's response constitutes an incomplete answer under M.P.E.P. § 707.07 and, therefore, makes the finality of the Office Action improper. In order to comply with 35 U.S.C. § 132, sufficient detail must be provided by the Examiner regarding the alleged correspondence between the claimed invention and the cited reference to enable Applicant to adequately respond to the rejections. *See, also,* 37 CFR 1.104 ("The pertinence of each reference, if not apparent, must be clearly explained and each rejected claim specified.") and M.P.E.P. § 706.02(j), ("It is important for an Examiner to properly communicate the basis for a rejection so that the issues can be identified early and the applicant can be given fair opportunity to reply."). Because the Examiner has repeatedly failed to identify specific elements of the '600 reference which provide correspondence (as requested in the previous response), Applicant submits that the Office Action is unresponsive to Applicant's arguments and Applicant requests the finality of the Office Action be withdrawn.

Applicant respectfully traverses the § 112(1) rejection of claim 12 because aspects of the claim directed to a RISC processor are fully supported by Applicant's specification in compliance with the written description requirement. As shown in Figure 1 and related discussion at paragraph 0028 of Applicant's published specification, "the functions of the cable modem and data networking are rationally distributed among three different processors: DOCSIS MAC processor 114 (ARM #2); DOCSIS controller 116 (ARM #1); and data networking engine 120 (ARM #3)." Applicant submits that ARM, as commonly used in the art, refers to the Advanced RISC Machine (ARM). ARM is a 32-bit reduced instruction set computer (RISC) instruction set architecture developed by ARM Holding. Applicant submits that word-for-word correspondence is not required by the M.P.E.P. or relevant law, and maintains that the figures, together with the aforementioned discussion in the specification, fully support the claim limitations. *See, e.g., Union Oil Co. of California v. Atlantic Richfield Co.*, 208 F.3d 989 (Fed. Cir. 2000), *cert. denied*, 69 U.S.L.W. 3165 (Feb. 20, 2001) (No. 00-249) (quoting *In re Gosteli*, 872

F.2d 1008, 1012, 10 U.S.P.Q.2d 1614, 1618 (Fed. Cir. 1989) ("The written description requirement does not require the applicant "to describe exactly the subject matter claimed, [instead] the description must clearly allow persons of ordinary skill in the art to recognize that [he or she] invented what is claimed. "). Accordingly the 112(1) rejection is improper and should be withdrawn.

Applicant respectfully traverses the § 112(2) rejection of claims 12-14. While the Office Action erroneously suggests that "substantially" must be defined in the specification. Consistent with § 112(2), Applicant submits that, as used, the phase "substantially all" would be understood by one of ordinary skill in the art in light of the specification and in the context of decoupling performance of data networking and home networking applications from the implementation of the MAC and VoIP functionality. *See, Andrew Corp. v. Gabriel Electronics*, 847 F.2d 819 (Fed. Cir. 1988). Accordingly, the §112(2) rejection of claims 12-14 fails. Notwithstanding the above, Applicant has amended the claims for clarity and to better reflect the original intent of the claims. The §112(2) rejection is believe to no longer apply.

In view of the above, Applicant believes that each of the rejections is improper and should be withdrawn and that the application is in condition for allowance. Should there be any remaining issues that could be readily addressed over the telephone, the Examiner is asked to contact the agent overseeing the application file, Peter Zawilski, of NXP Corporation at (408) 474-9063 (or the undersigned).

Please direct all correspondence to:

Corporate Patent Counsel
NXP Intellectual Property & Standards
1109 McKay Drive; Mail Stop SJ41
San Jose, CA 95131

CUSTOMER NO. 65913

By: _____
Name: Robert J. Crawford
Reg. No.: 32,122
651-686-6633
(NXPS.615PA)

Attorney Docket No.: 348162-982350

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: G. Li

Serial No: 10/675,566

Filed: September 30, 2003

Title: Architecture For A Flexible And High-Performance Gateway Cable Modem

Docket No.: 348162-982350

Customer No.: 94518

Certificate of Transmission Under 37 CFR 1.8

I hereby certify that this correspondence is being transmitted via electronic submission, Commissioner for Patents, Alexandria, VA 22313-1450 on:

April 5, 2010 /Susan Pingue/

Date *Susan Pingue*

***

COMMUNICATION

Assistant Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313

Sir:

Attached herewith are copies of the Power of Attorney Form (SB/80) and Statement Under 37 CFR 3.73(b) (SB/96) signed by David L. Teichmann, Secretary and Director of Trident Microsystems (Far East) Ltd. in connection with the above-referenced US patent application.

Please note that the new Attorney Docket Number is 348162-982350.

The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 07-1896 referencing our Docket No. 348162-982350.

Respectfully submitted,

DLA PIPER LLP US

Dated: April 5, 2010

By /David L. Alberti/
David L. Alberti
Reg. No. 43,465
Attorney for Applicants

DLA Piper LLP US
2000 University Avenue
East Palo Alto, CA 94303
Telephone: (650) 833-2052
Facsimile : (650) 833-2001

CUSTOMER NO. 94518

/SCP

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D	9980

94518 7590 05/11/2010

DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303

EXAMINER	
HOSSAIN, TANIM M	
ART UNIT	PAPER NUMBER
2445	

MAIL DATE	DELIVERY MODE
05/11/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Advisory Action Before the Filing of an Appeal Brief	**Application No.** *10/675,566*	**Applicant(s)** LI ET AL.	
	Examiner Tanim Hossain	**Art Unit** 2445	

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 05 April 2010 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

1. ☒ The reply was filed after a final rejection, but prior to or on the same day as filing a Notice of Appeal. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114. The reply must be filed within one of the following time periods:
   a) ☐ The period for reply expires _____months from the mailing date of the final rejection.
   b) ☒ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

   Examiner Note: If box 1 is checked, check either box (a) or (b). ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☐ The proposed amendment(s) filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   (a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below);
   (b) ☐ They raise the issue of new matter (see NOTE below);
   (c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   (d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

   NOTE: _____. (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☒ For purposes of appeal, the proposed amendment(s): a) ☐ will not be entered, or b) ☒ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.
   The status of the claim(s) is (or will be) as follows:
   Claim(s) allowed: _____.
   Claim(s) objected to: _____.
   Claim(s) rejected: *1-16*.
   Claim(s) withdrawn from consideration: _____.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ The affidavit or other evidence filed after a final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

11. ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: See Continuation Sheet.
12. ☐ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). _____
13. ☐ Other: _____.

/VIVEK SRIVASTAVA/
Supervisory Patent Examiner, Art Unit 2445

Continuation of 11. does NOT place the application in condition for allowance because: Brooks' abstract, for example, discloses bifurcated processing architecture. The first processor processes information flowing to and from cable media interface circuitry. This constitutes the data networking engine, which performs the interacting with equipment, as claimed. The second processor performs the management of some message processing and scheduling, which constitutes cable modem functions other than those of the data networking engine (please see paragraph 0026). This then constitutes the cable modem engine, as claimed. Claim 9 of the Brooks reference further teaches partitioned processors, where the co-processor supports the processing of cable media and performs data transfer, and the first processor performs a plurality of other processing functions.

The 112 rejections are hereby withdrawn.

Finality of the previous office action is proper, given that the cited paragraphs point to the birfurcated nature of the cable modem, where each of the processors perform different functions. This is sufficient to equate the corresponding processor to the data networking engine (the processor that handles the data flow), and the other to the cable modem engine (the processor that performs other functions).

Reply under 37 C.F.R. 1.116
Expedited Procedure
Technology Center 2445

Confirmation No. 9980

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	LI *et al.*	Examiner:	Hossain, Tanim
Serial No.:	10/675,566	Group Art Unit:	2445
Filed:	September 30, 2003	Docket No.:	81373818US01 (NXPS.615PA)
Title:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM		

REQUEST TO WITHDRAW FINALITY AND RESPONSE TO FINAL OFFICE ACTION

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Customer No.
65913

Okay to enter amendments.
Thanks, TH

Dear Sir:

In acknowledgement of the Final Office Action dated February 5, 2010, please reconsider the application in view of the following amendments and remarks.

A complete listing of the claims, including any amendments, and Remarks/Arguments follow.

Authorization is given to charge/credit **Deposit Account 50-4019 (81373818US01)** all required fees/overages to enter this paper.

PTO/SB/30 (09-08)
Approved for use through 10/31/2008. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Request for Continued Examination (RCE) Transmittal

Address to:
Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Application Number	10/675,566
Filing Date	September 30, 2003
First Named Inventor	Gordon Y. Li
Art Unit	2445
Examiner Name	Tanim M. Hossain
Attorney Docket Number	348162-982350 [81373818US01]

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. Submission required under 37 CFR 1.114 Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

   a. ☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

      i. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

      ii. ☐ Other _____

   b. ☑ Enclosed

      i. ☑ Amendment/Reply

      ii. ☐ Affidavit(s)/ Declaration(s)

      iii. ☐ Information Disclosure Statement (IDS)

      iv. ☐ Other _____

2. Miscellaneous

   a. ☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

   b. ☐ Other _____

3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

   a. ☑ The Director is hereby authorized to charge the following fees, any underpayment of fees, or credit any overpayments, to Deposit Account No. 07-1896.

      i. ☑ RCE fee required under 37 CFR 1.17(e)

      ii. ☑ Extension of time fee (37 CFR 1.136 and 1.17)

      iii. ☐ Other _____

   b. ☐ Check in the amount of $ _____ enclosed

   c. ☐ Payment by credit card (Form PTO-2038 enclosed)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Signature	/Gerald T. Sekimura/	Date	June 7, 2010
Name (Print/Type)	Gerald T. Sekimura	Registration No.	30,103

CERTIFICATE OF MAILING OR ELECTRONIC TRANSMISSION

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450 or electronically transmitted to the U.S. Patent and Trademark Office on the date shown below.

Signature	/Ta-Tanisha L. Henry/		
Name (Print/Type)	Ta-Tanisha L. Henry	Date	June 7, 2010

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Appl. No.	:	10/675,566	Confirmation No. 9980
Applicants	:	Gordon Y. Li, et al.	
Filed	:	September 30, 2003	
TC/A.U.	:	2445	
Examiner	:	Tanim M. Hossain	
Docket No.	:	348162-982350 [81373818US01]	
Customer No.	:	94518	

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

AMENDMENT

Sir:

In connection with the Request for Continued Examination, filed herewith, please amend the subject application as follows:

Any Amendments to the Claims are reflected in the listing of claims which begins on page **2** of this paper.

Remarks/Arguments begin on page 6 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine; and

a data bus that connects the data networking engine to the cable modem engine,

wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

2. (Original) A cable modem system as claimed in claim 1, wherein all DOCSIS functions are localized in the cable modem engine.

3. (Original) A cable modem system as claimed in claim 2, wherein VoIP functionality is embedded in the cable modem engine.

4. (Previously presented) A cable modem system as claimed in claim 1, and further comprising an advanced crypto engine configured to perform all crypto functions for both the data networking engine and the cable modem engine, the advanced crypto engine being separate from both the data networking engine and the cable modem engine.

5. (Previously presented) A cable modem system as claimed in claim 1, wherein the cable modem engine includes:

a DOCSIS PHY layer;

a DOCSIS MAC processor; and

a DOCSIS controller, and

wherein the at least one processor of the data networking engine is a RISC processor.

6. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS PHY layer includes a hardware transmitter and receiver.

7. (Previously presented) A cable modem system as claimed in claim 5, wherein the DOCSIS MAC processor is configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput.

8. (Original) A cable modem system as claimed in claim 5, wherein all VoIP functionality is implemented in the DOCSIS controller.

9. (Original) A cable modem system as claimed in claim 8, wherein the VoIP functionality is in conformance with the PacketCable specification.

10. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine is configured to perform all data networking processing including advanced multi-port bridging routing with NAT/firewall and VPN, and home networking applications.

11. (Original) A cable modem system as claimed in claim 10, wherein the data networking engine comprises the entire embedded portal services functionality of the CableHome specification.

12. (Previously presented) A cable modem system as claimed in claim 5, wherein the cable modem engine includes:

the DOCSIS PHY layer includes a transmitter and receiver;

the DOCSIS MAC processor is configured to implement real-time MAC functions for both upstream and downstream communications; and

the DOCSIS controller is configured to implement VoIP functionality; and wherein

the data networking engine includes a RISC processor configured to implement a majority of data networking processing and home networking applications decoupled from the implementation of the MAC functions and the VoIP functionality of the cable modem engine.

13. (Previously presented) A cable modem architecture as claimed in claim 12, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, wherein the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

14. (Original) A cable modem architecture as claimed in claim 13, wherein the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor.

15. (Original) A method for providing a flexible and partitioned cable modem gateway comprising: providing data and home networking functionality in a data networking engine; providing DOCSIS and VoIP functionality in a cable modem engine; and partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VoIP functionality.

16. (Previously presented) A cable modem system as claimed in claim 5, wherein the data networking engine includes consumer provided equipment drivers including a USB driver and an Ethernet driver and the data networking engine is configured to provide the embedded portal services functionality of the CableHome specification, wherein the DOCSIS controller is configured to provide VoIP functionality in accordance with the PacketCable specification, and wherein the CableHome functionality provided by the data networking engine is completely decoupled from the PacketCable and DOCSIS functionality provided by the cable modem engine.

REMARKS/ARGUMENTS

Reconsideration of the subject application, as amended, is respectfully requested.

Claims 1-16 are pending in the subject application. Claim 1 has been amended to recite that the cable modem functions include interfacing with cable media. Support for this amendment is found in the implementation examples of Figures 1 and 2, and the illustrated interfaces to the HFC or RF external sources.

In the February 5, 2010 Office Action, made final, the Examiner rejected claims 1-16 under 35 USC 102(e) as being anticipated by Brooks (U.S. 2001/0039600) ("Brooks '600"). (See, Office Action, p. 3.) Claim 12 was rejected under 35 USC 112, first paragraph, as failing to comply with the written description. Claims 12-14 were rejected under 35 USC 112, second paragraph, as indefinite.

A Request to Withdraw Finality and Response to Final Office Action was filed on April 5, 2010 in which claims 1 and 12 were amended to address the Examiner's section 112 rejections, and it was pointed out that there was continued uncertainty as to how the Examiner was interpreting and applying the disclosures of Brooks '600 to the claims at issue. More specifically, it was pointed out that in Brooks '600, only two processors were disclosed. Therefore, from the Examiner's position that "the data networking engine and cable modem engines are represented in figures 1 and 2" (Office Action, p. 8), it would follow that one of the two processors corresponded to the networking engine, and the other of the two processors corresponded to the cable modem engine. It was further pointed out that while the discussion concerning Figure 2 in Brooks '600 paragraph 0042 makes clear that cable modem functions are performed by CMAC unit 224, if the cable modem engine is to contain a processor and perform CMAC functions as claimed, the cited cable modem engine must include circuitry

to connect one of the processors with the CMAC unit. It was noted, however, that because available connecting circuitry would be shared by both the one processor and the other processor, the asserted cable modem engine and home networking engine could not be completely partitioned as claimed.

In the Examiner's Advisory Action (notification date May 11, 2010) the Examiner withdrew the section 112 rejections, continued the finality of the 102(e) rejection, and provided a limited further explanation of his view of how the disclosure of Brooks '600 applies to the pending claims. However, despite this further explanation, it is still not clear as to what the Examiner considers to be the cable modem engine and the data networking engine in Brooks '600.

The Examiner explained that:

> Brooks' abstract, for example, discloses bifurcated processing architecture. The first processor processes information flowing to and from cable media interface circuitry. This constitutes the data networking engine, which performs the interacting with equipment, as claimed. The second processor performs the management of some message processing and scheduling, which constitutes cable modem functions other than those of the data networking engine (please see paragraph 0026). This the constitutes the cable modem engine, as claimed. Claim 9 of the Brooks reference further teaches partitioned processors, where the co-processor supports the processing of cable media and performs data transfer, and the first processor performs a plurality of other processing functions.

(Advisory Action Before Filing of an Appeal Brief, sheet 3.)

First of all, the Examiner's assertion that "[t]his constitutes the data networking engine, which performs the interacting with equipment, as claimed" appears to equate the "cable media interface circuitry" with the "customer provided equipment" of, for example, claim 1. Presumably, the Examiner is referring to the CMAC/CPHY block (114, 118, 224 and 228) of Fig. 2 as the cable media interface circuitry. However, Brooks '600 does not describe such blocks as customer provided equipment. Thus, it is not clear what the Examiner considers to correspond to "customer provided equipment" in Brooks '600.

Further, from the above explanation, it appears that the Examiner may be asserting that the cable modem engine includes second processor 104, that the data networking engine is first processor 102 (see Fig. 2), and that the CMAC/CPHY block (114, 118, 224 and 228) is also a part of the cable modem engine. However, processor 102 handles many cable modem functions (see Fig. 4, paragraphs 0053 to 0062), and is explicitly described as "programmed to implement the desired MAC functionality" (paragraph 0026). Paragraph 0025 states "[i]n the case of DOCSIS, typical MAC functionality includes MPEG and MCNS decoding and frame synchronization." On the other hand, processor 104 is described only as providing operating system support and that it "may manage some message processing and scheduling" (paragraph 0026, emphasis added). Thus, the Examiner's designation of the first processor as the "data networking engine" is at odds with the Brooks '600 description of processor 102 as being "programmed to implement the desired MAC functionality."

The Examiner's apparent designation of the first processor 102 in Brooks '600 as the "data networking engine," and the second processor 104 and the CMAC/CPHY block (114, 118, 224 and 228) as the "cable modem engine," further does not square with the claim 1 feature that "the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine," and the claim 15 feature of "partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VOIP functionality." This is because the CMAC/CPHY block (114, 118, 224 and 228) communicates with both the processors 102 and 104 by sharing the same data paths and sharing the same direct memory access controller. (See peripheral bus 112 – bridge 110 – system bus 108 in Fig. 1 and APB 214 – DMA Controller/ASB-APB Bridge 212 – ASB 210 in Fig. 2, and paragraphs 0034 and 0035).

Further, accepting the Examiner's assertion that first processor 102 handles data networking functionality, and considering the description of paragraphs 0025 and 0026 that processor 102 is programmed to implement the desired MAC functionality (which would include typical DOCSIS MAC functionality), leads to a conclusion that the Brooks '600 processor 102 does not implement a complete partitioning or a completely decoupled arrangement of the data networking engine from the cable modem engine.

Thus, Brooks '600 does not provide the complete partitioning or completely decoupled arrangement of the data networking engine from the cable modem engine that the Examiner apparently asserts it does.

For at least the above reasons, it is respectfully submitted that Brooks '600 does not teach or make obvious the claimed subject matter.

The Examiner also asserts that claim 9 of the Brooks reference:

> further teaches partitioned processors, where the co-processor supports the processing of cable media and performs data transfer, and the first processor performs a plurality of other processing functions.

(Advisory Action Before Filing of an Appeal Brief, sheet 3.)

It is respectfully submitted that the description that the "co-processor supports the processing of cable media and performs data transfer" (emphasis added) indicates that there is no partitioning of cable modem functionality from data networking functionality in the co-processor, but instead a combining of the same. Thus, claim 9 of Brooks '600 does not support the Examiner's rejection of the claims of the subject application.

In view of the above, it is respectfully submitted that the application is now in condition for allowance. The Examiner's reconsideration and further examination are respectfully requested.

The undersigned attorney would welcome an opportunity to discuss the claims as amended and Brooks '600 with the Examiner in order to better understand the Examiner's interpretation of the same, and to advance the subject application toward allowance.

Respectfully submitted,

DLA Piper LLP (US)

Dated: June 7, 2010

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UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,566	09/30/2003	Gordon Y. Li	81373818US01-02CXT0070D	9980

94518 7590 09/02/2011

DLA PIPER LLP (US)
2000 UNIVERSITY AVENUE
EAST PALO ALTO, CA 94303

EXAMINER	
WINDER, PATRICE L	
ART UNIT	PAPER NUMBER
2452	

MAIL DATE	DELIVERY MODE
09/02/2011	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/675,566	LI ET AL.	
	Examiner	Art Unit	
	PATRICE WINDER	2452	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 June 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-16* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-16* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on June 7, 2010 has been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-2, 4-6, 10, 11, are rejected under 35 U.S.C. 103(a) as being unpatentable over Schain et al., US 6,944,706 B2 (hereafter referred to Schain).

Regarding claim 1, Schain taught a cable modem system (column 4, lines 12-21) comprising:

a data networking engine implemented in a first circuit that includes at least one processor (processing element), the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data

networking engine to perform home networking functions including interfacing with customer provided equipment (column 4, lines 22-28);

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit (column 10, lines 28-34), the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media (column 4, lines 28-43; column 8, lines 35-48), and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine (column 10, lines 28-34); and

a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine (column 9, lines 26-28). Schain does not specifically teach separate processing elements but suggests embodiments where the engines would be implemented in the separate processing elements (column 10, lines 10-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made that incorporating separate processing elements would have been equivalent embodiment.

Regarding dependent claim 2, Schain taught all DOCSIS functions are localized in the cable modem engine (column 8, lines 49-51).

III. Service

A. Professional Activities

1. Society Memberships

Member, Association for Computing Machinery (ACM): 1993-present
Member, ACM Special Interest Group on Communications (SIGComm): 1993-present
Fellow, Institute of Electrical and Electronics Engineers (IEEE): 1993-present
Member, IEEE Communications Society (IEEE ComSoc): 1993-present
Member, American Society for Engineering Education (ASEE): 2003-2006

2. Review Work for Technical Journals and Publishers

NSF CISE research proposals, IEEE/ACM Transactions on Networking, IEEE/ACM Transactions on Computers, IEEE/ACM Transactions on Communications, IEEE Transactions on Circuits and Systems for Video Technology, IEEE Transactions on Parallel and Distributed Systems, IEEE Transactions on Multimedia, IEEE Communications, IEEE Communications Letters, IEEE Network, IEEE Internet Computing, IEEE Multimedia, IEEE Aerospace & Electronics Systems Magazine, ACM Transactions on Internet Technology, ACM Transactions on Multimedia Computing, Communications and Applications, ACM Computing Surveys, ACM Computer Communications Review, ACM Computeres in Entertainment, ACM/Springer Multimedia Systems Journal, AACE Journal of Interactive Learning (JILR), International Journal of Computer Mathematics, Journal of Communications and Networks, Journal of Parallel and Distributed Computing, Journal of Network and Systems Management, Journal of High Speed Networking, Journal of Communications and Networks, Journal on Selected Areas in Communications, Journal of Wireless Personal Communications, Personal Mobile Communications, Annals of Telecommunications, International Journal of Wireless and Mobile Computing, Pervasive and Mobile Computing (PMC), Wireless Networks Journal, Computer Networks Journal, Cluster Computing, Computer Communications, Mobile Computing and Communications Review, Performance Evaluation, Software--Practice & Experience, Information Processing Letters, ACM Sigcomm, ACM Multimedia, ACM Network and System Support for Digital Audio and Video Workshop (NOSSDAV), ACM Sigcomm Workshop on the Economics of Peer-to-Peer Systems (P2PEcon), ACM Sigcomm Workshop on Challenged Networks (CHANTS), IEEE Infocom, IEEE Globecom, IEEE Global Internet (GI) Symposium, IEEE Globecom Automatic Internet Symposium, IEEE Globecom Internet Services and Enabling Technologies (IS&ET) Symposium, IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM), IEEE International Conference on Network Protocols (ICNP), IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON), IEEE International Conference on Multimedia and Exposition (ICME), IEEE International Conference on Communications (ICC), IEEE International Conference on Parallel and Distributed Systems (ICPADS) IEEE International Symposium on High-Performance Distributed Computing (HPDC), IEEE International Conference on Distributed Computing Systems (ICDCS), IEEE International Workshop on Quality of Service (IWQoS),

IEEE/IFIP Network Operations and Management Symposium (NOMS), IFIP/IEEE International Symposium on Integrated Network Management (IM), IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS), IEEE Aerospace & Electronics Systems Magazine, SPIE Conference on Multimedia Computing and Networking (MMCN), IFIP Networking, IASTED International Conference on Information Systems and Databases (ISD), IASTED International Conference on Communications, Internet, and Information Technology, IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA), IASTED International Conference on European Internet and Multimedia Systems and Applications (EuroIMSA), IASTED International Conference on Communications and Computer Networks (CCN), IASTED International Conference on Software Engineering and Applications (SEA), International Conference on Computer and Information Science (ICIS), International Association for Development of the Information Society (IADIS) International Conference on the WWW/Internet, Workshop on Network Group Communication (NGC), International Conference on Next Generation Communication (CoNEXT), International Conference on Parallel Processing (ICPP), International Conference on Computer Communications and Networks (IC3N), International Workshop on Hot Topics in Peer-to-Peer Systems (Hot-P2P), International Workshop on Wireless Network Measurements (WiNMee), International Workshop on Incentive-Based Computing (IBC), International Workshop on Multi-hop Ad Hoc Networks (REALMAN), International Workshop on Broadband Wireless Multimedia: Algorithms, Architectures and Applications (BroadWIM), International Packet Video (PV) Workshop, High Performance Networking Conference (HPN), International Parallel Processing Symposium (IPPS), International Symposium on Innovation in Information & Communication Technology (ISIICT), Workshop on Coordinated Quality of Service in Distributed Systems (COQODS), Pearson Education (Cisco Press) Publishers, Macmillan Technical Publishing, and Prentice Hall Publishers.

3. Conference Committee Activities

Journal/Magazine Editorial Board

IEEE Transactions on Mobile Computing (TMC): 2006-2011, 2017-2020 (Associate Editor-in-Chief)
IEEE Networking Letters: 2018-2021
IEEE Transactions on Network and Service Management (TNSM): 2015-2021
Journal of Network and Systems Management (JNSM): 2011-present
IEEE/ACM Transactions on Networking (ToN): 2003-2009, 2013-2017
ACM Computers in Entertainment: 2002-2015
IEEE Network: 1999-2012
AACE Journal of Interactive Learning Research (JILR): 2003-2012
IEEE Transactions on Mobile Computing (TMC): 2006-2011
ACM Computer Communications Review (CCR): 2006-2010

Journal/Magazine Guest Editorship

IEEE Journal on Selected Areas in Communications (JSAC) Special Issue on "Delay and Disruption Tolerant Wireless Communication", June 2008
Computer Communications Special Issue on "Monitoring and Measuring IP Networks", Summer 2005
Computer Communications Special Issue on "Integrating Multicast into the Internet", March 2001

Conference/Workshop Steering Committee

IEEE International Conference on Network Protocols (ICNP): 2007-present
ACM Sigcomm Workshop on Challenged Networks (CHANTS): 2006-present
IEEE Global Internet (GI) Symposium: 2005-2013, 2018-present
International Workshop on Network and Operating System Support for Digital Audio and Video (NOSSDAV): 2001-2020, 2005-2011 (chair), 2012-2020 (co-chair)
IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2005-2009

Conference/Workshop Chair

International Conference on Communication Systems and Networks (COMSNETS): 2014 (co-chair)
ACM International Conference on Next Generation Communication (CoNext): 2013 (co-chair)
ACM RecSys News Recommender Systems (NRS) Workshop and Challange: 2013 (co-chair)
ACM Sigcomm Workshop on Challenged Networks (CHANTS): 2006 (co-chair)
IEEE International Conference on Network Protocols (ICNP): 2003 (co-chair), 2006
International Workshop on Wireless Network Measurements (WiNMee): 2006 (co-chair)
IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2002 (co-chair)
International Workshop on Network and Operating System Support for Digital Audio and Video (NOSSDAV): 2002 (co-chair), 2003 (co-chair)
IEEE Global Internet (GI) Symposium: 2001 (co-chair), 2018 (co-chair)
International Workshop on Networked Group Communication (NGC): 2000 (co-chair)

Program Chair

International Conference on Computer Communication and Networks (ICCCN): 2015 (Track co-chair) International Conference on Communication Systems and Networks (COMSNETS): 2010
IEEE International Conference on Network Protocols (ICNP): 2008 (co-chair)
IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON): 2007 (co-chair)
IFIP Networking: 2005 (co-chair)

Posters/Demonstrations Chair

ACM Sigcomm: 2012 (co-chair)

Student Travel Grants Chair

ACM Sigcomm: 2010 (co-chair)

Publicity Chair

IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2004 (co-chair)

Keynote Chair

IEEE Infocom: 2005 (co-chair)

Local Arrangements Chair

Internet2 "Field of Dreams" Workshop: 2000

Tutorial Chair

ACM Multimedia: 2000
IEEE International Conference on Network Protocols (ICNP): 1999

Panel/Session Organizer

NSF ANIR PI 2003 Panel on "Core Networking Issues and Protocols for the Internet"
CCW 2001 Session on "Multicast/Peer-to-Peer Networking"
NOSSDAV 2001 Panel on "Multimedia After a Decade of Research"
NGC 2000 Panel on "Multicast Pricing"

Technical Program Committee

IEEE International Conference on Network Protocols (ICNP): 1999, 2000, 2001, 2003, 2004, 2005, 2006, 2007, 2008, 2009 (Area Chair), 2010 (Area Chair), 2011 (Area Chair), 2012 (Area Chair), 2013, 2014 (Area Chair), 2015 (Area Chair), 2016 (Area Chair), 2017 (Area Chair), 2018 (Area Chair), 2019 (Area Chair), 2020 (Area Chair), 2021 (Area Chair)
International Workshop on Network and Operating System Support for Digital Audio and Video (NOSSDAV): 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
ACM Multimedia (MM): 2001, 2003, 2004, 2005 (short paper), 2006, 2007, 2008, 2008 (short paper), 2010, 2011, 2012, 2013, 2015, 2016, 2017, 2018, 2019
IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON): 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011 (Area Chair), 2012 (Area Chair), 2013, 2014 (Area Chair), 2015, 2016 (Area Chair), 2017, 2018, 2019
IEEE/IFIP Network Operations and Management Symposium (NOMS): 2004, 2006, 2010
IEEE Infocom: 2004, 2005, 2006, 2008, 2009, 2010 (Area Chair), 2011 (Area Chair), 2012 (Area Chair)
IFIP Networking: 2004, 2005, 2006, 2007, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2022
IEEE International Conference on Communications (ICC) Next Generation Networking and Internet Symposium (NGNI): 2018, 2019
ACM Workshop on Mobile Video (MoVid): 2014, 2015, 2016, 2017
ACM Student Research Competition (SRC) Grand Finals: 2014
Mobile and Social Computing for Collaborative Interactions (MSC): 2014
IEEE Conference on Communications and Network Security (CNS): 2013
IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM): 2005, 2006, 2007, 2008, 2009, 2010
ACM Sigcomm Workshop on Challenged Networks (CHANTS): 2006, 2008, 2009, 2010, 2011, 2012, 2016, 2017, 2018, 2019
IEEE International Conference on Distributed Computing Systems (ICDCS): 2006, 2010, 2011, 2012, 2013
International Workshop on Wireless Network Measurements (WiNMee): 2006, 2008, 2010
ACM Sigcomm: 2008 (poster), 2010
IEEE International Conference on Computer Communication and Networks (IC3N): 2008, 2009, 2010, 2011, 2012
International Conference on Communication Systems and Networks (COMSNETS): 2009,

2010, 2011, 2012, 2013
International Conference on Sensor Networks (SENSORNETS): 2012
International Workshop on Social and Mobile Computing for Collaborative Environments (SOMOCO): 2012
Workshop on Scenarios for Network Evaluation Studies (SCENES): 2009, 2010, 2011
ACM Multimedia Systems (MMSys): 2010, 2011, 2012, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022
IEEE Internation Symposium on Multimedia (ISM): 2016
IEEE International Conference on Pervasive Computing and Communications (PerCom): 2010
IEEE Wireless Communications and Networking Conference (WCNC): 2010, 2011
ACM International Symposium on Mobility Management and Wireless Access (MobiWac): 2010, 2011
International Conference on Computing, Networking and Communications, Internet Services and Applications Symposium (ICNC-ISA): 2012, 2013
IEEE WoWMoM Workshop on Hot Topics in Mesh Networking (HotMesh): 2010, 2011, 2012, 2013
IEEE Workshop on Pervasive Group Communication (PerGroup): 2010
ACM International Conference on Next Generation Communication (CoNEXT): 2005, 2006, 2007, 2009, 2012
IEEE International Conference on Broadband Communications, Networks, and Systems (BroadNets) Wireless Communications, Networks and Systems Symposium: 2007, 2008, 2009
IEEE International Conference on Broadband Communications, Networks, and Systems (BroadNets) Internet Technologies Symposium: 2007, 2008, 2009
International Workshop on Mobile and Networking Technologies for Social Applications (MONET): 2008, 2009
Extreme Workshop on Communication-The Midnight Sun Expedition (ExtremeCom): 2009
IEEE International Workshop on Cooperation in Pervasive Environments (CoPE): 2009
International Workshop on the Network of the Future (FutureNet): 2009, 2010, 2011, 2012
IEEE International Conference on Multimedia and Exposition (ICME): 2010
SPIE Conference on Multimedia Computing and Networking (MMCN): 2004, 2008
ACM Sigcomm Workshop on the Economics of Networks, Systems, and Computation (NetEcon): 2008
IEEE International Conference on Communications (ICC): 2008
IEEE International Conference on Mobile Ad-hoc and Sensor Systems (MASS): 2008
IFIP/IEEE International Symposium on Integrated Network Management (IM): 2005, 2007
Global Internet (GI) Symposium: 2001, 2002, 2004, 2006, 2007, 2022, 2023
IEEE/ACM International Conference on High Performance Computing (HiPC): 2007
ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc): 2007
IEEE Workshop on Embedded Systems for Real-Time Multimedia (ESTIMedia): 2007
IEEE/IFIP Wireless On Demand Network Systems and Services (WONS): 2007
IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2001, 2002, 2003, 2004, 2005, 2006
IASTED International Conference on European Internet and Multimedia Systems and Applications (EuroIMSA): 2004, 2006
IEEE International Conference on Parallel and Distributed Systems (ICPADS): 2005, 2006
IEEE Globecom Internet Services and Enabling Technologies (IS&ET) Symposium: 2006

International Workshop on Incentive-Based Computing (IBC): 2006
IEEE International Workshop on Quality of Service (IWQoS): 2006, 2014, 2015
International Workshop on Multi-hop Ad Hoc Networks (REALMAN): 2006
IEEE Globecom Automatic Internet Symposium: 2005
ACM Sigcomm Workshop on the Economics of Peer-to-Peer Systems (P2PEcon): 2005
International Conference on Parallel Processing (ICPP): 2001, 2003, 2004
International Packet Video (PV) Workshop: 2002, 2003, 2004
IEEE International Symposium on High-Performance Distributed Computing (HPDC): 2004
ACM Sigcomm: 2004 (poster)
International Workshop on Broadband Wireless Multimedia: Algorithms, Architectures and Applications (BroadWIM): 2004
International Symposium on Innovation in Information & Communication Technology (ISIICT): 2004
Workshop on Coordinated Quality of Service in Distributed Systems (COQODS): 2004
IASTED International Conference on Networks and Communication Systems (NCS): 2004
IASTED International Conference on Communications, Internet, and Information Technology (CIIT): 2004
IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA): 2003, 2004
International Workshop on Networked Group Communication (NGC): 1999, 2000, 2001, 2002, 2003
International Association for Development of the Information Society (IADIS) International Conference on the WWW/Internet: 2003
International Conference on Computer and Information Science (ICIS): 2003
Human.Society@Internet: 2003
IASTED International Conference on Communications and Computer Networks (CCN): 2002
The Content Delivery Networks (CDN) Event: 2001
IP Multicast Initiative Summit: 1998, 1999, 2000
Corporation for Education Network Initiatives in California (CENIC): 1999
Internet Bandwidth Management Summit (iBAND): 1998, 1999

B. Technical Activities

1. Working Groups

Internet2 Working Group on Multicast, Chair: 1998-2005
IEEE Communications Society Internet Technical Committee (ITC), Conference Coordinator: 2000-2004
IETF Multicast Directorate (MADDOGS), Member: 1999-2001
IASTED Technical Committee on the Web, Internet and Multimedia, Member: 2002-2005
Internet Engineering Task Force (IETF), various working groups: 1995-present

2. Meeting Support Work

Internet Engineering Task Force MBone broadcasts: 1995-2005
Conference MBone broadcasts: Sigcomm '99, and '00
Interop+Networld Network Operations Center (NOC) Team Member: 1995-1997
ACM Multimedia technical staff: 1994

C. University of California Committees

1. Department of Computer Science Committees

Public Relations: 2005-2006 (chair 2005-2006), 2009-2011 (chair 2009-2011)
Strategic Planning: 2000-2002, 2003-2006, 2009-2011
Undergraduate Advising and Affairs: 2006-2007, 2014-2015
Vice Chair: 2000-2005
Graduate Admissions: 2000-2005 (chair 2000-2005), 2011-2012
Graduate Affairs: 2000-2005 (co-chair 2000-2005)
Teaching Administration: 2000-2005
Facilities: 1997-2001 (chair 1999-2000), 2006-2007
External Relations: 1999-2002
Computer Engineering Public Relations: 2011-2012
Computer Engineering Awards: 2011-2012
Computer Engineering Administration/Recruiting: 1998-2001
Computer Engineering Lab and Computer Support: 1998-2001
Faculty Recruiting: 1999-2002
Graduate Advising: 1998-1999, 2000-2005

2. University Committees

Member, Campus Budget and Planning: 2013-2015
Faculty, Cognitive Science Program: 2006-2020
Faculty, Technology Management Program (TMP): 2003-2014
Faculty, Media Arts and Technology (MAT) Program: 1998-2014
Faculty, Computer Engineering Degree Program: 1998-2020
Steering Committee, Center for Information Technology and Society (CITS): 2012-2020
Associate Director, Center for Information Technology and Society (CITS): 1999-2012
Member, Campus Committee on Committees: 2010-2013
Member, Campus Income and Recharge Committee: 2010-2013
Member, College of Engineering Executive Committee: 2010-2012 (chair 2011-2012), 2014-2015 (chair 2014-2015)
Member, Distinguished Teaching Award Committee: 2009, 2010, 2011
Member, Campus Classroom Design and Renovation Committee: 2003-2010
Member, ISBER Advisory Committee: 2008-2011
Member, Fulbright Campus Review Committee: 2007
Member, Faculty Outreach Grant Program Review Committee: 2007
Executive Vice Chancellor's Information Technology Fee Committee: 2005-2006
Council on Research and Instructional Resources: 2003-2006
Executive Vice Chancellor's Working Group on Graduate Diversity: 2004-2005
Member, Engineering Pavillion Planning Committee: 2003-2005

Information Technology Board: 2001-2004
Executive Committee, Center for Entrepreneurship & Engineering Management (CEEM): 2001-2004

3. System Wide Committees

UCSB Representative to the Committee on Information Technology and Telecommunications Policy (ITTP): 2003-2005
UCSB Representative to the Executive Committee, Digital Media Innovation (DiMI): 1998-2003

D. Georgia Tech Committees and Service (while a graduate student)

Graduate Student Body President: 1994-1995
Georgia Tech Executive Board: 1994-1995
Georgia Tech Alumni Association Executive Committee: 1994-1995
Dean of Students National Search Committee: 1995
Institute Strategic Planning Committee: 1994-1996

Cases in last 4 years I have been deposed or testified:

- Depositions in Inter Partes Review of U.S. Patent Nos. 8,886,739 (IPR2018-00200); 9,306,885 (IPR2018-00312); 9,315,155 (IPR2018-00369); 9,306,886 (IPR2018-00397); 8,935,351 (IPR2018-00404); 9,338,111 (IPR2018-00408); 9,413,711 (IPR2018-00416 and IPR2018-00439); 9,313,157 (IPRs018-00455); and 9,313,156 (IPR2018-00458) [Snap, Inc. v. Vaporstream, Inc.]. Finished 04/2019.
- Depositions in Rmail Limited, et al. v. Amazon.com, Inc.; Docusign, Inc.; Right Signature, LLC, et al.; and Adobe Systems Inc., et al. (2:10-cv-258-JRG, 2:11-cv-299-JRG, 2:11-cv-300-JRG, 2:11-cv-325-JRG, E. D. Tex.). Finished 06/2019.
- Depositions and trial testimony in Certain Wireless Mesh Networking Products and Related Components Thereof (US ITC Inv. No. 337-TA-1131) [SIPCO, LLC v. Emerson Electric Co]. Finished 09/2019.
- A deposition in Packet Intelligence v. Nokia of America Corporation (2:18-cv-382-JRG, E. D. Tex.). Finished 09/2019.
- A deposition in TQ Delta, LLC v. Zyxel Communications, Inc. (13-cv-2013-RGA, D. Del.). Finished 11/2019.
- A deposition and trial testimony in Implicit, LLC v. NetScout Systems, Inc. and Sandvine Corporation (2:18-cv-0053-JRG and 2::18-cv-0054-JRG, E. D. Tex.). Finished 12/2019.
- A deposition and trial testimony in Sony Music Entertainment, et al. v. Cox Communications, Inc. et al. (1:18-cv-00950-LO-JFA, E. D. Va.). Finished 12/2019.
- Depositions in Inter Partes Review of U.S. Patent Nos. 9,369,741 (IPR2019-00231) and 9,621,956 (IPR201-00281) [Comcast Cable Communications, LLC v. Rovi Guides Inc.]. Finished 01/2020.
- A deposition and trial testimony in Certain Digital Video Receivers, Broadband Gateways, and Related Hardware and Software Components (US ITC Inv. No. 337-TA-1158) [Rovi Guides, Inc. v. Comcast Cable Communications, LLC]. Finished 01/2020.
- A deposition in Innovation Sciences, LLC v. Resideo Technologies, Inc. (4:18-cv-00475-ALM, E. D. Tex.). Finished 02/2020.
- Depositions and a claim construction tutorial in Blackberry Limited v. Facebook, Inc. and Snap, Inc. (2:18-cv-01844 GW(KSx) and 2:18-cv-02693-GW(KSx), C. D. Cal.). Finished 03/2020.
- A deposition in Inter Partes Review of U.S. Patent Nos. 9,912,983 (IPR2019-01306) [Resideo Technologies, Inc. v. Innovation Sciences, LLC]. Finished 05/2020.
- A deposition in Sprint Communications Company LP v. Charter Communications, Inc. et al. (17-1734-RGA, D. Del.). Finished 06/2020.
- Depositions in Inter Partes Review of U.S. Patent Nos. 9,369,741 (IPR2019-00231), 9,621,956 (IPR2019-00281), and 9,118,948 (IPR2019-01421) [Comcast Cable Communications, LLC v. Rovi Guides Inc.]. Finished 07/2020.
- Depositions and claim construction tutorial in Netfuel, Inc. v. Cisco Systems, Inc. (5:18-cv-2352-EJD, N. D. Cal). Finished 08/2020.

- A deposition in Inter Partes Review of U.S. Patent No. 9,663,659 (IPR2019-00992) [Cisco Systems, Inc. v. NetFuel, Inc.]. Finished 09/2020.
- A deposition in Monarch Network Solutions, LLC v. Cisco Systems, Inc. (2:20-cv-00015-JRG, E. D. Tex.). Finished 09/2020.
- A deposition in Finjan, Inc. v. Rapid7, Inc. (1:18-cv-01519-MN, D. Del.). Finished 09/2020.
- A deposition in Finjan, Inc. v. SonicWall, Inc. (5:17-cv-04467-BLF-HRL, N. D. Cal.). Finished 10/2020.
- Depositions and trial testimony in TQ Delta, LLC v. 2Wire, Inc. (1:13-cv-01835-RGA, D. Del.). Finished 11/2020.
- A deposition in Linksmart Wireless Technology, LLC v. Gogo, LLC and Panasonic Avionics Corp (8:18-cv-00654-JAK-JDE and 8:18-cv-00662-JAK-JDE). Finished 12/2020.
- A deposition and trial testimony in Certain Audio Players and Controllers, Components, Thereof and Products Containing the Same (ITC Inv. No. 337-TA-1191) [Sonos, Inc. v. Google LLC and Alphabet, Inc.]. Finished 02/2021.
- A deposition in Finjan, Inc. v. Cisco Systems, Inc. (5:17-cv-00072-BLF-SVK, N. D. Cal). Finished 02/2021.
- A deposition and trial testimony in Gigamon, Inc. v. Apcon, Inc. (2:19-cv-300-JRG, E. D. Tex.). Finished 04/2021.
- A deposition in Certain IP Camera Systems including Video Doorbells and Components Thereof (US ITC Inv. No. 337-TA-1242) [SkyBell Technologies, Inc., SB IP Holdings, LLC, and Eyetalk365, LLC v. SimpliSafe, Inc., Arlo Technologies, Inc., and Vivint Smart Home, Inc.]. Finished 09/2021.
- A deposition in Warner Records, Inc. et al. v. Charter Communications, Inc. (19-cv-00874-RBJ-MEH, D. Colo.). Finished 10/2021.
- A deposition and trial testimony in VideoShare, LLC v. Google LLC (6:19-cv-00663-ADA, W. D. Tex.). Finished 11/2021.
- A deposition in The Chamberlain Group, LLC v. Overhead Door Corp. (2:21-cv-0084, E. D. Tex.). Finished 12/2021.
- Depositions in Contour IP Holding, LLC v. GoPro, Inc. (17-cv-04738-WHO, N. D. Cal.). Finished 12/2021.
- A deposition in Chewy, Inc. v. International Business Machines Corporation (1:21-cv-1319-JSR, S. D.N.Y.). Finished 02/2022.
- A deposition in Flexiworld Technologies, Inc. v. Roku, Inc. (6:20-cv-00819-ADA, W. D. Tex.). Finished 02/2022.
- A deposition in Proven Networks, LLC v. NetApp, Inc. (6:20-cv-00369-ADA, W. D. Tex.). Finished 03/2022.

- Trial testimony in Two Way Media LTD v. Telefonica (517/2017-X, Barcelona, Spain). Finished 05/2022.
- A deposition and claim construction hearing testimony in Peloton Interactive, Inc. v. Icon Health and Fitness, Inc. (1:20-cv-00662-RGA, D. Del.). Finished 05/2022.
- Depositions in Icon Health and Fitness, Inc. v. Peloton Interactive, Inc. (20-1386-RGA, D. Del.). Finished 05/2022.
- A deposition and hearing testimony in UMG Recordings, Inc., et al. v. Bright House Networks, LLC (8:19-cv-00710-MSS-TGW, M. D. Fla.). Finished 05/2022.
- A deposition in Inter Partes Review of U.S. Patent Nos. 9,860,198 (IPR2021-00882) and 10,728,192 (IPR2021-00883) [Meta Platforms, Inc. v. WrinkI Inc.]. Finished 06/2022.
- Depositions in Inter Partes Review of U.S. Patent Nos. 8,166,081 (IPR2021-01267), 8,688,028 (IPR2021-01303), 8,903,307 (IPR2021-01305), and 8,200,203 (IPR2021-01371) [Hyundai Motor America v. StratosAudio, Inc.]. Finished 08/2022.
- A deposition and trial testimony in Shopify, Inc. v. Express Mobile, Inc. (1:19-cv-00439-RGA, D. Del.). Finished 08/2022.
- Depositions in Inter Partes Review of U.S. Patent Nos. 9,291,475 (IPR2022-00708 and IPR2023-00031); 9,602,608 (IPR2022-00709); 7,484,008 (IPR2022-00857); and 6,832,283 (IPR2022-0970) [Toyota Motor Corp. and American Honda Motor Co, Inc. v. Intellectual Ventures II LLC]. Finished 02/2023.
- A deposition and trial testimony in Express Mobile, Inc. v. GoDaddy.com, LLC (1:19-cv-01937-RGA, D. Del.). Finished 03/2023.
- Depositions in TQ Delta, LLC v. AdTran, Inc. (14-cv-954-RGA, 15-cv-121-RGA, D. Del).
- A deposition in Motorola Solutions, Inc. v. Hytera Communications Corp. LTD (1:17-cv-01972, N. D. Ill.)
- Depositions and trial testimony in Luminati Networks Ltd. v. UAB Tesonet and UAB Metacluster LT (2:18-cv-00299-JRG, E. D. Tex.); Luminati Networks Ltd. v. Teso LT, UAB; Oxysales, UAB; and Metacluster LT, UAB, (2:19-cv-00395-JRG, E. D. Tex.); Luminati Networks Ltd. v. Code 200, UAB; Oxysales, UAB; and Metacluster LT, UAB (2:19-cv-00396-JRG, E. D. Tex.); and Bright Data Networks Ltd. v. Tefincom S.A. (2:19-cv-00414-JRG, E. D. Tex.)
- A deposition and trial testimony in Centripetal Networks, Inc. v. Cisco Systems, Inc. (2:18-cv-00094, E. D. Va.).
- Depositions in Personal Audio, LLC v. Google, Inc. (1:17-cv-01751-VAC-CJB, D. Del)
- A deposition in Post-Grant Review of U.S. Patent No. 10,782,951 (PGR2021-00096) and 11,157,256 (PGR2022-00053) [IronSource Ltd. v. Digital Turbine, Inc.].
- A deposition in FirstFace Co, LTD v. Apple, Inc (3:18-cv-02245-JD, N. D. Cal.).
- A deposition in Touchstream Technologies, Inc. v. Google, LLC (6:21-cv-00569-ADA, W. D. Tex.).

- A deposition in WebRoot, Inc. and Open Text, Inc. v. Trend Micro, Inc. (22-cv-00239-ADA-DTG, W. D. Tex.).
- A deposition in WSOU Investments, LLC v. Cisco Systems, Inc. (6:20-cv-00128-ADA, W. D. Tex.)
- Depositions in Sonos, Inc. v. Google LLC (6:20-cv-881-ADA, W. D. Tex.; 3:20-cv-06754-WHA, N. D. Cal.; and 3:21-cv-07559-WHA, N. D. Cal.)

Appendix B

NEWTON's TELECOM DICTIONARY

OCT 17 2001
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The Official Dictionary of Telecommunications
Networking and Internet

STAY INFORMED

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alternate functions. Some carrier telephone equipment designed for ringdown manual operation can be modified with applique to allow for use between points having dial equipment.

APPN Advanced Peer-to-Peer Networking is, according to its creator IBM, a leading-edge distributed networking feature IBM has added to its Systems Network Architecture (SNA). It provides optimized routing of communications between devices. In addition to simplifying the addition of workstations and systems to a network and enabling users to send data and messages to each other faster, APPN is designed to support efficient and transparent sharing of applications in a distributed computing environment. Because APPN permits direct communication between users anywhere on a network, it facilitates the development of client/server computing, in which workstation users anywhere on a network can share processing power, applications and data without regard to where the information is located. Workstations on an APPN network are dynamically defined so they can be relocated easily on the network without extensive re-programming. APPN also allows remote workstations to communicate with each other, without intervention by a central computer. Also, IBM's Advanced Peer-to-Peer Networking software.

APPN End Node An APPN end node is the final destination of user data. The end node cannot function as an intermediate node in an APPN network and cannot perform routing functions. See APPN.

Approved Ground Grounds that meet the requirements of the NEC (National Electrical Code), such as building steel, concrete-encased electrodes, ground rings, and other devices. See AC and Grounding.

AppServer A SCSA term. AppServer defines the software environment that enables voice processing applications to run on any computing platform. AppServer sits on a PC equipped with call processing hardware and allows a remotely hosted application to control the call processing hardware.

APR Annual Percentage Rate. A percentage calculation of a finance charge portion of a financing contact.

APS Automatic Protection Switching. A means of achieving network resiliency through switching devices which automatically switch from a primary circuit to a secondary (usually geographically diverse) circuit. This switching process would take place when the primary circuit fails or when the error rate on the primary line exceeds a set threshold. There are two basic APS architectures in SONET optical fiber networks: 1+1 and 1:N. A 1+1 architecture is characterized by permanent electrical bridging to service and protection equipment, which is placed at both ends of the circuit. At the head end, or transmitting end, the same payload signal is sent over both the primary and the secondary optical circuit. The optical signal is monitored for failures at the tail end independently and identically over both optical circuits. The receiving equipment at the tail end selects either the service channel (primary circuit) or the protection channel (secondary circuit), based on pre-defined switching performance criteria. A 1:N protection switch architecture is one in which any of "N" (i.e., any Number of) service channels (primary circuits) can be bridged to a single optical protection channel (secondary circuit).

APT Asia-Pacific Telecommunity.

AQCB Automated Quote Contract Billing. System used to price non-tariffed products and services.

AR Automatic Recall.

ARA AppleTalk Remote Access. Provides an asynchronous AppleTalk connection to another Macintosh and its network services through a modem. A remote user using ARA can log on to a remote server and mount the volume on his desktop as if he were connected locally.

ARAB Attendant Release Loop. A feature of the PBX console. See Release.

Arabic Numerals Shakespeare was right when he asked, "What's in a name?" The jackrabbit is not a rabbit. It is a hare. A Jerusalem artichoke is not an artichoke; it is a sunflower. Arabic numerals are not Arabic; they were invented in India. India ink (sometimes referred to as "Chinese ink") was not known until recently in either China or India.

ARAM Audio grade DRAM. DRAMS are low cost integrated circuits that are widely used in consumer electronic's products to store digital data.

Aramid Aramid is a synthetic textile material which is lightweight, nonflammable, and highly impact-resistant. Dupont markets it under the trademark Kevlar. In addition to being used in construction of some fiber optic cables to provide tensile strength, aramid fibers are used in bulletproof vests, sailboat sails, and industrial-strength shoelaces. See Tight Buffer Fiber Optic Cables.

Arbitrated Loop Arbitrated loop is a shared, 100 MBps (200 MBps full duplex) architecture. Analogous to Token Ring, multiple devices can be attached to the same loop segment, typically via a loop hub. Up to 126 devices and one fabric (switch) attachment are allowed, although the majority of arbitrated loops are deployed with from four to 30 devices. Since the loop is a shared transport medium, devices must arbitrate for access to the loop before sending data. Fibre Channel provides a superset of commands to provide orderly access and ensure data integrity. A GBIC, or gigabit interface converter, is a removable transceiver and is commonly used in Fibre Channel switches, hubs and host bus adapters. A transceiver converts one form of signaling into another, e.g., fiber optic signals to electrical signals.

Arbitrated Loop Topology A Fibre Channel topology that provides a (FC-AL) low-cost solution to attach multiple communicating ports in a loop. Nodes are linked together in a closed loop. Traffic is managed with a token-acquisition protocol, and only one connection can be maintained within the loop at a time. See Fibre Channel.

Arbitrage The price of gold in London equals the price of gold in New York. If it didn't, traders would step in, buy in one place and sell in another. This process is called arbitrage. There are huge price differences in long distance and international calling from different carriers. In the late 1990s, there was talk of "on-line arbitrage" — whereby I would indicate that I wanted to make a call, and offer that call to on-line traders who would instantly find me a cheap rate.

Arbitration A Fibre Channel term. The process of selecting one respondent from a collection of several candidates that request service concurrently.

ARC Attached Resource Computer, the root name of the local area networks (LAN). It was developed by Datapoint Corporation called ARCNET. It was one of the first LANs. Ethernet and Datapoint's incompetent management killed it. See ARCNET.

ARCH Access Response CHannel. Specified in IS-136, ARCH carries wireless system responses from the cell site to the user terminal equipment. ARCH is a logical subchannel of SPACH (SMS (Short Message Service) point-to-point messaging, Paging, and Access response CHannel), which is a logical channel of the DCCH (Digital Control CHannel), a signaling and control channel which is employed in cellular systems based on TDMA (Time Division Multiple Access). The DCCH operates on a set of frequencies separate from those used to support cellular conversations. See also DCCH, IS-136, SPACH and TDMA.

Archie An Internet term. A corruption of "archive," Archie is a FTP search engine located on several computers around the country. It's sort of a superdirectory to the files on the Internet. If you're looking for a file or even a particular topic, Archie provides its specific location. Veronica, Jughead and WAIS (Wide Area Information Servers) are other tools for searching the huge libraries of information on the Internet. Some companies, such as Hoyes, make Archie software which give you a menu driven interface that lets you browse through the various Archie servers on the Internet as though browsing through card catalogs of remote libraries.

Architectural Assemblies Walls, partitions, or other barriers that are not load bearing. In contrast, Architectural Structures are load bearing.

Architectural Freedom An AT&T term for flexibility in locating functions, such as control, storage or processing of information, at any site in or around a network, such as customer premises, central offices or regional service bureaus. Architectural freedom also means the ability to distribute functions among combinations of locations and have them interrelate through a high-throughput, low-delay, transparent network. See also Architecture.

Architectural Structures Walls, floors, floor/ceilings and roof/ceilings that are load bearing. In contrast, Architectural Assemblies are not load bearing.

Architecture The architecture of a system refers to how it is designed and how the components of the system are connected to, and operate with, each other. It covers voice, video, data and text. Architecture also includes the ability of the system to carry narrow, medium and broadband signals. It also includes the ability of the system to grow "seamlessly" (i.e. without too many large jumps in price).

Architecture Police An individual or group within a company that makes sure software and hardware development follows established corporate guidelines. The architecture police tend to rein in creative development efforts.

Archival Readable (and sometimes writable) media. Archival media have defined minimum life-spans over which the information will remain stable (i.e, accurate without degradation).

Archive A backup of a file. An archived file may contain backup copies of programs and files in use or data and materials no longer in use, but perhaps needed for historical or tax purposes. Archive files are kept on paper, on microfilm, on disk, on floppies, etc. They may be kept in compressed or uncompressed form. See Archiver.

Archive Bit A Windows NT (soon to be Windows 2000) term. Backup programs use

typically, cable management covers keeping track of where the cables are (maps are useful), what type and quality the cable is, and what is attached to either end of it. Cable management for corporations is critical, since stringing, laying and snaking of new cable can be inordinately expensive.

Cable Mapping Cable mapping is the task of trying to track every single pair of wire or circuit from beginning to end. You will need to know where all cables reside, not just the circuits that are in use. Cable mapping is critical for any organization — from company to university — which has a lot of cables floating around. Installing more of it — when there are plenty of spare pairs — is stupid and expensive. Thus, the need for cable mapping.

Cable Mile Also known as sheath mile. The measurement, in miles, of fiber optic cable that is deployed. Contrast with fiber mile and route mile.

Cable Modem A cable modem is a small box that connects your PC to the Internet via your local cable TV provider. A cable modem will typically have three connections, one to the coaxial cable wall outlet coming in from your friendly local CATV provider and the other two to connect to your PC and your TV. That PC connection will typically be a standard 10Base-T RJ-45 Ethernet connector, the same connection as you have in your office on your LAN. In essence, a cable modem is a 10 megabit per second Ethernet local area network, in which all the other local cable subscribers are essentially on the same LAN, one end of which is connected to the Internet. Because a cable modem creates a LAN, you have to be careful when using it since all the other local subscribers can "see" your hard disk. As a result, it's important not to allow sharing on your hard disk. Cable modems allow PC users to download information from on-line services at speeds one hundred times faster than today's fastest telephone modems. What actual speed you'll get with your cable modem depends, of course, on a lot of things: how many people are on your "cable LAN" and are presently transmitting or receiving; how fast the connection is from your cable LAN to the Internet; how fast the connections are along the way; how fast the distant server is that you're attached to, etc. etc.

In short, a cable modem is a modem designed for use on a TV coaxial cable circuit. The appeal of a cable modem to a cable TV operator is simple: Put the cable modem on a home cable TV line, provide the subscriber a high-speed circuit to the Internet and the Web, and charge extra for the privilege. The appeal of a cable modem to a user is higher speed. Friends who have such cable modems are in love with them. After using a cable modem to surf the Internet, they all tell me they would never, ever go back to a dial-up connection.

Because the cable modem system effectively turns the cable TV system into a very large LAN, users have to share the available bandwidth with any other active users on the same node, which will result in a reduction in data throughput as the number of users increases. This characteristic is the key difference between cable modem systems and the xDSL solutions which telcos are deploying, where the bandwidth to the user is dedicated. See also 10Base-T, DOCSIS, Modem, NIC and SNMP. www.cable-modems.org.

Cable Modem Termination System CMTS. To deliver data services over a cable network, one six-MHz television channel (in the 50-750 MHz range) is typically allocated for downstream traffic to homes and another channel (in the 5-42 MHz band) is used to carry upstream signals. A headend CMTS communicates through these channels with cable modems located in subscriber homes to create a virtual LAN connection.

Cable Normal Switch A mechanism incorporated into a consumer television receiver which allows the user to select the channel assignment plan. In older receivers, this mechanism is usually a physical switch; in newer receivers, it is usually incorporated as an option in the setup menu. All cable/normal switches allow two choices: "standard" (sometimes called "normal" or "off air") which tunes to the channel assignments used by broadcast stations for over-the-air transmission; and "cable" (sometimes called "CATV" or "STD") which tunes to cable channels. Many receivers also include a third option called HRC or Harmonically-Related Carriers.

Cable Plant A term which refers to the physical connection media (optical fiber, copper wiring, connectors, splicers, etc.) in a local area network. It is a term also used less frequently by the telephone company to mean all its outside cables — those going from the central office to the subscribers' offices.

Cable Programming Service Any tier of cable television programming except: - The basic tier (see Basic Cable Television Service). - Any programming offered on a per-channel or per-program basis.

Cable Protection There are three basic types of protection in addition to standard plastic cladding:

- ElectroMagnetic (EM) Shielding: Prevents possive coupling. EM shielding can be a metallic conduit or metal wrapping with appropriate grounding on the wires.
- Penetration-Resistant Conduit: Used to secure the cable from cutting or tapping. Note, however, not all penetration-resistant conduits provide EM shielding.
- Pressurized Conduit: Detects intrusion by monitoring for pressure loss. Fiber optic cable is extremely difficult to tap and if tapped, the intrusion can be detected through signal attenuation. But since fiber optic cable can be cut, penetration-resistant conduit is recommended to protect the cable.

Cable Racking Framework fastened to bays to support cabling between them.

Cable Reregulation Act Of 1992 Cable Reregulation Bill 1515 passed Congress in October 1992, forcing the FCC to reregulate cable television and cable television rates (after the Cable Act of 1984 effectively de-regulated the cable TV industry). After the Act was passed, the FCC forced the industry to reduce its rates by 10% in 1993 and then again by 7% in 1994.

Cable Riser Cable running vertically in a multi-story building to serve the upper floors.

Cable Run Conduit used to run cables through a building. Also, path taken by a cable or group of cables.

Cable Scanner A device which tests coaxial, twisted-pair, and fiber-optic cable. It measures the length of a cable segment, tests for opens and shorts, and can report on the distance to the problem so the problem can be found and fixed. Many scanners also indicate if a cable segment has RFI or EMI.

Cable Sheath A covering over the conductor assembly that may include one or more metallic members, strength members, or jackets. See Cable Shield.

Cable Shield A metallic component of the cable sheath which prevents outside electrical interference and drains off current induced by lightning.

Cable Stripper 1. Tool used to strip the jackets off ALPETH and lead-jacketed telephone cable. Cable strippers include cable knives and snips.

2. A professional or amateur stripper who appears on X-rated, or community access channels. Quality varies widely. Pay is often non-existent.

Cable Telephony Cable Telephony is transmitting anything other than TV pictures over a cable TV system. That "anything" might be anything from a data connection to the Internet to simple, standard, analog voice phone calls — local, long distance and international. Typically transmitting anything other than TV over the standard coaxial cable CATV providers install at your house requires a cable modem. See Cable Modem.

Cable Television Relay Station CARS. A fixed or mobile station used for the transmission of television and related audio signals, signals of standard and FM broadcast stations, signals of instructional television fixed stations, and cablecasting from the point of reception to a terminal point from which the signals are distributed to the public.

Cable Type The type of cable used. Also called the media. Examples are coaxial, UTP (Unshielded Twisted Pair), STP (Shielded Twisted Pair) and fiber. Factors including cost, connectivity and bandwidth are important in determining cable type. Choosing cable is getting more and more complex. Our tip: Choose and buy well in advance of when you'll need it. The cable you want will not always be in stock.

Cable Vault Room under the main distribution frame in a central office building. Cables from the subscribers lines come into the building through the cable vault. From here they snake their way up to the main distribution frame. The cable vault looks like a bad B-movie portrayal of Hell, replete with thousands of dangerous black snakes. Cable vaults are prime targets for the spontaneous starting of fires. They should be protected with Halon gas, but usually aren't because some parts of the phone industry think Halon is too expensive.

Cable Weight Expressed in lbs per 1000 (without reel weight included). Affects sag, span and size of the messenger in aerial applications.

Cablecast Cablecasting. Non-broadcast radio or television programming transmitted by a cable television system to its subscribers. Cablecast programming may be originated by the cable operator itself ("origination cablecasting" or "local origination") or by an access organization.

Cablegram Service An MCI definition. An MCI International service which provides cablegram communication to International destinations through the use of a computerized message switching center in New York City.

Cablehead The point where a marine cable connects to terrestrial facilities.

CableLabs Cable Television Laboratories, Inc. A research and development consortium of cable television system operators established in 1988. CableLabs plans and funds research and development projects to help member companies and the cable industry take advantage of opportunities and meet challenges in the telecommunications industry. A

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MDMF Multiple Data Message Format. See Caller ID Message Format.
MDN Mobile Dialing Number. The originating telephone number of the cellular caller.
MDPE Medium-Density PolyEthelyne. A type of plastic materiol used to monufacture jacketing for cable systems.
MDQ Market Driven Quality. An IBM term of the mid-1980s.
MDRAM Multibank Dynamic Random Access Memory. Memory normally used in video boards that boasts extended performance with high bandwidth and short access times. The MDRAM chip can access several memory banks at a time.
MDS 1. An FCC term for a fixed station operating between 2.15 and 2.162 GHz.
2. Multi-Point Distribution Service.
MDSI Message Delivery Service Interaffice. Data link using a 9600 baud modem asynchronous 10-bit character transmission. An obsolete term.
MDT Mean Down Time.
MDU 1. Message Display Unit. See Readerboard.
2. Multiple Dwelling Unit. Any housing structure that is broken into more than one living area to accommodate multiple "family" units (apartment buildings, condominiums, duplexes, etc.).
MDUs Multiple Dwelling Units. A telephony jargon word for high-rise apartment buildings.
MDVC Mobile Digital Voice Channel. The channel between a mobile phone and a cell site antenna in a digital cellular or PCS environment. The MDVC supports both voice and data transmission, although the allocated bandwidth is designed primarily to support voice. Signaling and control functions take place over separate channels set aside specifically for that purpose.
MDWDM Metropolitan dense wave division multiplexing. It is DWDM technology which boosts the carrying capacity of fiber optic telecommunication networks. See DWDM.
ME Mechanical Engineer.
MEA Metropolitan Economic Area. See Metropoliton Statistical Area and MSA.
Meaconing A system for receiving radio beacon signals and retransmitting them on the same frequency to confuse navigation and cause inaccurate bearings to be obtained by aircraft or ground stations.
Mean The sum of all items divided by the number of items, e.g., for the five numbers 7, 7, 8, 10, and 11, the mean is $(7 + 7 + 8 + 10 + 11)/5 = 43/5 = 8.6$. The average (also the arithmetic average) and the mean are the same. What's different is the median. The median of a set is the number that divides the set in half, so that as many numbers are larger than the median as are smaller. The median of 7, 7, 8, 10, and 11 is 8. If the set has an even number of elements, the median is the number halfway between the middle pair. The median is widely used as a measure of central tendency. See several Mean definitions below.
Mean Busy Hour For a telephone line or group of lines or a switch the Mean Busy Hour is the 60 minute period where traffic is the greatest.
Mean Deviation An average of all deviations, plus or minus from the mean. It is occasionally used as a measure of dispersion.
Mean Opinion Score See MOS.
Mean Power Of A Radio Transmitter The average power supplied to the antenna transmission line by a transmitter during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions. Normally, a time of 0.1 second, during which the mean power is greatest, will be selected.
Mean Time Between Failure MTBF. The average time a manufacturer estimates before a failure occurs in a component, a printed circuit board or a complete telephone system. One must check, since MTBFs are cumulative. MTBF was developed and administered by the U.S. military for purposes of estimating maintenance levels required by various devices and systems. Since accurate statistics require a basis of "failures per million hours of operation," an MTBF estimate on a single device is not very accurate; it would take 114 years to see if the device really had that many failures! Similarly, since the MTBF is an estimate of averages, half of the devices can be expected to fail before then, and half after. MTBF cannot be used as a guarantee. Telecommunications systems operate on the principle of "Availability," for which there is a body of CCITT Recommendations.
Mean Time Between Outages MTBO. The mean time between equipment failures or significant outages which essentially render transmission useless. See Mean Time Between Failure.
Mean Time To Repair MTTR. The vendor's estimated average time required to do repairs on equipment.
Mean Time To Service Restoral MTSR. The mean time to restore service following system failures that result in a service outage. The time to restore includes all time from the occurrence of the failure until the restoral of service.
Measured Load The load that is indicated by the average number of busy servers in a group over a given time interval, usually determined with a scanning device.
Measured Rate A message rate structure in which the monthly phone line rental includes a specified number of calls within a defined area, plus a charge for additional calls. See Local Measured Service.
Measured Service Also known as USAGE SENSITIVE PRICING (USP). A local phone company method of pricing used to bill local phone calls. Measured service is often charged on the number of calls, the time of day, the distance traveled and the length of the call. See Local Measured Service.
Measurement Interval A Frame Relay term defining the interval of time which the carrier uses to measure burst rates which exceed the CIR, as well as the length of the bursts.
Meatware People. See also Vaporware.
MECAB Multiple Exchange Carrier Access Billing.
MECAL Master Event Calendar.
MECCA Multiplex Engineering Control Center Activity.
Mechanic A programmer.
Mechanical Equipment Room A room serving the space needs for HVAC and other building systems other than telecommunications equipment. These are often special-purpose rooms.
Mechanical Hold A very basic line-holding mechanism used on simple two- and three-line phones that operated by placing a short circuit or a resistor across one phone line while talking on another. Chief disadvantage was that a call put on hold at one phone could not be taken off hold at another phone. Inexpensive multi-line phones with electronic holds largely replaced mechanical holds in the 1980s.
Mechanical Loop Test MLT. Also called Direct-Access Test Unit (DATU) added or built into a central office switch. With MLT a technician can execute tests for shorts, opens and grounds remotely. The technician gets a digital voice, enters a password and is given a series of options. The technician can get results as a digital recording or through an alpha-numeric pager. MLT units can send a locating tone as TIP, RING or a combination of both. The unit can short lines and remove battery voltage for testing.
Mechanical Splice A splice in which optical glass fibers are joined mechanically (e.g., glued or crimped in place) but not fused (i.e. melted) together.
Mechanical Stripping Removing the coating from a fiber using a tool similar to those used for removing insulation from wires.
Mechanized Calling Card Service MCCS was formerly known as ABC Service. MCCS is a central office switch feature that automatically bills credit card calls made on DDD (direct distance dial) rates without the involvement of an operator.
Mechanized Line Testing MLT. The system provides computer control of accurate and extensive loop testing functions in the customer contact, screening, testing, dispatch and closeout phases of trouble report handling. It also provides full diagnostic outputs instead of just pass/fail indications.
MECOD Multiple Exchange Carriers Ordering and Design.
Media In the context of telecommunications, media is most often the conduit or link that carries transmissions. Transport media include coaxial cable, copper wire, radio waves, waveguide and fiber.
Media Access Control MAC. The real term is Medium Access Control. But some naughty people call it, incorrectly, Media Access Control. See Medium Access Control for a full explanation.
Media Access Control Convergence Functions MCF. Media Access Control Convergence performs functions or processes which map information received from IEEE 802.2 Layer 2 LLC into a format acceptable to the lower layer medium.
Media Compatible Usually used to refer to floppy disk media. Even though two different computers (e.g. on AT&T PC 6300 and an Apple IIe) both use 5 1/4 inch floppy disks, the information recorded on them is recorded in a different format and thus, they are not media compatible. You can put one disk in another's machine. But it won't work. You'll get a dumb error message.
Media Filter A device used to convert the output signal from a token-ring adapter board to work with a specific type of wiring. For example, a media filter can link 16Mbps token-ring network interface cards with unshielded twisted-pair (UTP) wiring, thus saving

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the expense of additional cable runs.

Media Gateway Controller See MGCP.

Media Gateway See MGCP.

Media Gateway Control Protocol See MGCP.

Media Independent Interface MII. A part of the Fast Ethernet specification. The MII replaces 10Base-T Ethernet's Attachment Unit Interface (AUI), and is used to connect the MAC layer to the physical layer. The MII establishes a single interface for the three 100Base-T media specifications (100Base-TX, 100Base-T4, and 100Base-FX).

Media Interface Connector An optical fiber connector which links the fiber media to the FDDI node or another cable.

Media Path Same as wire run. The means by which telephone signals are conveyed from the Network Interface Jack to the Communications Outlet.

Media Processor A special microprocessor whose job is to perform processing for multimedia devices, e.g. videophones, audio, computer telephony devices, voice recognition and 3-D, while the computer's main microprocessor (e.g. a Pentium) handled the basic processing and input/output (I/O) processing. Such media processors might have all the characteristics of digital signal processors and then some. See also MMX.

Media Processing The processing of transactions during a telephone call; these transaction may include fax operations, speech recognition and synthesis, Touch Tone recognition, voice and fax store-and-forward messaging, and the conversion of messages from one format to another (such as from text to voice, or fax to text).

Media Server A new term for a file server on a local area network which contains files containing voice, images, pictures, video, etc. In short, a media server is a repository for media of all types. Media servers are also called file servers. Here's a definition of Media Server, courtesy of Oracle Corporation, writing in early 1994: "The media server harnesses the power of the fastest computers ever built — massively parallel computers. Media servers support diverse clients so that users don't have to discard existing systems. They provide storage, network interfaces and memory — plus support for all forms of multimedia information. Because they use thousands of low-cost microprocessors, media servers offer astonishing performance at low cost."

Media Service Instance A logical server providing access to media services (e.g., Accessing a DataStream, Sending & Receiving Faxes, Playing & Recording Sounds, Engaging other VRU services) that can be associated with a call through a Media Access Device. See MediaStreamID.

Media Stream The information content carried on a call-that is, what actually is transmitted and received over the line, and can, with the necessary hardware, be read and written by a media stream API.

Media StreamID Allows an association to be established between a given call and Media Services available on a Media Service Instance that can be associated with the call through a Media Access Device. See Media Service Instance.

Media Type A call's media type describes what type of information the call is carrying, such as data or voice. A computing domain can use this information, for example, to route the call to a more appropriate computing domain, such as a data computing domain for an incoming data call.

Median The average and the mean are the same. What's different is the median. See Mean for a full explanation.

Mediation System A wireless telecommunications term. A mediation system provides for three functions for transporting data from one device to another. These include protocol conversion, message routing, and store-and-forward processing.

Medium 1. The material on which data is recorded; for example, magnetic type, diskette.

2. Any material substance that is, or can be, used for the propagation of signals, usually in the form of modulated radio, light, or acoustic waves, from one point to another, such as optical fiber, cable, wire, dielectric slab, water, air, or free space.

Medium Access Control MAC. The IEEE sublayer in a LAN (Local Area Network) which controls access to the shared medium by LAN-attached devices. In the context of the OSI Reference Model, the MAC layer extends above to the Data Link Layer (Layer 2), and below to the Physical Layer (Layer 1). Within the MAC sublayer are defined Data Link Layer options which specify the basis on which devices access the shared medium, and the basis on which congestion control is exercised. Defined at the Physical Layer are media options such as UTP (Unshielded Twisted Pair) CAT 3, 4, and 5 (Categories of wire); STP (Shielded Twisted Pair); fiber optic cable; and wireless radio and infrared. Specific IEEE MAC standards are defined for LANs such as CSMA/CD (802.3), Token Passing Bus (802.4), Token Passing Ring (802.5), Metropolitan Area Networks (802.6), and Wireless LANs (802.11). The MAC sublayer works in conjunction with the Logical Link Control Layer of the IEEE model; at this higher level are defined specific LLC conventions such as frame format and addressing.

Medium Attachment Unit A device used in a data station to couple the data terminal equipment (DTE) to the transmission medium.

Medium Dependent Interface MDI-X. The physical components of a network interface which handle the electrical or optical connection to a cable. This includes the connector, transceivers, and other physical layer components. MDI-X refers to a physical connection which includes an internal crossover of the transmit and receive signals. All standard repeater ports are MDI-X and are often marked with just an X by the port. Some repeater ports are changeable to a DTE port. In this case, the port is changed to a MDI port for connection to a MDI-X port on another repeater. An example of a DTE port is the connection on a NIC.

Medium Earth Orbit MEO. Medium (or Middle) Earth Orbit satellites orbit the earth at distances between LEOs and GEOs (Low Earth Orbit satellites and Geosynchronous Earth Orbit satellites). Because MEOs operate at heights greater than LEOs, they have larger footprints, or areas of coverage, so that fewer satellites are needed to provide complete coverage over the earth. The planned Odyssey system, which will have 12 satellites, is one MEO with complete world coverage. See also LEO, MEO, GEO and Geosynchronous.

Medium Frequency MF. Radio frequencies from 300 KHz to 3000 KHz.

Medium Interface Connector MIC. In LAN/MAN systems, the connector at the interface point between the bus interface unit and the terminal, termed the medium interface point.

MEE Multiplex Equipment Engineering.

Meet-Me Conference A teleconferencing term. Meet-Me Conferencing is an arrangement by which you can dial a specific, pre-determined telephone number and security access code to join a conference with other participants. You are automatically connected to the conference through a conference bridge. Conference participants may call in at a preset time or may be directed to do so by a conference coordinator. Meet-Me Conferences may be set up through a teleconferencing service provider, generally with the capability to conference thousands of participants. It also can be provided through a phone system, such as a PBX, key system or hybrid. Some phone systems restrict this to intercom circuits only. In almost all phone systems there is a maximum number of parties that can be connected in such conference at one time.

Meet-Me Intercom Conference Dial a special number ("access code") and any telephone can join an intercom conference call.

Meet-Me Page A feature which allows a person to answer an intercom page from any phone in the system.

Meet Point A location at which the facilities of two carriers connect.

Meet-Point Billing This is a billing arrangement that applies when two Local Exchange Carriers in the same LATA are used to complete a private line circuit.

Mega A prefix meaning one million, also represented as an M. MEGABIT = one million bits. MEGABYTE = one million bytes. MEGAHERTZ = one million cycles per second. See also Megabyte.

Megabits per Second A measurement of speed indicating that one million bits of information travel a certain distance in one second.

Megabyte MB. A combination of the Greek "mega," meaning "large," and the English "bite," meaning "a small amount of food." A unit of measurement for physical data storage on some form of storage device-hard disk, optical disk, RAM memory, etc. The actual definition can be confusing, since there are two measurements. In the metric system, a megabyte is 1,000,000 bytes. In the computer world, things tend to be measured in binary terms — 1s and 0s. In binary terms, a megabyte is 2 to the 20th power, i.e., 1,048,576 bytes, which is the closest power of two to one million.i.e. 1024 x 1024. A megabyte can be either a decimal (metric) megabyte or a binary megabyte, depending on the context. A decimal megabyte also is called a "millionsbyte" or a "miobyte," and is used to describe capacity in newer ROM BIOS drives. Binary megabytes are used to describe capacity in DOS FSISK, Windows 3.x File Manager, and CMOS setup in older ROM BIOS drives. Here is a summary of sizes:

MB = Megabyte (2 to the 20th power)
GB = Gigabyte (2 to the 30th power)
TB = Terabyte (2 to the 40th power)

that receives the data from a PAD Packet Assembly Disassembler) through a modem. The PSE makes and holds copies of each packet before sending them to the PSE they're addressed to. After the far-end PSE acknowledges receipt of the original, the copies are discarded.

Packet Switching Network A network designed to carry data in the form of packets. See Packet Switching.

Packet Telephony Another name for Internet Telephony. Also called Voice Over the Internet. See VoIP.

Packet Tracing The monitoring and reporting a particular packet addresses or types for diagnostic purposes.

Packet Type Identifier In packet data networking technology, the third octet in the packet header that identifies the packet's function and, if applicable, its sequence number.

Packet-centric A growing focus in the telecom industry away from voice-dominant (circuit-centric) networks and toward IP packet networks as the future delivery system for combined data and telephony. Definition courtesy Wireless Magazine.

PacketCable PacketCable is a project conducted by CableLabs and its member companies aimed at identifying, qualifying and supporting Internet-based voice and video products and cable systems.

Packetized Video First, read the definition of "Packet Switching." Then read the definition of "Packetized Voice" just below. The concept of packetized video is basically the same as that of packetized voice. A video camera feeds the signal into a codec, which converts the native analog signal into a digital format, and segments the data into data packets. The packets are sent across a packet network as a packet stream for reassembly by a codec on the receiving end of the transmission before presentation on a monitor. While packetized video performance is improving in quality through the application of increasingly sophisticated video compression techniques, it suffers from the same intrinsic packet-switching characteristics as does packetized voice. Namely, packet latency and loss. The result often is a video image which is less than pleasing. Note that voice and video are isochronous data, meaning that they are stream-oriented. In other words, the transmitting device must have regular and reliable access to the network. Further, the network must transport and deliver the data on a regular and reliable basis in order that a stream of information reach the presentation device. Such regular and reliable ingress, transport and egress of data results in a image of consistent quality. As packet-switched networks are not designed to support isochronous data communications, they generally are considered unsuitable for voice and video communications. Additionally, video is very bandwidth-intensive, thereby placing additional stress on packet-switched networks such as the Internet, which already is overloaded.

An example might help. Let's say that you are using an inexpensive ($200 or so) videoconferencing package consisting of a camera and software. Your friend has the same package. At a pre-arranged time, you place a call over the Internet to establish a videoconference. At two fps (frames per second) the videoconference goes along pretty smoothly, although both the video and voice quality are a bit rough. At some point, your friend turns his head quickly; at the same time, the Internet bogs down. The packet which contains the image of your friend's nose gets delayed or lost in the network. The video image of your friend now is missing a nose. Funny the first time, aggravating the second, maddening thereafter. The upside is that the videoconference is cheap, if not free, depending on your cost of Internet access. See also Packet Switching, Videoconferencing Internet and Isochronous.

Packetized Voice First read the definition of "Packet Switching" just above. The idea is to digitize voice and, compress it, and then slice it up into packets and send those packets from the sender by various routes and assemble them as they get to the receiver. Packet switching for data makes sense. Packet switching for voice has not made sense because the voice is too sensitive to latency, or delay, especially the variable delay which is part and parcel of packet-switched networking. Recently developed software and DSP hardware, which employs sophisticated compression techniques has improved the ability to conduct "reasonable" quality packet voice conversations over the Internet. See Packet Switching, IP Telephony, TAPI 3.0.

PacketNet Sprint's internal X.25 Packet Network.

PACS Personal Communications Access System. PACS is a cellular system providing limited, regional mobility in a given area. It provides mobility between that of a cordless phone and a full-fledged cellular system. Originally developed by Bell Labs in the early 1980s, PACS is a comprehensive framework for the deployment of PCS and applies to both licensed and unlicensed applications. Now it is approved by the TIA and Exchange Carriers Standards Associations. Today's currently implemented versions of PCS are "up-banded" versions of the 900 MHz AMPS and GSM cellular standards.

PACT Siemens' PBX And Computer Teaming. It defines protocols between Siemens PBXs and external computers.

Pad 1. A device inserted into a circuit to introduce loss, i.e., to reduce the level of a signal. "Level" is a measurement of amplitude (signal power) at a specified point in a circuit known as a Transmission Level Point (TLP). "Loss" is the measurement of the decrease in amplitude between two TLPs, and is measured in decibels (dB). A pad may consist of any combination of inductors, resistors and capacitors.

2. Packet Assembler/Disassembler. A device that accepts characters from a terminal or host computer and puts the characters into packets that can be handled by a packet switching network. It also accepts packets from the network, and disassembles them into character streams that can be handled by the terminal or host. PADs generally are associated with X.25, an ITU-T Standards Recommendation for an access protocol used in older packet-switched networks. See also X.25.

3. A concrete slab used as the foundation for a microwave radio tower or satellite dish.

Pad Characters In (primarily) synchronous transmission, characters that are inserted to ensure that the first and last characters of a packet or block are received correctly. Inserted characters that aid in clock synchronization at the receiving end of a synchronous transmission link. Also called Fill Characters.

Pad Switching A technique of automatically cutting a transmission loss pad into and out of a transmission circuit for different operating conditions.

PAF File A British term. Post Office Address file, a publicly available data file that, when integrated with an application, links postcodes to full addresses. When using a PAF file, an agent can save time by entering only the postcode. The PAF file automatically inserts post town, street and country.

Page A chunk of information, like a document or file, on the Web. A hypermedia document as viewed through a World Wide Web browser. Pages are the way you make information available on the Web. They can contain text, black and white and color photographs, audio and video.

Page hits A measure of the number of Web pages accessed at a particular site, or of the number of times a single page is accessed.

Page Mirroring You're surfing the Internet. You come upon an Web site and find something you want to buy. It has a button that says, "To speak to an Agent, push here." You do. An agent in a distant office calls you on another phone line. You're now both speaking to each other and your agent is also seeing the screen you're seeing. As you move to different screens (to different pages), the agent sees the same screens you are looking at. This is called page mirroring. At present, the technology won't allow the agent to move the pages which you see. Only you can move the screens.

Page Recall A feature which allows subscribers to telephone a toll-free number to check messages at any time. Messages are stored in the IVR (Interactive Voice Response) device for a period of 99 hours.

Page Scan State A Bluetooth term. A mode where a device listens for page strains containing its own device access code (DAC). A mode that a RemDev enters when advertising that a service is available.

Page State A Bluetooth term. A mode that a LocDev enters when searching for services. The LocDev sends out a page to notify other devices that it wants to know about the other devices and/or their services.

Page train A Bluetooth term. A series of paging messages sent over the baseband.

Page Zone A local area in the office that can receive directed Page announcements independently of the remainder of the office.

Pager A small one-way (typically) wireless receiver you carry with you. When someone wants you, they make your pager receiver alert you via a tone or a vibrator. They can activate your pager in a number of ways, including dialing your pager digits directly into a computer; calling your pager from a telephone; or the old, low-tech approach of giving your name and pager number to an operator who then punches out your numbers. Pagers have became small, cheap and very reliable. Monthly service costs have dropped and the area which you can be paged in most areas has widened dramatically. With most pagers you can be reached in most major metropolitan areas of the US. This minor miracle is accomplished through a combination of satellite and terrestrial radio networks; if the network can't reach you to deliver the page, it will store the message until you can be reached. Some pagers also display small alphanumeric messages-like phone numbers to call and

don't have to return. It closes deals that can't wait. And it gives customers immediate answers. In short, it improves corporate efficiency and customer satisfaction.

Voice over IP VoIP. The technology used to transmit voice conversations over a data network using the Internet Protocol. Such data network may be the Internet or a corporate Intranet, or managed networks typically used by long and local service traditional providers and ISPs that use VoIP. There are several potential benefits to moving voice over a data network using Internet Protocol: First, You may save some money. Second, you may achieve benefits of managing a voice and data network as one network. Third, if you have IP phones, moves, adds and changes will be easier and cheaper. (IP phones have individual numbers, with memories, user profiles and software upgrades are typically centrally managed using standard computing systems. So they're more "user friendly.") And fourth — the key attraction of IP telephony — is added (and integrated) new services, including integrated messaging, bandwidth on demand, voice emails, the development of "voice portals" on the Web and the much simplified setting up, tearing down and transferring of phone calls. See Internet Protocol.

Voice Paging Access Gives attendants and phone users the ability to dial loudspeaker paging equipment throughout the building. An unbelievably useful feature, if your people are prone to wander.

Voice Portal Call a phone number, have an interactive voice response system answer you, respond to your words with speech recognition, read your emails with text-to-speech skills, perhaps even allowing you to "surf" the Web. The classic definition of a portal is a door, gate, or entrance, especially one of imposing appearance, as to a palace. In the Internet / World Wide Web business, a portal is a site, which the owner positions (through marketing) as an entrance to other sites on the Internet. There are two types of portals — the conventional PC-based, browser based — and the newer one using the telephone. For a bigger explanation of a portal, see Portal.

Voice Print See Voiceprint.

Voice Processing Think of voice processing as a voice computer. Where a computer has a keyboard for entering information, a voice processing system recognizes touch tones from remote telephones. It may also recognize spoken words. Where a computer has a screen for showing results, a voice processing system uses a digitized synthesized voice to "read" the screen to the distant caller.

Whatever a computer can do, a voice processing system can too, from looking up train timetables to moving calls around a business (auto attendant) to taking messages (voice mail). The only limitation on a voice processing system is that you can't present as many alternatives on a phone as you can on a screen. The caller's brain simply can't remember more than a few. With voice processing, you have to present the menus in smaller chunks.

Voice processing is the broad term made up of two narrower terms — call processing and content processing. Call processing consists of physically moving the call around. Think of call processing as switching. Content consists of actually doing something to the call's content, like digitizing it and storing it on a hard disk, or editing it, or recognizing it (voice recognition) or some purpose (e.g. using it as input into a computer program.) See Voice Board, Voice Response Unit and Voice Server.

Voice Profile for Internet Messaging See VPIM.

Voice Recognition The ability of a machine to recognize your particular voice. This contrasts with speech recognition, which is different. Speech recognition is the ability of a machine to understand human speech — yours and most everyone else's. Voice recognition needs training. Speech recognition doesn't. See Speaker Dependent and Speaker Independent Voice Recognition.

Voice Response Unit VRU. Think of a Voice Response Unit (also called Interactive Voice Response Unit) as a voice computer. Where a computer has a keyboard for entering information, an IVR uses remote touchtone telephones. Where a computer has a screen for showing the results, an IVR uses a digitized synthesized voice to "read" the screen to the distant caller. An IVR can do whatever a computer can, from looking up train timetables to moving calls around an automatic call distributor (ACD). The only limitation on an IVR is that you can't present as many alternatives on a phone as you can on a screen. The caller's brain simply won't remember more than a few. With IVR, you have to present the menus in smaller chunks. See IVR and Voice Board.

Voice Retrieval Message system that stores verbal messages (from callers or operator) for automatic retrieval at the customer's convenience.

Voice Ring Multiple Digital Intertie Buses connected in series to all nodes. Provides extra channels for voice data transmission when direct link (DI) channels are busy.

Voice Server A PC sitting on a LAN (Local Area Network) and containing voice files which are accessible by the PCs on the LAN. Such voice files may be transmitted on the LAN or over phone lines under the control of the PCs on the LAN. A voice server might contain voice mail. It might contain voice annotated electronic mail. Its primary function is to store voice in such a way that it's accessible easily. Voice servers are typically faster, have more disk capacity and more backup provisions than normal PCs. According to a letter I received in early May, 1993 from the lawyers for a company called Digital Sound Corporation, that company owns federal trademark registration number 1,324,258 for the mark Voiceserver, spelled as one word, not two.

Voice Service Personality A new name for dial tone.

Voice Store And Forward Voice mail. A PBX service that allows voice messages to be stored digitally in secondary storage and retrieved remotely by dialing access and identification codes. See Voice Mail System.

Voice Switched A device which responds to voice. When the device hears a voice, it turns on and transmits it, muting the receive side. The most common voice-switched device is the desk speakerphone. With voice switching, it's easy to hog a circuit. Just keep making a noise. Watch out for voice hogging. If you're calling someone and waiting for them by listening in on your speakerphone, mute your speakerphone. This way you'll hear them when they answer.

Voice Switching Equipment used in voice and video conferences. The equipment is activated by sounds of sufficient amplitude; hopefully speech, but also loud noises. Fast switching activates microphones so that only one conference participant can speak at a time. See also Voice Activated Video.

Voice Terminal A pretentious AT&T term for a Telephone.

Voice Verification The process of verifying one's claimed identity through analyzing voice patterns.

Voiceband A transmission service with a bandwidth considered suitable for transmission of audio signals. The frequency range generally is 300 or 500 hertz to 3,000 or 3,400 hertz — the frequency range the common analog home phone service is made at.

VoFR Voice over Frame Relay.

Voiceprint A voice recognition term. A voiceprint is a speech template used to recognize and verify callers. For example, Home shopping Network,
voice systems
When a system is operating,
the user's speech is compared to the stored voice prints. If they match, the system recognizes the word and executes the command.

VoIP Voice over Internet Protocol. The technology used to transmit voice conversations over a data network using the Internet Protocol. Such data network may be the Internet or a corporate Intranet. For a much longer explanation, see Voice over IP and VoIP Forum.

VoIP Forum Voice over Internet Protocol. The Voice over IP Forum was formed in 1996 by Cisco Systems, VocalTec, Dialogic, 3Com, Netspeak and others as a working group of the International Multimedia Teleconferencing Consortium (IMTC), which promotes the implementation of the ITU-T H.323 standard. The VoIP Forum is focused on extending the ITU-T standards to provide implementation recommendations as a means of supporting Voice over IP in order that devices of disparate manufacture can support voice communications over packet networks such as the Internet. By way of example, the VoIP Forum intends to establish directory services standards in order that Internet voice users can find each other. They also plan to port touch-tone signals to the Internet to allow the use of ACDs and voice mail systems. See also VON Coalition.

VolanoMark VolanoMark is a popular Java benchmark for measuring server throughput... it measures messages per second.

Volatile Storage Computer storage that is erased when power is turned off. RAM is volatile storage.

Volser An MCI term used to denote a volume of calls. Based on the words "Volume Serial." The term "Volser" can be applied to the manual collection of calls from a switch on a switch tape or through call data transmitted via NEMAS.

Volt The unit of measurement of electromotive force. Voltage is always expressed as the potential difference in available energy between two points. One volt is the force required to produce a current of one ampere through a resistance or impedance of one ohm.

Volt Meter An instrument for measuring voltages, resistance and current.

Voltage Electricity is a essentially a flow of electrons. They're pushed into a gadget — toaster, computer, phone — on one wire and they sucked out on the other wire. For this movement of electrons to occur there must be "pressure," just as there must be pressure in

Appendix C

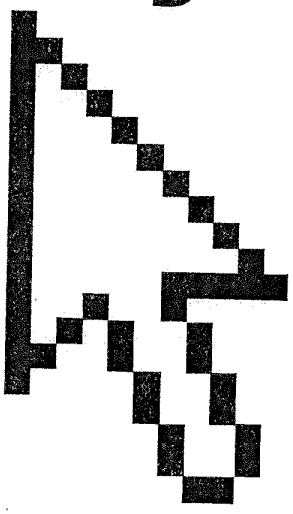
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Advanced Encryption Standard *n. See* AES.

Advanced Interactive Executive *n. See* AIX.

Advanced Mobile Phone Service *n. See* AMPS.

Advanced Power Management *n.* An older power management technology used in mobile PCs before the implementation of Advanced Configuration and Power Interface (ACPI). Advanced Power Management is a software interface that functions between the BIOS power-management software that is specific to the hardware and a power-management policy driver that is run by the operating system. *Acronym:* APM.

Advanced Program-to-Program Communication *n. See* APPC.

Advanced Research Projects Agency Network *n. See* ARPANET.

Advanced RISC *n.* Short for **Advanced** reduced instruction set computing. A specification for a RISC microchip architecture and system environment designed by MIPS Computer Systems to provide binary compatibility among software applications. *See also* RISC.

Advanced RISC Computing Specification *n.* The minimum hardware requirements enabling a RISC-based system to comply with the Advanced Computing Environment standard. *See also* Advanced RISC.

Advanced RISC Machines *n. See* ARM.

Advanced SCSI Programming Interface *n.* An interface specification developed by Adaptec, Inc., for sending commands to SCSI host adapters. The interface provides an abstraction layer that insulates the programmer from considerations of the particular host adapter used. *Acronym:* ASPI.*See also* adapter, SCSI.

Advanced Streaming Format *n.* An open file format specification for streaming multimedia files containing text, graphics, sound, video, and animation. Advanced Streaming Format (ASF) does not define the format for any media streams within the file. Rather, it defines a standardized, extensible file "container" that is not dependent on a particular operating system or communication protocol, or on a particular method (such as HTML or MPEG-4) used to compose the data stream in the file. An ASF file consists of three objects: a Header object containing information about the file itself, a Data object containing the media streams, and an optional Index object that can help support random access to data within the file. The ASF specification has been submitted to the ISO (International Organization for Standardization) for consideration. *Acronym:* ASF.*See also* streaming.

adventure game *n.* A role-playing computer game in which the player becomes a character in a narrative. In order to complete the game, the player must solve problems and avoid or overcome attacks and other forms of interference from the game's environment and other characters. The first adventure game was called "Adventure." It was developed in 1976 by Will Crowther of Bolt, Baranek & Newman. *See also* arcade game, computer game, role-playing game.

AE *n.* Acronym for application entity. In the ISO/OSI reference model, one of the two software parties involved in a communications session. *See also* ISO/OSI reference model.

A/E/C SYSTEMS conference *n.* Annual conference of the architecture, engineering, and construction industry. The conference promotes the exchange of information on new techniques and technologies used by these industries.

.aero *n.* One of seven new top-level domain names approved in 2000 by the Internet Corporation for Assigned Names and Numbers (ICANN). .aero is meant for use with air-transport industry-related Web sites. The seven new domain names became available for use in the spring of 2001.

AES *n.* Acronym for Advanced Encryption Standard. A cryptographic algorithm specified by the National Institute of Standards and Technology (NIST) to protect sensitive information. AES is specified in three key sizes: 128, 192, and 256 bits. AES replaces the 56-bit key Data Encryption Standard (DES), which was adopted in 1976. *See also* DES.

AFC *n. See* Application Foundation Classes.

AFDW *n. See* Active Framework for Data Warehousing.

affinity *n.* For Network Load Balancing, the method used to associate client requests to cluster hosts. When no affinity is specified, all network requests are load balanced across the cluster without respect to their source. Affinity is implemented by directing all client requests from the same IP address to the same cluster host. *See also* client request, IP address.

AFIPS *n.* Acronym for American Federation of Information Processing Societies. An organization formed in 1961 for the advancement of computing and information-related

ARM *n.* Short for **A**dvanced **R**ISC **M**achines. A name for any of a group of small, high-performance 32-bit RISC-based microprocessors licensed to various semiconductor manufacturers by designer ARM Limited. ARM chips are notable for their low cost and efficient use of power. They are used in a wide variety of products, including mobile phones, handheld computers, automotive and embedded solutions, and consumer electronics, including digital cameras and game systems. *See also* StrongARM.

ARP *n.* Acronym for **A**ddress **R**esolution **P**rotocol. A TCP/IP protocol for determining the hardware address (or physical address) of a node on a local area network connected to the Internet, when only the IP address (or logical address) is known. An ARP request is sent to the network, and the node that has the IP address responds with its hardware address. Although ARP technically refers only to finding the hardware address, and RARP (for Reverse ARP) refers to the reverse procedure, ARP is commonly used for both senses. *See also* IP address, TCP/IP.

ARPANET *n.* A large wide area network created in the 1960s by the U.S. Department of Defense Advanced Research Projects Agency (ARPA, renamed DARPA in the 1970s) for the free exchange of information between universities and research organizations, although the military also used this network for communications. In the 1980s MILNET, a separate network, was spun off from ARPANET for use by the military. ARPANET was the network from which the Internet evolved. *See also* ALOHAnet, Internet, MILNET.

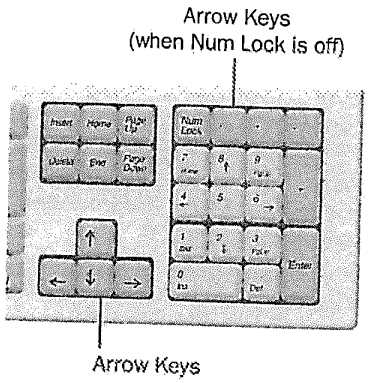
ARP request *n.* Short for **A**ddress **R**esolution **P**rotocol **request**. An ARP packet containing the Internet address of a host computer. The receiving computer responds with or passes along the corresponding Ethernet address. *See also* ARP, Ethernet, IP address, packet.

array *n.* In programming, a list of data values, all of the same type, any element of which can be referenced by an expression consisting of the array name followed by an indexing expression. Arrays are part of the fundamentals of data structures, which, in turn, are a major fundamental of computer programming. *See also* array element, index[1], record[1], vector.

array element *n.* A data value in an array.

array processor *n.* A group of interconnected, identical processors operating synchronously, often under the control of a central processor.

arrow key *n.* Any of four keys labeled with arrows pointing up, down, left, and right, used to move the cursor vertically or horizontally on the display screen or, in some programs, to extend the highlight. See the illustration.



Arrow key. *When Num Lock is off, the arrow keys on the number keypad can be used.*

ART *n.* Acronym for **A**daptive **R**esonance **T**heory. First introduced as a theory of human information processing by Stephen Grossberg, ART has evolved into several classes of self-organizing neural networks that use two layers of ideal cases to predict outcome. It is a form of cluster analysis where data is classified or matched to the previously stored pattern it most closely resembles. This data is said to *resonate* with the ideal case layer, which is then updated to reflect the new information. The constant recategorization of input results in a powerful autonomous neural network. *See also* artificial intelligence, cluster analysis, neural network.

article *n.* A message that appears in an Internet newsgroup. *Also called:* post. *See also* newsgroup.

articulation *n.* A series of adjustments applied by a synthesizer to the pitch, volume, and other parameters of an instrument sound to make it more realistic.

artifact *n.* A visible imperfection or distortion in a digital image. Artifacts may be caused by hardware/software limitations or may be a byproduct of compression.

artificial intelligence *n.* The branch of computer science concerned with enabling computers to simulate such aspects of human intelligence as speech recognition, deduction, inference, creative response, the ability to learn

systems integrate computer-aided design and engineering (CAD/CAE), material requirements planning (MRP), and robotic assembly control to provide "paperless" management of the entire manufacturing process. 3. Acronym for computer-input microfilm. A process in which information stored on microfilm is scanned and the data (both text and graphics) converted into codes that can be used and manipulated by a computer. Computer-input microfilm is similar to processes such as optical character recognition, in which images on paper are scanned and converted to text or graphics. *Compare* COM (definition 4).

CIP *n.* 1. Short for Commerce Interchange Pipeline. A Microsoft technology that provides for secure routing of business data between applications over a public network such as the Internet. CIP is independent of data format and supports encryption and digital signatures, as well as various transport protocols including SMTP, HTTP, DCOM, and EDI value-added networks. Typically, data such as invoices and purchase orders travel over a network through a transmit pipeline and are read from the network by a receive pipeline that decodes and prepares the data for the receiving application. 2. Short for Common Indexing Protocol. A protocol defined by the Internet Engineering Task Force (IETF) for enabling servers to share indexing information. CIP was developed to provide servers with a standard means of sharing information about the contents of their databases. With such sharing, a server unable to resolve a particular query would be able to route the query to other servers that might contain the desired information—for example, to find the e-mail address of a particular user on the Web.

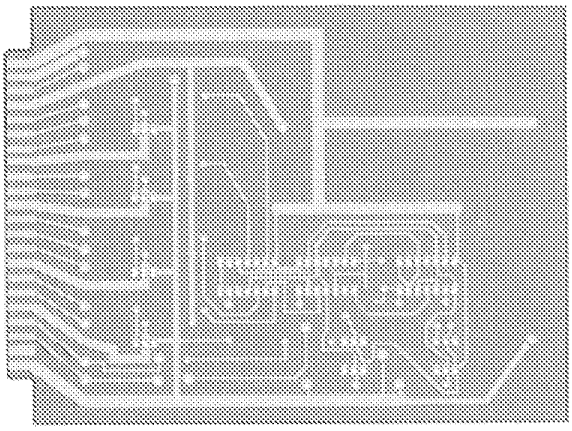
cipher *n.* 1. A code. 2. An encoded character. 3. A zero.

ciphertext *n.* The scrambled or otherwise encoded text of an encrypted message. *See also* encryption.

circuit *n.* 1. Any path that can carry electrical current. 2. A combination of electrical components interconnected to perform a particular task. At one level, a computer consists of a single circuit; at another, it consists of hundreds of interconnected circuits.

circuit analyzer *n.* Any device for measuring one or more characteristics of an electrical circuit. Voltage, current, and resistance are the characteristics most commonly measured. Oscilloscopes are circuit analyzers.

circuit board *n.* A flat piece of insulating material, such as epoxy or phenolic resin, on which electrical components are mounted and interconnected to form a circuit. Most modern circuit boards use patterns of copper foil to interconnect the components. The foil layers may be on one or both sides of the board and, in more advanced designs, in several layers within the board. A printed circuit board is one in which the pattern of copper foil is laid down by a printing process such as photolithography. See the illustration. *See also* board, printed circuit board.



Circuit board.

circuit breaker *n.* A switch that opens and cuts off the flow of current when the current exceeds a certain level. Circuit breakers are placed at critical points in circuits to protect against damage that could result from excessive current flow, which is typically caused by component failure. Circuit breakers are often used in place of fuses because they need only to be reset rather than replaced. *Compare* surge protector.

circuit card *n. See* circuit board.

Circuit Data Services *n.* A GTE service that uses circuit switching technology to provide fast data transfer using a laptop computer and cellular telephone. *Acronym:* CDS. *See also* circuit switching.

circuit-switched data *n.* An ISDN option that can be specified for B (bearer) channels that enables an ISDN user to transmit digital data over the channel at 64 Kbps along a point-to-point, dedicated connection for the duration of a call. *Acronym:* CSD. *See also* alternate circuit-switched voice/circuit-switched data, B channel, ISDN. *Compare* circuit-switched voice.

circuit-switched voice *n.* An ISDN option that can be specified for B (bearer) channels that uses the channel to set up a point-to-point, dedicated connection for the digital transmission of voice communications for the duration of a call. *Acronym:* CSV. *See also* alternate circuit-switched

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D

the parts of the system work in harmony so that data is stored safely and accurately. Application programs manage data by receiving and processing input according to the user's commands, and sending results to an output device or to disk storage. The user also is responsible for data management by acquiring data, labeling and organizing disks, backing up data, archiving files, and removing unneeded material from the hard disk.

data manipulation *n.* The processing of data by means of programs that accept user commands, offer ways to handle data, and tell the hardware what to do with the data.

data manipulation language *n.* In database management systems, a language that is used to insert data in, update, and query a database. Data manipulation languages are often capable of performing mathematical and statistical calculations that facilitate generating reports. *Acronym:* DML. *See also* structured query language.

data mart *n.* A scaled-down version of a data warehouse that is tailored to contain only information likely to be used by the target group. *See also* data warehouse.

data medium *n.* The physical material on which computer data is stored.

data migration *n.* **1.** The process of moving data from one repository or source, such as a database, to another, usually via automated scripts or programs. Often data migration involves transferring data from one type of computer system to another. **2.** In supercomputing applications, the process of storing large amounts of data off line while making them appear to be on line as disk-resident files.

data mining *n.* The process of identifying commercially useful patterns, problems, or relationships in a database, a Web server, or other computer repository through the use of advanced statistical tools. Some Web sites use data mining to monitor the efficiency of site navigation and to determine changes in the Web site's design based on how consumers are using the site.

data model *n.* A collection of related object types, operators, and integrity rules that form the abstract entity supported by a database management system (DBMS). Thus, one speaks of a relational DBMS, a network DBMS, and so on, depending on the type of data model a DBMS supports. In general, a DBMS supports only one data model as a practical rather than a theoretical restriction.

data network *n.* A network designed for transferring data encoded as digital signals, as opposed to a voice network, which transmits analog signals.

Data Over Cable Service Interface Specification *n. See* DOCSIS.

data-overrun error *n.* An error that occurs when more data is being acquired than can be processed. *See also* bps.

data packet *n. See* packet.

data path *n.* The route that a signal follows as it travels through a computer network.

data point *n.* Any pair of numeric values plotted on a chart.

data processing *n.* **1.** The general work performed by computers. **2.** More specifically, the manipulation of data to transform it into some desired result. *Acronym:* DP. *Also called:* ADP, automatic data processing, EDP, electronic data processing. *See also* centralized processing, decentralized processing, distributed processing.

Data Processing Management Association *n. See* DPMA.

data projector *n.* A device, similar to a slide projector, that projects the video monitor output of a computer onto a screen.

data protection *n.* The process of ensuring the preservation, integrity, and reliability of data. *See also* data integrity.

data rate *n.* The speed at which a circuit or communications line can transfer information, usually measured in bits per second (bps).

data record *n. See* record[1].

data reduction *n.* The process of converting raw data to a more useful form by scaling, smoothing, ordering, or other editing procedures.

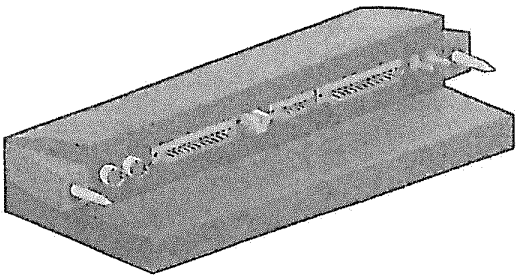
data segment *n.* The portion of memory or auxiliary storage that contains the data used by a program.

Data Service Unit *n. See* DDS.

data set *n.* **1.** A collection of related information made up of separate elements that can be treated as a unit in data handling. **2.** In communications, a modem. *See also* modem.

Data Set Ready *n. See* DSR.

data sharing *n.* The use of a single file by more than one person or computer. Data sharing can be done by physically transferring a file from one computer to another, or, more commonly, by networking and computer-to-computer communications.



Docking station.

DOCSIS *n.* Acronym for **D**ata **O**ver **C**able **S**ervice **I**nterface **S**pecification. The International Telecommunications Union standard (ITU Recommendation J.112) that specifies functions and internal and external interfaces for high-speed, bidirectional transfer of digital data between cable television networks and subscribers. DOCSIS-compliant equipment ensures interoperability between cable modems and the cable television infrastructure, regardless of manufacturer or provider. Initially developed by a group of cable television providers, including Time Warner and TCI, DOCSIS was designed to support data, video, and rapid Internet access. Data rates are 27 Mbps to 36 Mbps downstream (from the cable network) and 320 Kbps to 10 Mbps upstream (to the cable network). *See also* cable modem. *Compare* IEEE 802.14.

doctype *n.* A declaration at the beginning of an SGML document that gives a public or system identifier for the document type definition (DTD) of the document. *See also* SGML.

document[1] *n.* Any self-contained piece of work created with an application program and, if saved on disk, given a unique filename by which it can be retrieved. Documents are generally thought of as word-processed materials only. To a computer, however, data is nothing more than a collection of characters, so a spreadsheet or a graphic is as much a document as is a letter or report. In the Macintosh environment in particular, a document is any user-created work named and saved as a separate file.

document[2] *vb.* To explain or annotate something, such as a program or a procedure.

documentation *n.* The set of instructions shipped with a program or a piece of hardware. Documentation usually includes necessary information about the type of computer system required, setup instructions, and instructions on the use and maintenance of the product.

document-centric *adj.* Of, pertaining to, or characteristic of an operating system in which the user opens document files and thus automatically invokes the applications (such as word processors or spreadsheet programs) that process them. Many graphical user interfaces, such as the Macintosh Finder, as well as the World Wide Web, are document-centric. *Compare* application-centric.

Document Content Architecture *n. See* DCA (definition 1).

Document Content Description *n. See* DCD (definition 2).

document file *n.* A user-created file that represents the output of a program. *Also called:* data file. *Compare* program file.

document image processing *n.* A system for storing and retrieving information for an enterprise in the form of bitmapped images of paper documents input with a scanner rather than in the form of text and numeric files. Document image processing takes more memory than purely electronic data processing, but it more readily incorporates signatures, drawings, and photographs and can be more familiar to users without computer training. *See also* paperless office.

Document Interchange Architecture *n. See* DIA.

document management *n.* The full spectrum of electronic document creation and distribution within an organization.

document management system *n.* A server-based network facility designed for the storage and handling of an organization's documents. A document management system, or DMS, is built around a central library known as a repository and typically supports controlled access, version tracking, cataloging, search capabilities, and the ability to check documents in and out electronically. The open interface specification known as ODMA (Open Document Management API) enables desktop applications that support ODMA to interface with a DMS so that users can access and manage documents from within their client applications. *Acronym:* DMS. *Also called:* EDMS, electronic document management system.

Document Object Model *n.* A World Wide Web Consortium specification that describes the structure of dynamic HTML and XML documents in a way that allows them to be manipulated through a Web browser. In the Document Object Model, or DOM, a document is presented as a logical structure rather than as a collection of

Appendix D

PACKETCABLE™

Built on top of the industry's highly successful DOCSIS® cable modem infrastructure, PacketCable™ networks use Internet protocol (IP) technology to enable a wide range of multimedia services, such as IP telephony, multimedia conferencing, interactive gaming, and general multimedia applications.

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Appendix E

PacketCable™ 1.0 Architecture Framework Technical Report

PKT-TR-ARCH-V01-991201

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Abstract

This technical report describes the architecture framework for PacketCable™ networks including all major system components and network interfaces necessary for delivery of PacketCable services. The intended audience for this document includes developers of equipment intended to be conformant to PacketCable specifications, and network architects who need to understand the overall PacketCable architecture framework.

Document Status Sheet

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Date:	December 1, 1999

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ENTROPIC COMMUNICATIONS, LLC,

Plaintiff,

v.

CHARTER COMMUNICATIONS, INC.,

Defendant.

Civil Action No. 2:22-cv-00125-JRG

JURY TRIAL DEMANDED

PLAINTIFF'S REPLY CLAIM CONSTRUCTION BRIEF

TABLE OF CONTENTS

I. CONSTRUCTION OF TERMS 1
A. '775 Patent 1
1. "a data networking engine . . ." / "a cable modem engine . . ." 1
2. "data bus" / "wherein the cable modem functions performed by the cable modem engine are completely partitioned . . ." 2
3. "DOCSIS functions" 3
4. "DOCSIS MAC processor" / "DOCSIS controller" 3
B. '826 Patent 4
5. "network management messages" 4
C. '008 Patent 4
6. "operable to" 4
7. "digitize a received signal spanning an entire television spectrum . . ." 4
8. "signal monitor" / "data processor" / "channelizer" 5
D. '690 Patent 6
9. "probe" / "physical layer probe" 6
10. "probe request" 6
11. "generating the probe in accordance with . . ." / "wherein the probe is generated in accordance with . . ." / "the first plurality of probe parameters comprising a form . . ." 7
E. '362 Patent 8
12. "downconverting . . . a plurality of frequencies" / order of the steps 8
F. '682 Patent 9
13. "a composite SNR-related metric . . ." 9
14. "service group[s]" 9
15. "said one of said plurality of service groups" 10

TABLE OF AUTHORITIES

Page(s)

Cases

3M Innovative Properties Co. v. Tredegar Corp.,
725 F.3d 1315 (Fed. Cir. 2013).....3

Barkan Wireless IP Holdings, L.P. v. Samsung Elecs. Co.,
No. 2:18-cv-28-JRG, 2019 WL 497902 (E.D. Tex. Feb. 7, 2019).....3

Finalrod IP, LLC v. Endurance Lift Solutions, Inc.,
2021 WL 2187980 (E.D. Tex. May 28, 2021).....2

GE Lighting Solutions, LLC v. AgriLight, Inc.,
750 F.3d 1304 (Fed. Cir. 2014).....7

PC Connector Solutions LLC v. SmartDisk Corp.,
406 F.3d 1359 (Fed. Cir. 2005).....6

Smartflash LLC v. Apple Inc.,
77 F. Supp. 3d 535 (E.D. Tex. 2014).....3

Vstream Technologies, LLC v. PLR Holdings, LLC,
2016 WL 6211550 (E.D. Tex. Sept. 27, 2016).....2

Wilson Sporting Goods Co. v. Hillerich & Bradsbury Co.,
442 F.3d 1322 (Fed. Cir. 2006).....6

TABLE OF EXHIBITS

No.	Description
Exhibit 1 to Entropic's Opening *Markman* Brief (Dkt. 97-1)	U.S. Patent No. 8,223,775
Exhibit 2 to Entropic's Opening *Markman* Brief (Dkt. 97-2)	U.S. Patent No. 8,792,008
Exhibit 3 to Entropic's Opening *Markman* Brief (Dkt. 97-3)	U.S. Patent No. 9,825,826
Exhibit 4 to Entropic's Opening *Markman* Brief (Dkt. 97-4)	U.S. Patent No. 8,284,690
Exhibit 5 to Entropic's Opening *Markman* Brief (Dkt. 97-5)	U.S. Patent No. 9,210,362
Exhibit 6 to Entropic's Opening *Markman* Brief (Dkt. 97-6)	U.S. Patent No. 10,135,682
Exhibit 7 to Entropic's Opening *Markman* Brief (Dkt. 97-7)	Rebuttal Expert Declaration of Dr. Richard A. Kramer Regarding Claim Construction
Exhibit 8 to Entropic's Opening *Markman* Brief (Dkt. 97-8)	Declaration of Dr. Kevin Almeroth Regarding Claim Construction
Exhibit 9 to Entropic's Opening *Markman* Brief (Dkt. 97-0)	Condensed Transcript of the Deposition of Dr. Kevin Almeroth, dated April 28, 2023
Exhibit 10 to Entropic's Opening *Markman* Brief (Dkt. 97-10)	Excerpts from the IEEE Standard Dictionary of Electrical and Electrical Terms, IEEE Std. 100-1996, 6th Edition (1996)
Exhibit 11 to Entropic's Opening *Markman* Brief (Dkt. 97-11)	Email from counsel for Charter, A. Boardman, dated March 28, 2023
Exhibit 12	U.S. Patent Publication No. 2021/0337543
Exhibit 13	Newton's Telecom Dictionary, 17th Edition (2001)
Exhibit 14	Microsoft Computer Dictionary, 5th Edition (2002)
Exhibit 15	Entropic's Technology Tutorial Slides and Script, submitted to the Court on May 9, 2023

TABLE OF ABBREVIATIONS AND ACRONYMS

Entropic	Plaintiff Entropic Communications, LLC
Charter	Defendant Charter Communications, Inc.
EBr.	Entropic's Opening *Markman* Brief, Dkt. 97
CBr.	Charter's Responsive *Markman* Brief, Dkt. 104
Kramer Decl.	Rebuttal Expert Declaration of Dr. Richard A. Kramer Regarding Claim Construction (Entropic's Expert)
Almeroth Decl.	Declaration of Dr. Kevin Almeroth Regarding Claim Construction (Charter's Expert)
'775 Patent	U.S. Patent No. 8,223,775
'008 Patent	U.S. Patent No. 8,792,008
'826 Patent	U.S. Patent No. 9,825,826
'690 Patent	U.S. Patent No. 8,284,690
'362 Patent	U.S. Patent No. 9,210,362
'682 Patent	U.S. Patent No. 10,135,682
DNE	data networking engine
CME	cable modem engine

For reasons stated in Entropic's opening brief and herein, the Court should find no constructions are necessary given the clear plain and ordinary meanings of these terms.

I. CONSTRUCTION OF TERMS

A. '775 Patent

1. *"a data networking engine . . ." / "a cable modem engine . . ."*

Charter alleges that "[t]here is no disclosure of a DNE or CME implemented in any circuit, much less two circuits which are 'separate' from one another." This is plainly contradicted by the '775 Patent. A circuit is simply "[a] combination of electrical components interconnected to perform a particular task." EBr. at 7 (citing Almeroth Decl. ¶ 65). The entire disclosure of the '775 Patent is about various functionality embodied in circuits—it could not be embodied otherwise. The '775 Patent describes its own Figures as: "Fig. 1 is a block diagram of a gateway cable modem architecture . . ." and "Fig. 2 is a functional block diagram implementing the cable modem architecture of Fig. 1." '775 Patent, 2:42–45.

Nor is there any question the '775 Patent discloses the claimed separation of the circuitry. Figure 2—the "functional block diagram"—depicts the circuitry of the CME and DNE in great detail. It shows the separation in function and hence the "combination[s] of electrical components interconnected to perform [the] particular task[s]" of the CME and DNE.

Charter argues that connecting items destroys their separateness, which is illogical. Fig. 2 shows interconnections between DNE and CME, yet treats them as separate. And it is routine for POSITAs to break down devices into identifiable constituent parts.[1] To support its skewed read of the claims, Charter cites to inapplicable case law involving pharmaceutical patents, relying on

[1] In fact, Charter does this in its own patent applications. For example, U.S. Pat. Publ'n No. 2021/0337543 is assigned to Charter Communications Operating LLC. The publication recites first and second RF integrated circuit apparatuses, and Figures 3–12 contain functional block diagrams illustrating exemplary embodiments. *See* Ex. 12.

Teva and *Dow*. The claims in those cases "both required measurement of a specific value to determine if the value fell within a range." *Finalrod IP, LLC v. Endurance Lift Solutions, Inc.*, 2021 WL 2187980 at *12 (E.D. Tex. May 28, 2021); *see also Vstream Technologies, LLC v. PLR Holdings, LLC*, 2016 WL 6211550 at *13 (E.D. Tex. Sept. 27, 2016) ("'Slope of strain hardening' is a very precise mathematical element that requires a specific computing method"). In contrast, a "circuit" is not a so-called term of degree and "does not require such mathematical precision" or some other measurement. *Vstream* at *13. The disclosure of the '775 Patent is in no way lacking or confusing to a POSITA.

2. *"data bus" / "wherein the cable modem functions performed by the cable modem engine are completely partitioned . . ."*

Charter argues the patent applicant somehow disclaimed a data bus, despite unambiguously claiming "a data bus." It is not possible to disclaim an element plainly and literally present in the claim. Prosecution history disclaimers operate to narrow what would otherwise fall within a claim; they do not operate to invalidate claims by eliminating elements textually present.

Substantively, Charter's brief argument rests entirely on a flawed reading of the prosecution history. *See* Kramer Decl. ¶¶ 60–77 (thoroughly analyzing the file history). Briefly, Brooks discloses two processors, **102** and **104,** which the Examiner had initially mislabeled as representing the separate DNE (allegedly **102**) and CME (allegedly **104**). *See* Kramer Decl. ¶¶ 66, 71, 105-6. The patent applicant pointed out the examiner's interpretation was unsupported by Brooks' actual disclosure. First, the "processor **102** [of Brooks] handles many cable modem functions . . . and is explicitly described as 'programmed to implement the desired MAC functionality.'" *Id.* at ¶ 73. Therefore, processor **102** itself performed a mix of DNE and CME functions, contrary to the claimed requirement of functional separation. *Id.* at ¶ 106. Second, applicant noted that both processors **102** and **104** in Brooks share equally an interface with a third

component—the CMAC/CPHY block containing some cable modem functions. *See id.* at ¶¶ 74, 109. The patent applicant's point was ***both*** processors **102** and **104** work with this cable modem engine circuitry, further indicating the processors were not functionally separated from one another. *See id.* at ¶¶ 111–112. Legally this is not a "clear and unmistakable" disclaimer of subject matter. *See 3M Innovative Properties Co. v. Tredegar Corp.*, 725 F.3d 1315, 1326 (Fed. Cir. 2013). It certainly is not an inverse disclaimer striking from the claim an element that is textually there.

3. *"DOCSIS functions"*

Claim 19 is not redundant of Claim 18. Claim 18 requires only that the CME perform "cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media." Thus, there may be certain cable modem functions, which are not necessarily implemented. Moreover, Claim 18 recites the broader "cable modem functions," which does not necessarily have the same scope as "all ***DOCSIS*** functions," referring to the DOCSIS standard.

4. *"DOCSIS MAC processor" / "DOCSIS controller"*

Charter's proposed construction is limited to "exactly as described in the patent specification." Yet Charter comes nowhere close to tackling the high bar needed to invoke a means-plus-function construction. The construction should be immediately rejected. Furthermore, even a watered-down version of Charter's means-plus-function construction is improper and unnecessary. Courts have routinely recognized that "processor" and "controller" are well-understood terms. *See e.g.*, *Smartflash LLC v. Apple Inc.*, 77 F. Supp. 3d 535, 541 (E.D. Tex. 2014); *Barkan Wireless IP Holdings, L.P. v. Samsung Elecs. Co.*, No. 2:18-cv-28-JRG, 2019 WL 497902, at *22 (E.D. Tex. Feb. 7, 2019). Here, the claims themselves describe the functions of the DOCSIS MAC processor and DOCSIS controller. Finally, Charter has made no argument that the DOCSIS MAC processor and DOCSIS controller should be limited to the specific ARM-based

embodiments disclosed in the specification. To the extent such a limitation is implicated in Charter's construction—and it must be, given Charter's "exactly as described" requirement—that is an additional reason the Court should deny Charter's proposed construction.

B. '826 Patent

5. *"network management messages"*

The real dispute between the parties is the content of network management messages—specifically, whether they must exclude a message "conveying measured/determined characteristics?" CBr. at 12. The intrinsic record confirms they do not exclude such messages because they are explicitly disclosed in the specification. '826 Patent, 3:67–4:1. Charter relies on claim language—but not of ***this*** patent. Instead, Charter relies on the parent patent (the '008 Patent also in suit) to limit this one. Charter cites no legal authority in support of this unique proposition.

Charter argues the need for construction revolves around how the "measured characteristic" is different from the "message." But the claim already requires "said measured characteristic is different than said network management messages." Charter is not defining "network management message"; Charter is simply arguing a question of ***fact***—what is or is not different. This is not claim construction. Regardless, Charter is wrong. The claimed message may "***convey***[] measured/determined characteristics…" *Id.* at 3:67–4:1. The message is the conveyor, the measured/determined characteristics are the content. They are different.

C. '008 Patent

6. *"operable to"*

Because it appears Charter has not attached any special meaning to "configured to," Entropic does not oppose construing "operable to" as "configured to."

7. *"digitize a received signal spanning an entire television spectrum . . ."*

The sole salient issue is whether a television spectrum may contain inside it something in

addition to individual television channels. The plain meaning says yes, because a POSITA would have been aware that not only may a spectrum contain unused portions such as guard bands, it may also contain useful data. The '008 Patent confirms data may be present, describing data-bearing DOCSIS channels in the monitored spectrum. *See* '008 Patent, 3:12–16, 4:45–47, 5:60–62.[2] Put simply, a television spectrum is a block of frequency containing television channels. It does not cease being a television spectrum if non-video signals are added within the block. Against this backdrop, Charter argues that the claims of a different patent limit the scope of the one in question. No legal precedent is cited, and doing so is in direct conflict with the plain meaning of the claim to a POSITA and the specification.

8. *"signal monitor" / "data processor" / "channelizer"*

The real issue is the separation of these components, and Charter's definition is unclear—does Charter's definition require these three elements to be embodied in separate, discrete chip packages? On one package but on different dies? Are separate circuit blocks of an SoC sufficient? Charter is (again) arguing a question of ***fact*** for the jury—what is separate—at the *Markman* stage.

Certainly any definition excluding the claimed devices residing on a single SoC is erroneous. By the priority date (2011), it was exceedingly common for a single SoC to embody many functional elements, as a POSITA would have been well aware.[3] The specification expressly

---

[2] Charter includes a straw man argument regarding the dictionary definition of "spans," but in doing so, acknowledges there are parts of the spectrum that includes data channels. *See* CBr. at 14.

[3] In fact, the approach of integrating many functional components on a single chip was so well-known that SoC's, which use the approach, achieved dictionary status at least as of 2001-2002. *See* Ex. 13 at 636; Ex. 14 at 488. Even the general public would have been aware of the SoC approach. In 2010 Steve Jobs introduced the first iPad and discussed the SoC at its heart: "We have a chip called A4, which is the most advanced chip we've done, that powers the iPad. It's got the processor, the graphics, the I/O, the memory controller, everything in this one chip." Apple Special Event announcement, 2010, @ 26:27 et seq., https://www.youtube.com/watch?v=QaEYIYJLVIw

contemplates this design choice: "[t]he various modules of the subassembly **174** may reside in . . . one or more integrated circuits (e.g., ***one or more silicon dice*** [*sic*, dies])." *Id.* at 4:56–59. An SoC is multiple integrated circuits on one die. Charter's construction, which—depending on how the construction is itself construed—excludes described embodiments and should not be adopted.

D. <u>'690 Patent</u>

9. *"probe" / "physical layer probe"*

Charter grounds its argument to limit "probe" based on ***post-priority, extrinsic*** evidence. The DOCSIS 3.1 standard was first published in 2013 (Charter cites a version published in 2014). *See* CEx. 4 at p.3. The '690 Patent was filed in 2009 (and relates back to a 2008 provisional), five years earlier. The evidence is not applicable because "meaning must be interpreted as of [the] effective filing date." *PC Connector Solutions LLC v. SmartDisk Corp.*, 406 F.3d 1359, 1363 (Fed. Cir. 2005). Charter's focus seems to be on the DOCSIS 3.1 cable modems accused of infringement in this case, thereby committing error in construing the claims with reference to the accused devices. *See Wilson Sporting Goods Co. v. Hillerich & Bradsbury Co.*, 442 F.3d 1322, 1330–31 (Fed. Cir. 2006) ("claims may not be construed with reference to the accused device").

Charter also relies on the '690 Patent's description of prior art probes. *See* '690 Patent, 1:52–57. But these probes are criticized as limited and inflexible. *Id.* at 1:60–62. No POSITA would rely upon this discussion to limit the meaning of "probe" in the invention.

Finally, with respect to "physical layer probe," Charter errs by importing an embodiment into the claims. The cited description of "physical layer probe" is merely an exemplary embodiment in the context of a MoCA network. *See* '690 Patent, 3:38–44. MoCA has its own particular messaging architecture, and the claimed probes must be broad enough to encompass it, but they are not limited to it.

10. *"probe request"*

Charter asserts that, because the "probe request" is the allegedly novel part of the invention, it cannot have a plain and ordinary meaning. Charter cites no legal authority for this argument, which is nonsensical—well-known components can be used or joined in novel ways. Here, "probe request" means simply a request for a probe. That request must meet certain criteria, but those are defined by the other elements of the claim, not by "probe request" itself.

Charter's resort to lexicography fails because the relied-upon passage is a description, not a definition which meets the high and "exacting" legal hurdle.[4] *See GE Lighting Solutions, LLC v. AgriLight, Inc.*, 750 F.3d 1304, 1309 (Fed. Cir. 2014). Furthermore, the description disproves Charter's argument because the required parameters relating to the payload do not necessarily include the payload's content—they may relate to the payload's form. The '690 Patent (in the sentence immediately following what Charter cites) provides illustrations of probe parameters, including four that relate to the payload. One of these is the payload ***itself***, but three others relate to the ***form*** of the payload:

ing the content of a payload of the probe. In one embodiment, the parameters further include: the modulation profile for the probe; the payload content of the probe; the number of times to transmit the probe; the number of symbols for the payload of the probe; the preamble type for the probe; the cyclic-prefix length for the payload of the probe; the transmit power for the probe; and the transmit power scaling factor for the payload of the probe. Accordingly, the probe that is transmitted in response to the probe request will have a form dictated by the parameters specified in the probe request.

- The payload content itself

but also:

- 3 parameters re the form of the payload content:
  - # of symbols
  - cyclic prefix length
  - transmit power scaling factor

'690 Patent, 2:9–16. This is contrary to Charter's lexicography definition.

11. *"generating the probe in accordance with . . ." / "wherein the probe is generated in accordance with . . ." / "the first plurality of probe parameters*

[4] This is doubly true where Charter's definition subtly ***alters*** the words of the '690 Patent, eliminating an important preposition—Charter removes the emphasized portion of the Patent in its definition: "… the content ***of a*** payload of the probe." '690 Patent, 2:9. This is not a typo—Charter re-states and argues around this text. CBr. at 19.

comprising a form . . ."

Central to Charter's indefiniteness argument is its contention that "***only*** the parameters sent in the probe request are used to generate and transmit a probe." CBr. at 21. However, the specification discloses the opposite: the probe may be based on additional information, namely "information that previously existed within the transmitting node." '690 Patent, 6:42–45. Given this clear statement, Charter's resort to lexicography is unavailing. At most, the passage at 2:3–9 of the '690 Patent confirms "form" parameters (sent by the other node) are used in the generation and transmission of the probe. But the converse is not true—not everything used to generate and transmit a probe must be sent by the other node. All elephants are gray, but not all gray things are elephants—logic confirmed by the '690 Patent at 6:42–45.

E. <u>'362 Patent</u>

12. *"downconverting . . . a plurality of frequencies" / order of the steps*

Charter's briefing reveals its order-of-steps construction is just an attempt to narrow the claim scope to downconversion solely in the analog—not digital—domain. But Charter has no answer to the legal presumption that methods steps may be performed in any order, nor the point that the claim grammar confirms this presumption here for the first two steps. Finally, to sidestep the specification, Charter argues that the disclosure of digital mixing effectively "doesn't count" because it applies only to desired channels. However, this is simply wrong. The specification describes both possibilities, right at the outset of describing digital downconversion (mixing):

of the analog filtered signal 226. Digital signals I **232** and Q **242** are then applied to a bank of N complex mixers **250**, wherein N is an integer value corresponding to the number of desired RF channels located in the non-contiguous portions of the frequency spectrum BW1. It is understood that the number N can be any integer value. In one embodiment, N can be equal to the number of all available channels that exist in the licensed frequency spectrum to provide system flexibility.

Digital domain mixing of:

- Some channels ("desired")

-OR-

- All channels available

'362 Patent, 5:31–38. Clearly from the above passage, the '362 Patent describes digital

downconversion of (1) only the desired channels, (2) any number of signals desired/undesired signals, and (3) all of the channels. The claim requires downconversion of both desired and undesired channels. Thus, read in light of the specification, the claim envisions digital and/or analog downconversion of desired and undesired channels.

F. '682 Patent

13. *"a composite SNR-related metric . . ."*

Charter's indefiniteness position is a chain of argument ultimately resting on a false equivalence of "composite SNR-related metric" and "worst-case SNR profile." They are not the same thing. The claim states the "composite SNR-related metric" is "***based at least in part on***" the "worst-case SNR profile." Logically they are not the same item—one is based on the other. Moreover, the claimed composite SNR-related metric could also be based on other things as well ("at least ***in part*** on"), destroying any notion of equivalence. *See* Kramer Decl. ¶¶ 168–69.

The specification is consistent. Contrary to Charter's assertion, composite metrics based on SNR-related metrics generally (not merely worst-case) are, in fact, disclosed. *See* '682 Patent, 4:40–52 (no mention of "worst-case"). Charter regrettably misrepresents Dr. Kramer's evidence—his declaration makes no reference to a "composite best case SNR profile"—and Charter conflates a "related metric" with "worst-case" and "profile" to support its false equivalence. *Compare* Kramer Decl. at ¶¶ 155–169, *with* CBr. at 28. But, at the end of the day, the claim language cannot be overcome. The composite metric is "***based*** at least in part" on a worst-case profile. The worst-case SNR profile must be considered in the creation of the composite metric. *See* '682 Patent, cl. 1. There is nothing indefinite here and the claim language needs no construction.

14. *"service group[s]"*

Nothing in the opposition overcomes the central point—the '682 Patent is described in terms of service groups consisting of groups of cable modems (CMs). "Figs. 4A and 4B illustrate

the network of FIG 1, with different groupings of CMs" '682 Patent, 2:24–27. The Figures' groupings **402**, **404**, **406** and **408** are groups of CMs, not channels (which are not even depicted). *See id.* at 6:46–7:6 (explaining groups). Without support in the intrinsic record, Charter relies on a single citation to extrinsic evidence, which post-dates the priority date by two years, violating the legal principle of construing claims at the time of the invention. *See* CBr. at 29. The DOCSIS definition of "cable modem service group" Charter relies on limits such groups to 1) the confines of the HFC topology and 2) a complete set of upstream and downstream channels. *See id.* In contrast, the '682 Patent specification contains no such limitations and specifically discloses groups of cable modems on a basis ***other than HFC location***. *See* '682 Patent, 6:39–45. Moreover, whatever DOCSIS might have later said, its use of terms cannot overcome the '682 Patent's usage.

15. *"said one of said plurality of service groups"*

The '682 Patent criticizes the folly of lumping all CMs together in a "lowest common denominator" approach. '682 Patent, 5:50–57. Instead, the '682 Patent groups CMs based on their performance (SNR). For each group, the invention can choose communication parameters based on group performance. The chosen parameters are used to communicate with that group. *E.g.*, *id.* at 5:42–50. This is precisely what the claim does. The "generating" step requires creating a composite metric for each service group. The "selecting step" uses the composite metric for a particular service group to choose one or more parameter(s) to use with ***that*** group. The "communicating" step uses the selected parameter(s) to communicate with ***that*** group.

Charter nonetheless argues there is "no way to know which one service group among the 'plurality of service groups' the 'communicating' and 'corresponding' steps should be performed on." CBr. at 30. However, the claim structure is logical and tracks the disclosure. Charter strangely cites *Lucent* for the proposition that the Court may not rewrite claims. Entropic is embracing the claim, not rewriting it. The POSITA would have no trouble understanding the claim.

Dated: May 30, 2023

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CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing document was filed electronically in compliance with Local Rule CV-5(a) and served on all counsel of record via the Court's CM/ECF system on this 30th day of May, 2023.

/s/ James A. Shimota
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EXHIBIT 12

US 20210337543A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0337543 A1**

Das et al. (43) **Pub. Date: Oct. 28, 2021**

(54) **NODE APPARATUS AND METHODS FOR PROVIDING HIGH-CAPACITY DATA SERVICES VIA A CONTENT DELIVERY NETWORK ARCHITECTURE**

(71) Applicant: **Charter Communications Operating, LLC**, St. Louis, MO (US)

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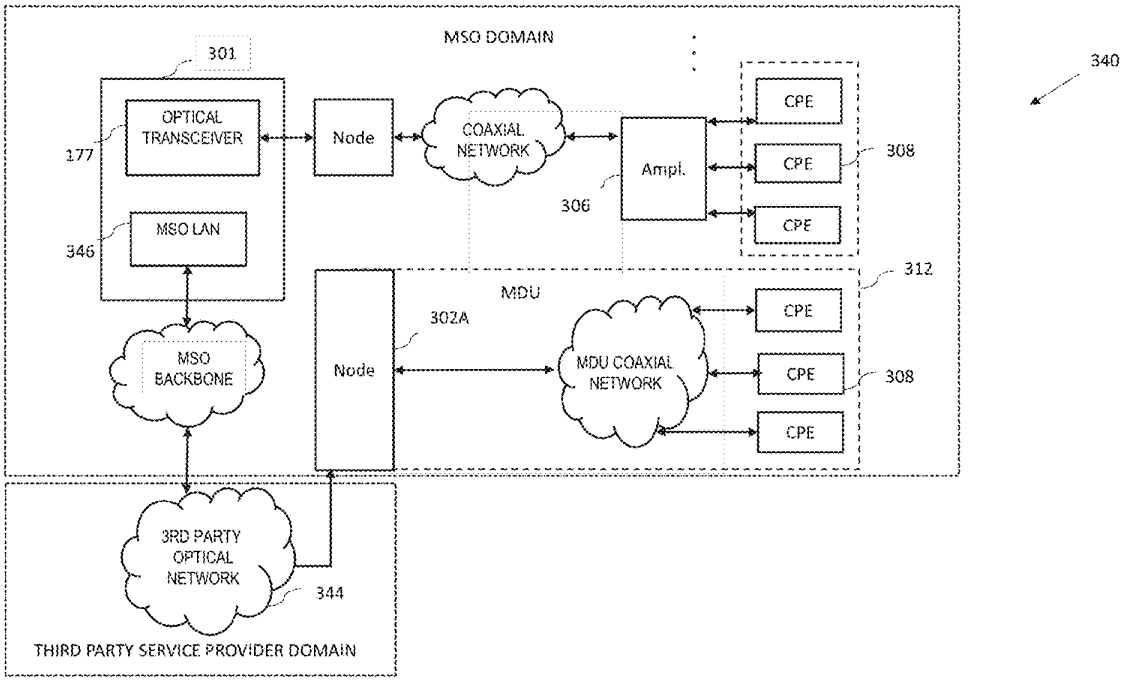
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(57) **ABSTRACT**

Node apparatus and methods for providing high-bandwidth, low-latency data service over a content delivery network including existing wireline infrastructure. In one embodiment, a network architecture having service delivery over at least portions of extant hybrid fiber coax (HFC) infrastructure is disclosed, which includes a node that enables standards-compliant ultra-low latency and high data rate services (e.g., 3GPP and IEEE Std. 802.11 services). In one variant, an expanded frequency band (e.g., 1.6 GHz in total bandwidth) is used over the coaxial portions of the HFC infrastructure, which is allocated to two or more sub-bands via 802.11ax protocols. The node is used in various network architectures configured to support different use cases such as for providing a small cell service, a distributed antenna system (DAS) at an enterprise premises or a venue, and a redundancy capability of data communication.



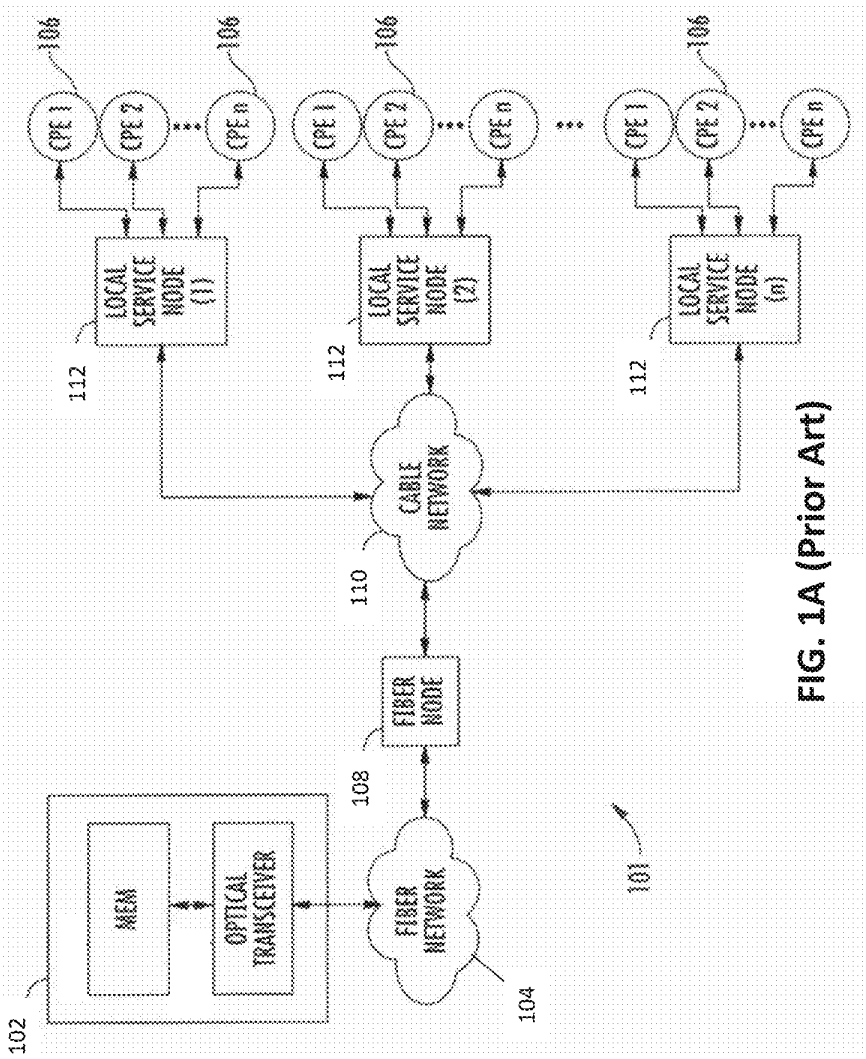


FIG. 1A (Prior Art)

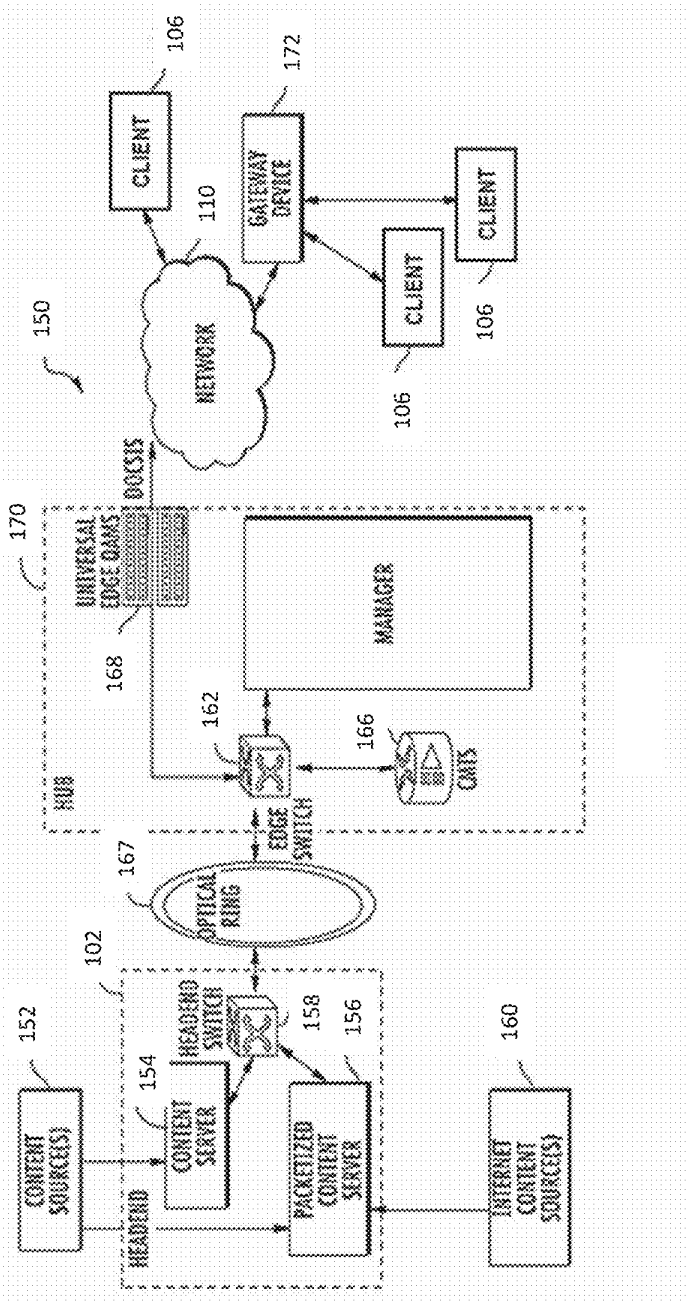


FIG. 1B (Prior Art)

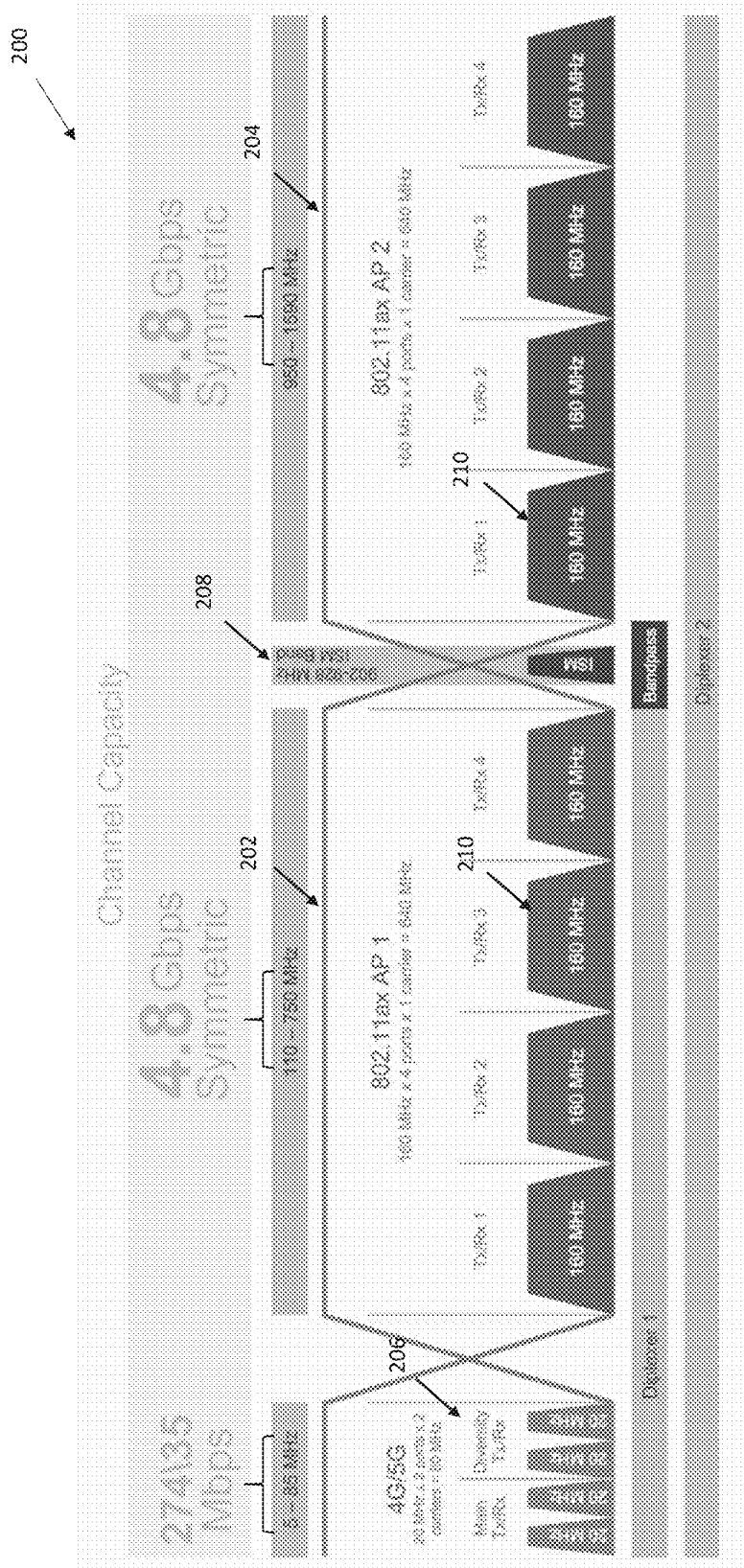

200
Channel Capacity
4.8 Gbps
Symmetric
274/35 Mbps
4.8 Gbps
Symmetric
202
204
206
208
210
802.11ax AP 1
802.11ax AP 2
4G/5G
160 MHz
Duplexer
Antenna 1
Antenna 2

FIG. 2

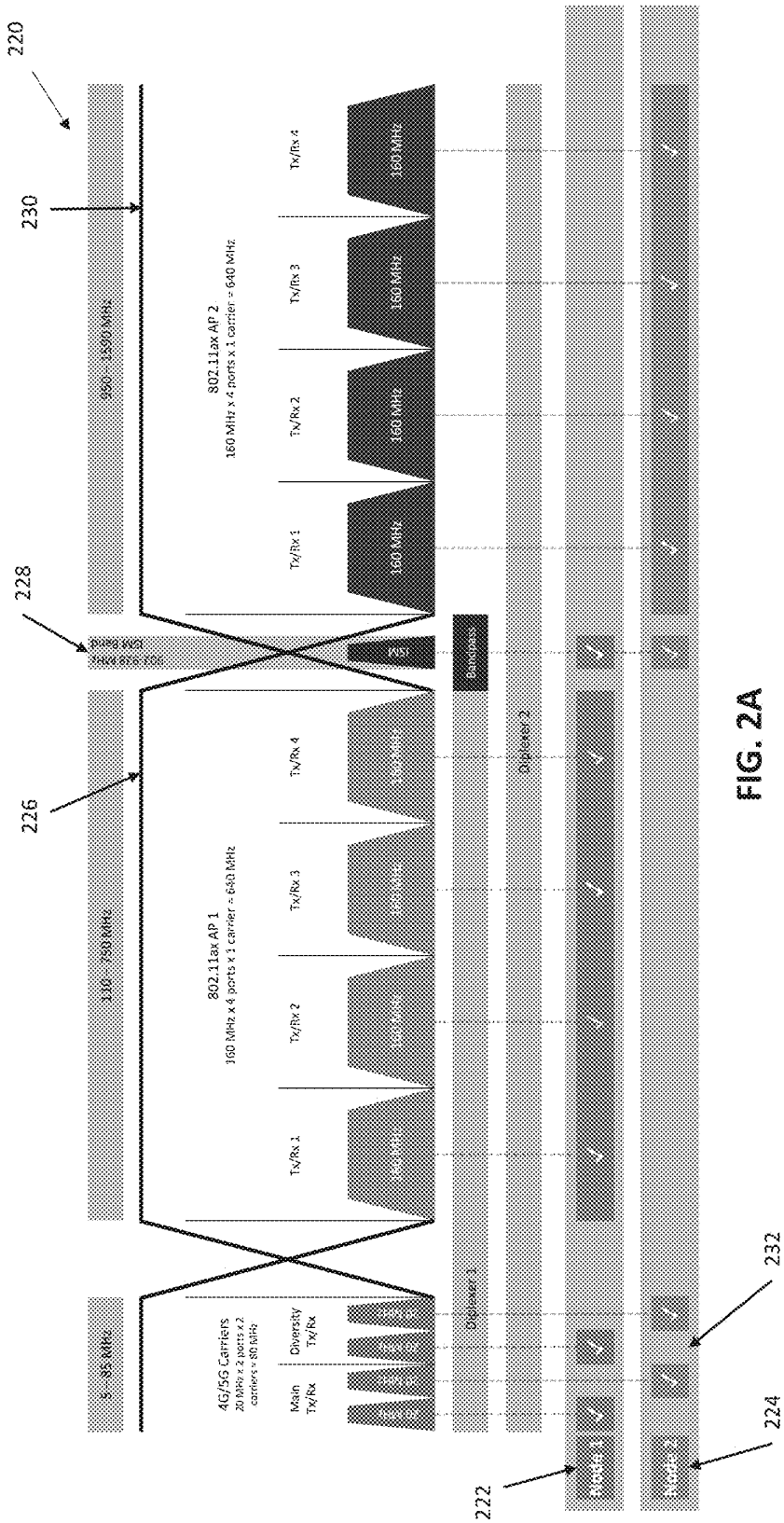

220
230
228
226
222
224
232
5 - 35 MHz
110 - 750 MHz
950 - 1350 MHz
4G/5G Carriers
20 MHz x 2 ports x 2 carriers = 80 MHz
Main Tx/Rx
Diversity Tx/Rx
802.11ax AP 1
160 MHz x 4 ports x 1 carrier = 640 MHz
802.11ax AP 2
160 MHz x 4 ports x 1 carrier = 640 MHz
Tx/Rx 1
Tx/Rx 2
Tx/Rx 3
Tx/Rx 4
160 MHz
Diplexer 1
Diplexer 2
Diplexer 3
Node 1
Node 2

FIG. 2A

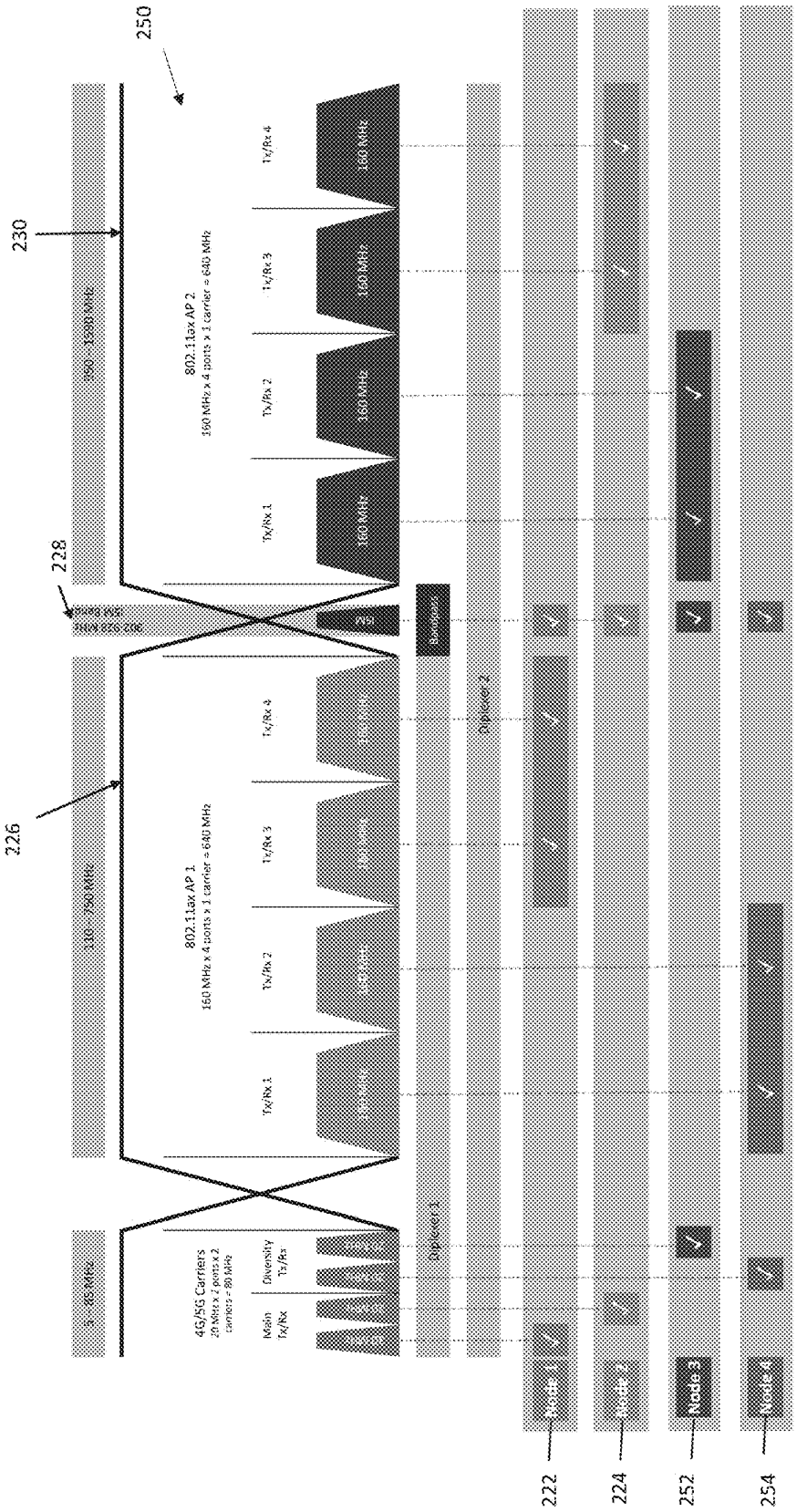

250
230
228
226
222
224
252
254
802.11ax AP 2
160 MHz x 4 ports x 1 carrier = 640 MHz
802.11ax AP 1
160 MHz x 4 ports x 1 carrier = 640 MHz
4G/5G Carriers
Main Tx/Rx
Diversity Tx/Rx
Diplexer 1
Diplexer 2
Node 1
Node 2
Node 3
Node 4

FIG. 2B

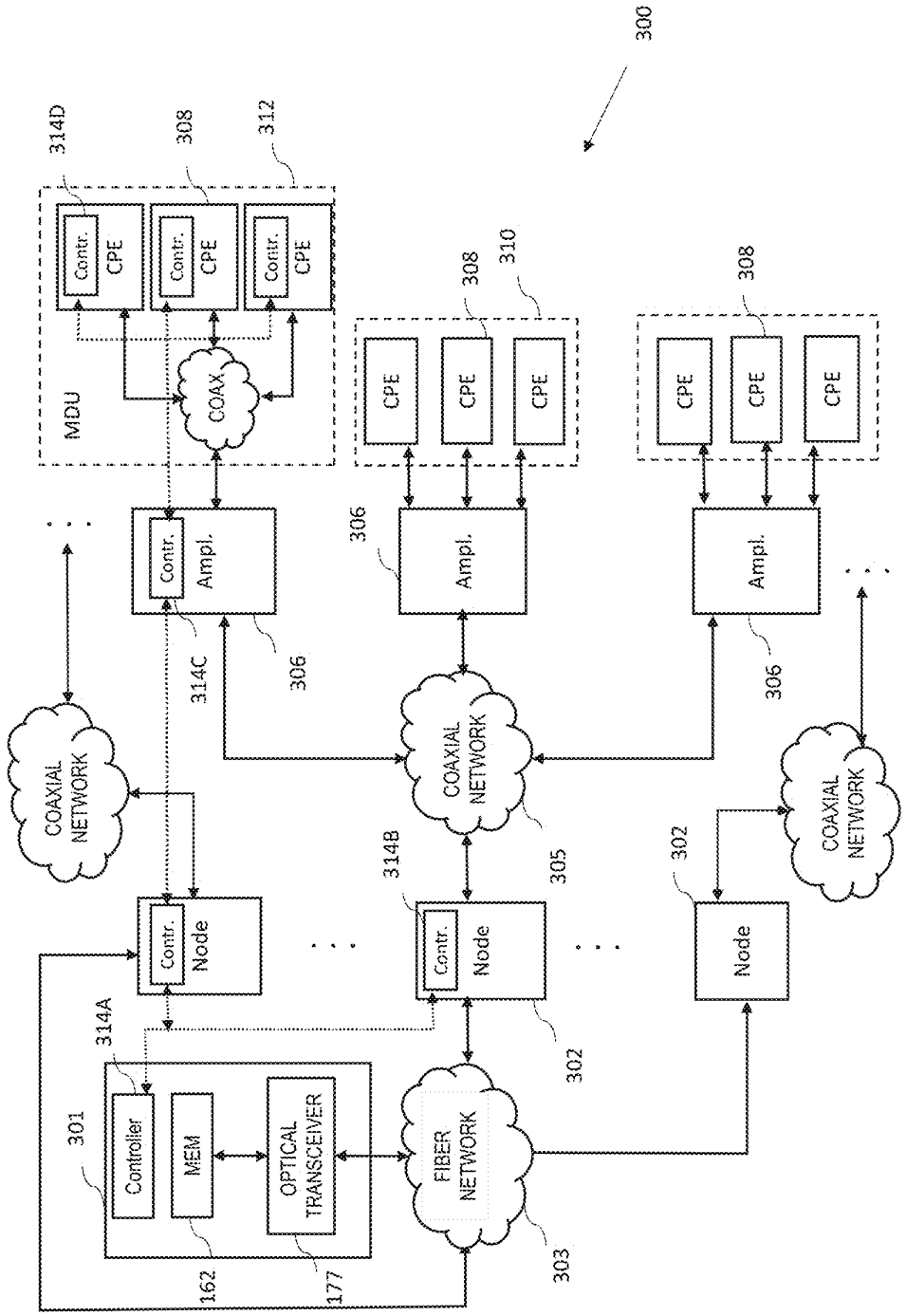

300
314D
308
312
Contr.
CPE
MDU
COAX
310
CPE
Ampl.
306
314C
COAXIAL NETWORK
314B
305
302
Node
314A
301
Controller
MEM
OPTICAL TRANSCEIVER
FIBER NETWORK
162
177
303

FIG. 3A

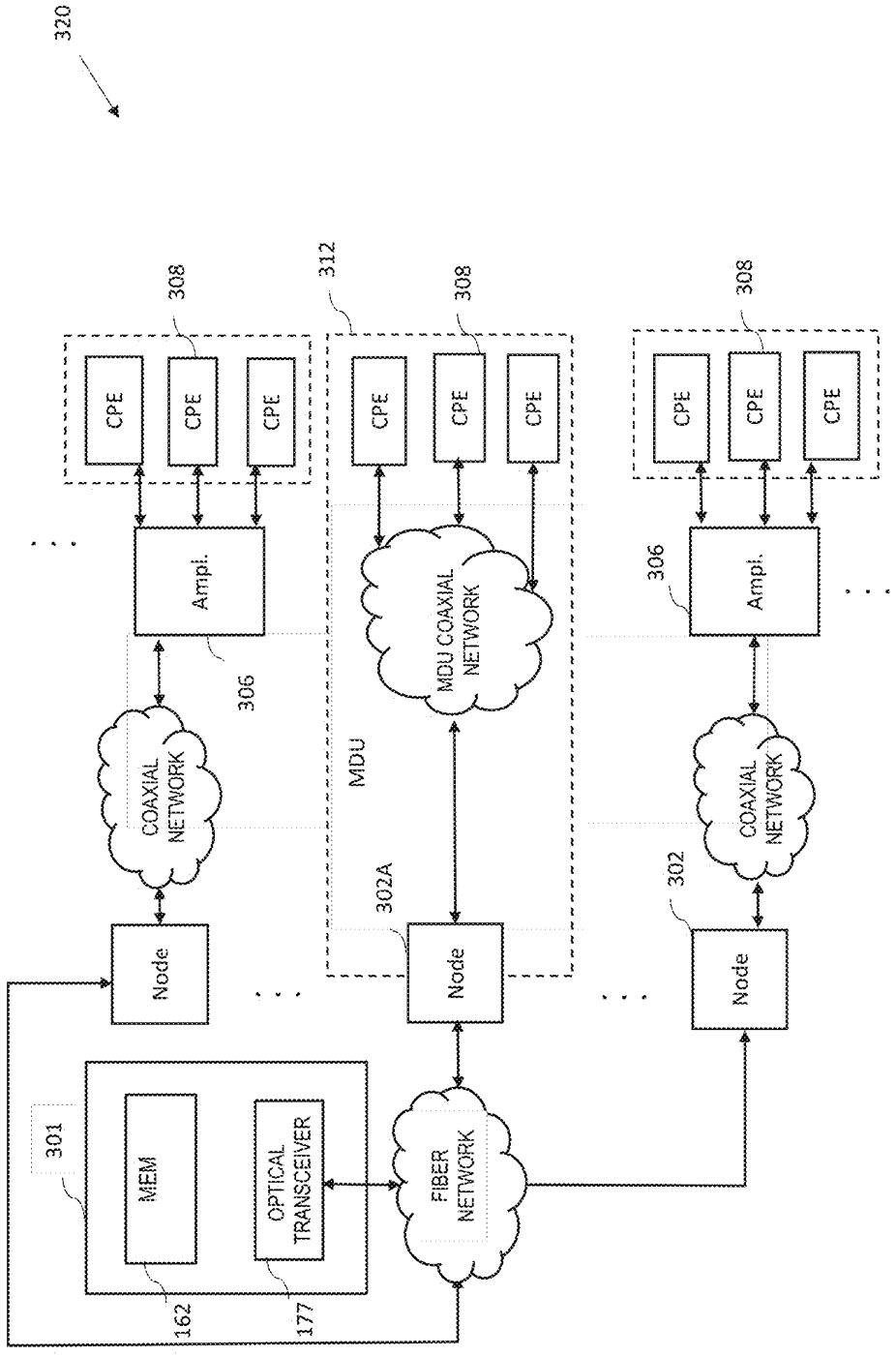

320
308
312
308
308
CPE
CPE
CPE
CPE
CPE
CPE
CPE
CPE
CPE
Ampl.
Ampl.
306
306
MDU COAXIAL NETWORK
COAXIAL NETWORK
COAXIAL NETWORK
MDU
302A
302
Node
Node
Node
301
MEM
OPTICAL TRANSCEIVER
FIBER NETWORK
162
177

FIG. 3B

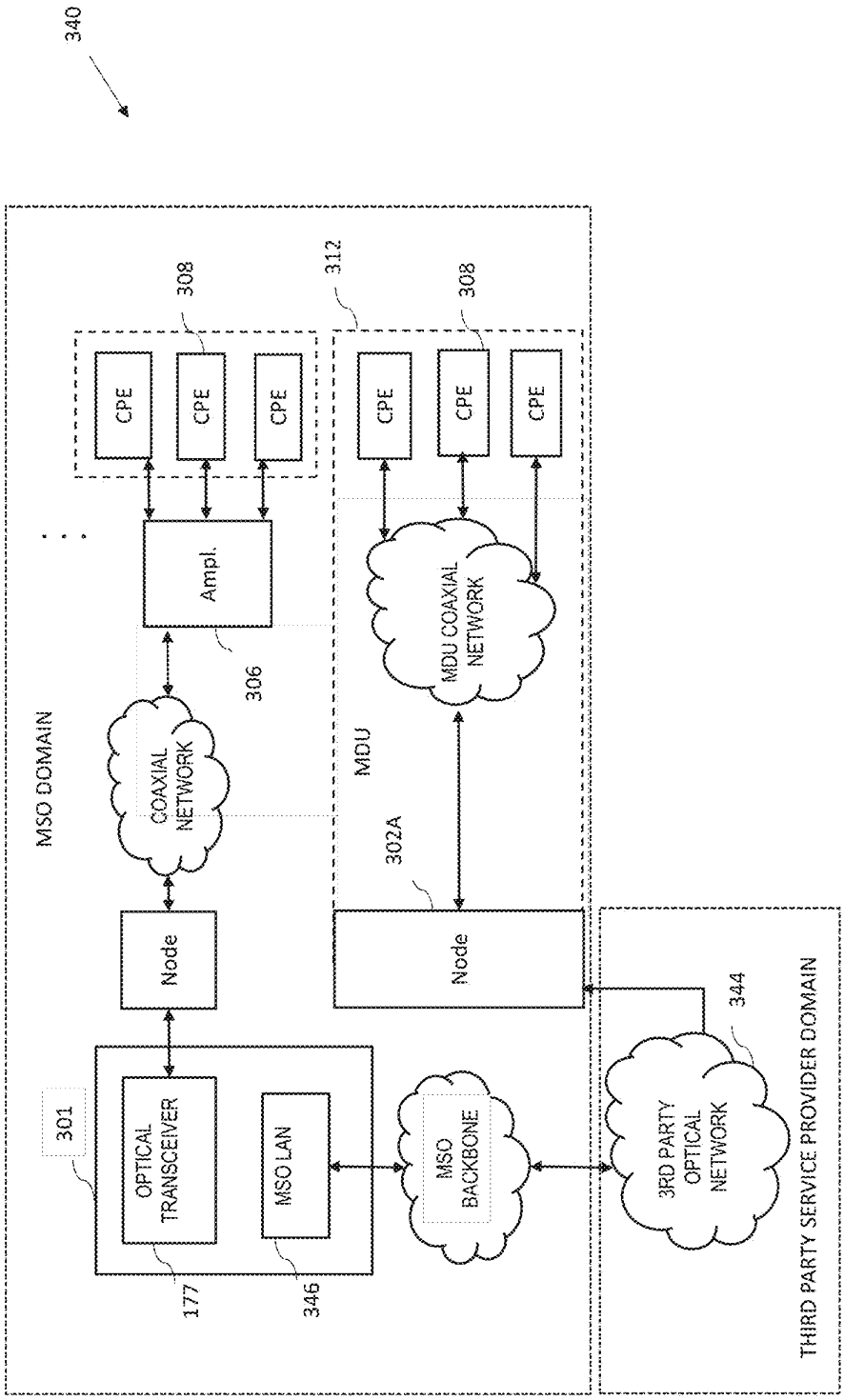

340
MSO DOMAIN
MDU
THIRD PARTY SERVICE PROVIDER DOMAIN
308
312
308
CPE
CPE
CPE
CPE
CPE
CPE
Ampl.
306
COAXIAL NETWORK
MDU COAXIAL NETWORK
302A
Node
Node
301
OPTICAL TRANSCEIVER
MSO LAN
MSO BACKBONE
3RD PARTY OPTICAL NETWORK
344
177
346

FIG. 3C

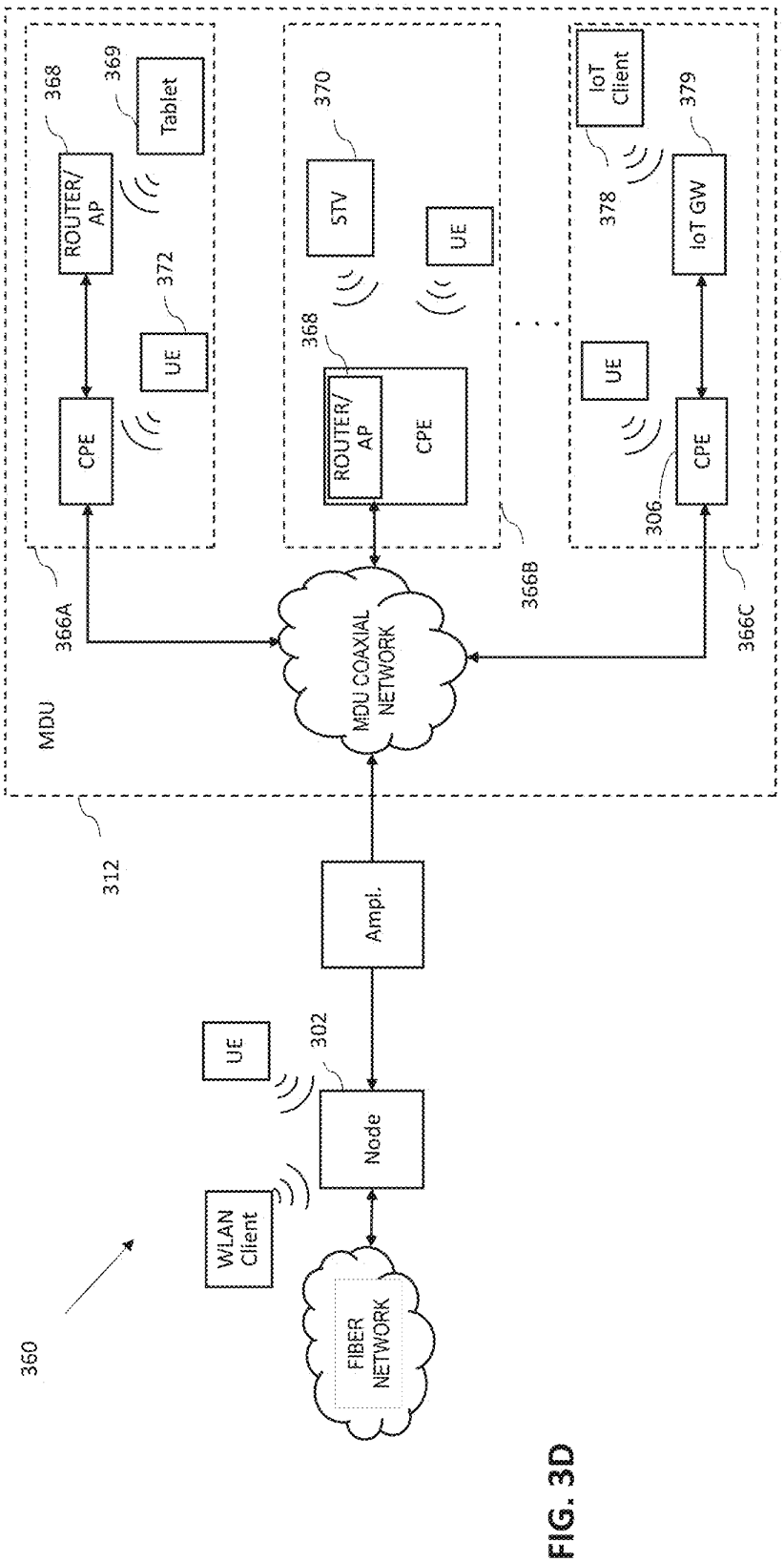

MDU
312
366A
366B
366C
MDU COAXIAL NETWORK
Ampl.
Node
FIBER NETWORK
360
WLAN Client
UE
302
ROUTER/ AP
CPE
368
Tablet
369
372
STV
370
IoT Client
378
IoT GW
379
306

FIG. 3D

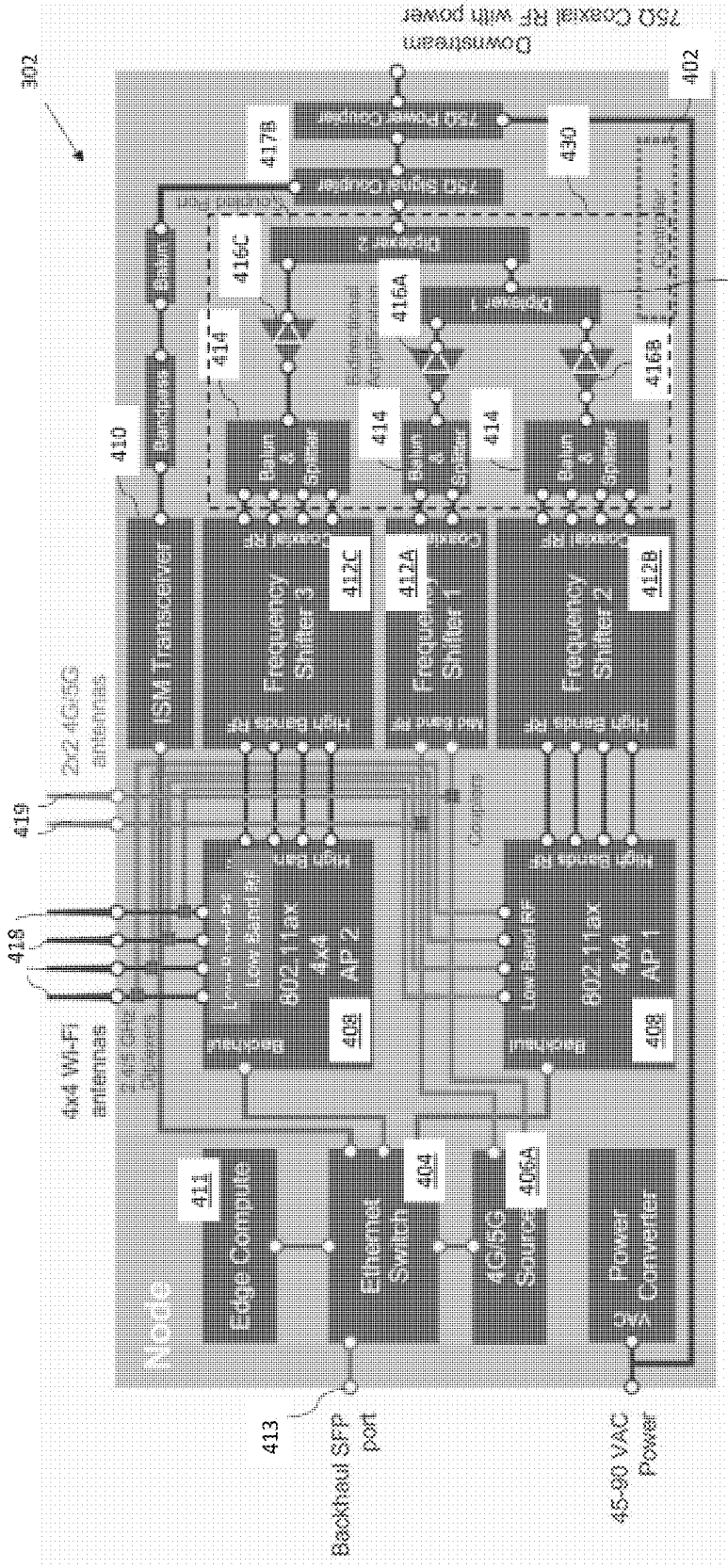

Downstream
750 Coaxial RF with power
302
402
417B
430
417A
416C
416A
416B
414
410
412C
412A
412B
ISM Transceiver
2x2 4G/5G antennas
419
418
4x4 Wi-Fi antennas
408
411
404
406A
Node
Edge Computing
Ethernet Switch
4G/5G Source
Power Converter
413
Backhaul SFP port
45-90 VAC Power

FIG. 4

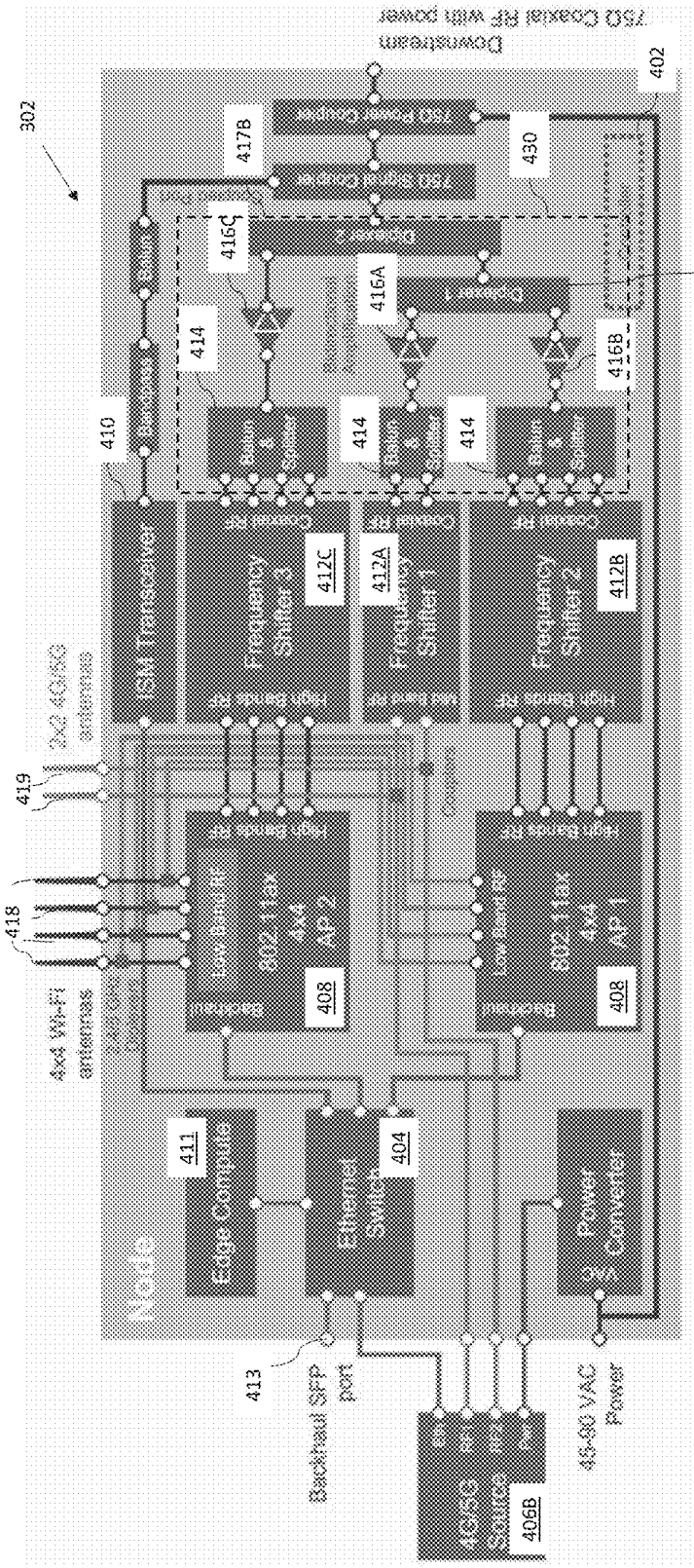

302
402
417B
430
417A
416C
416A
416B
414
410
412C
412A
412B
419
418
408
411
404
406B
413
Backhaul SFP port
48-90 VAC Power
Node
Edge compute
Ethernet Switch
Power AC/DC Converter
Access Switch
4x4 Wi-Fi antennas
2x2 4G/5G antennas
ISM Transceiver
Frequency Shifter 3
Frequency Shifter 1
Frequency Shifter 2
802.11ax 4x4 AP 2
802.11ax 4x4 AP 1

FIG. 5

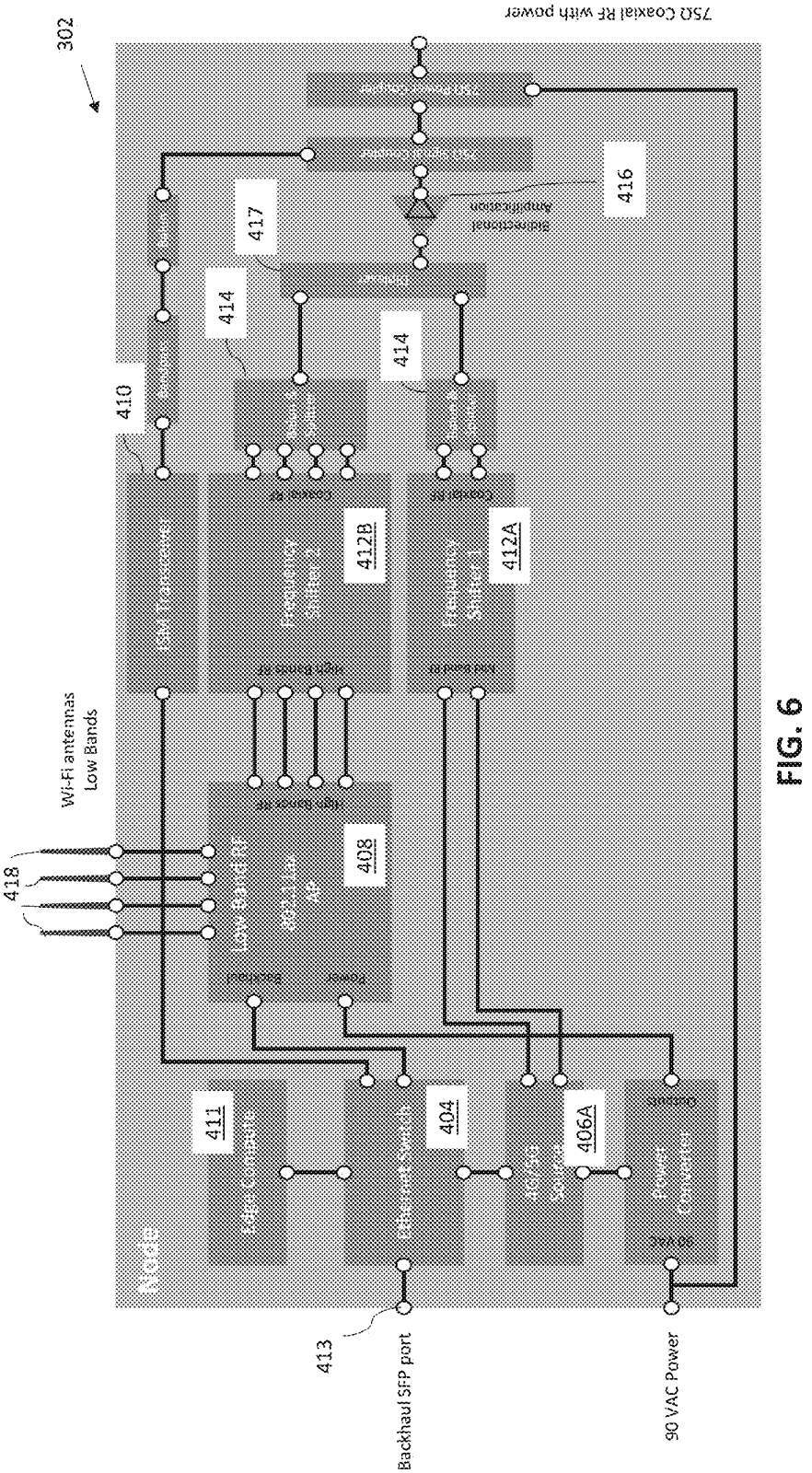

302
750 Coaxial RF with power
Bidirectional Amplification
416
417
414
414
410
412B
412A
Wi-Fi antennas Low Bands
418
408
411
404
406A
Node
413
Backhaul SFP port
90 VAC Power

FIG. 6

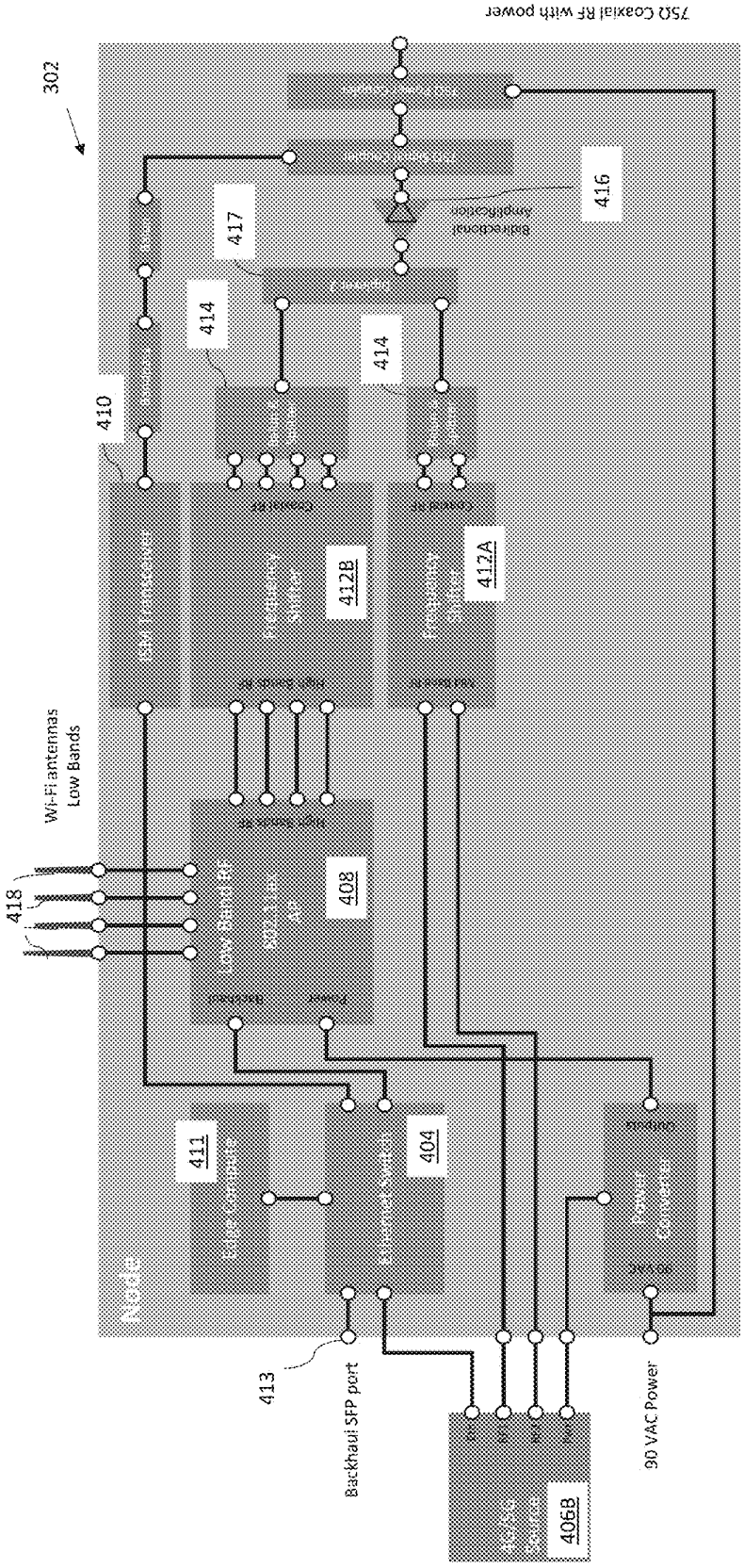

75Ω Coaxial RF with power
302
416
417
414
414
410
412B
412A
Wi-Fi antennas
Low Bands
418
408
411
404
Node
413
Backhaul SFP port
90 VAC Power
406B

FIG. 7

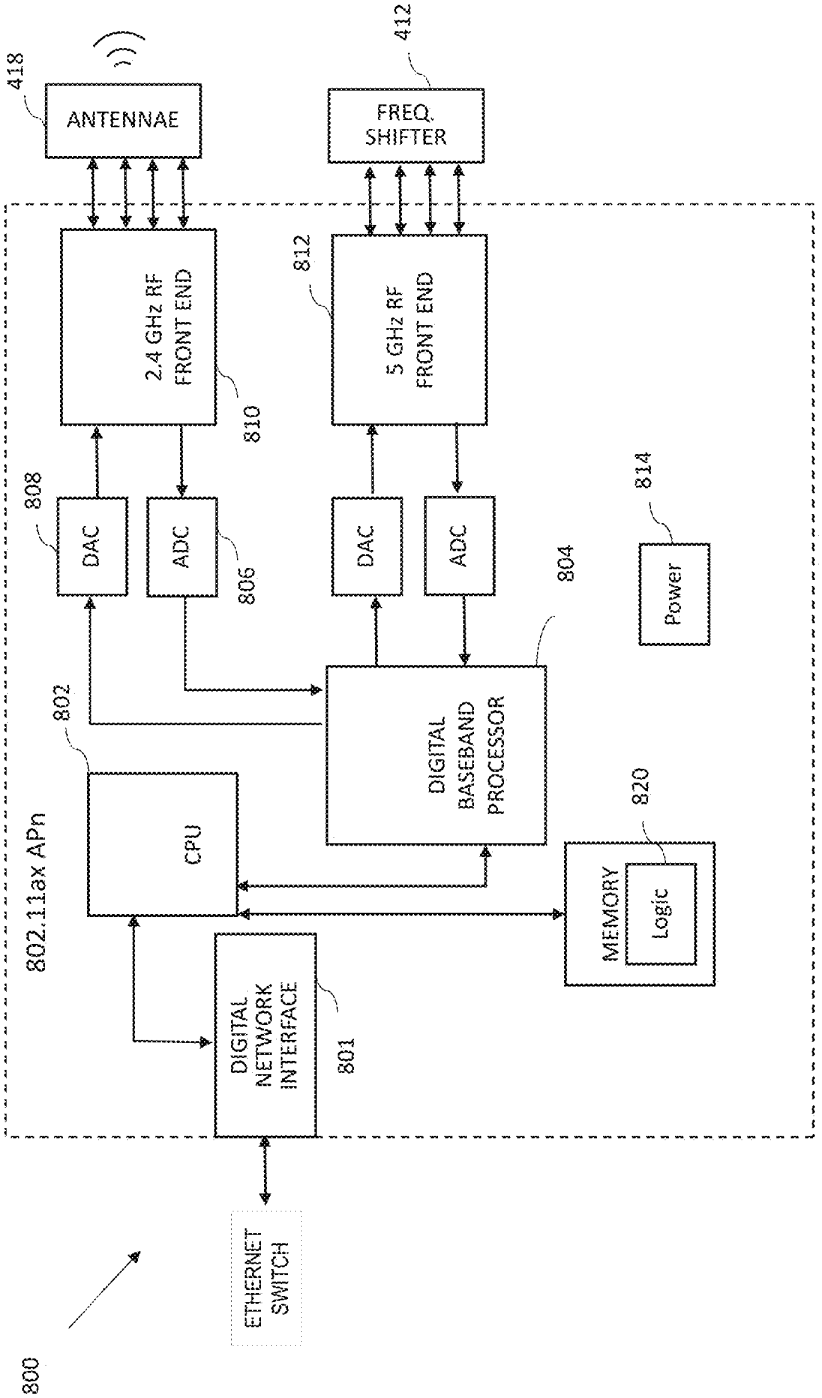

418
ANTENNAE
412
FREQ. SHIFTER
2.4 GHz RF FRONT END
810
812
5 GHz RF FRONT END
808
DAC
ADC
806
DAC
ADC
814
Power
804
802
DIGITAL BASEBAND PROCESSOR
CPU
820
MEMORY
Logic
802.11ax APn
DIGITAL NETWORK INTERFACE
801
ETHERNET SWITCH
800

FIG. 8

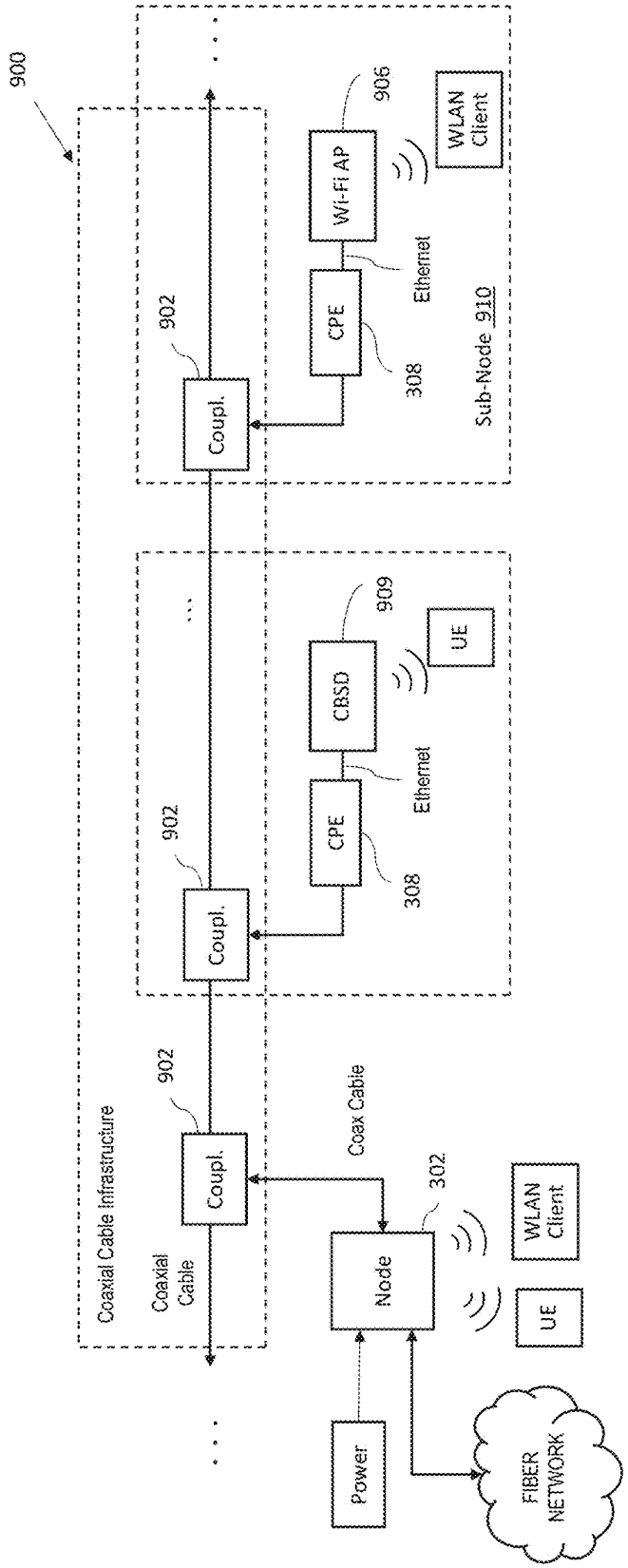

900
Coaxial Cable Infrastructure
Coaxial Cable
902
Coupl.
Coax Cable
Node
302
WLAN Client
UE
Power
FIBER NETWORK
Sub-Node 910
CPE
308
Ethernet
CBSD
909
Wi-Fi AP
906

FIG. 9

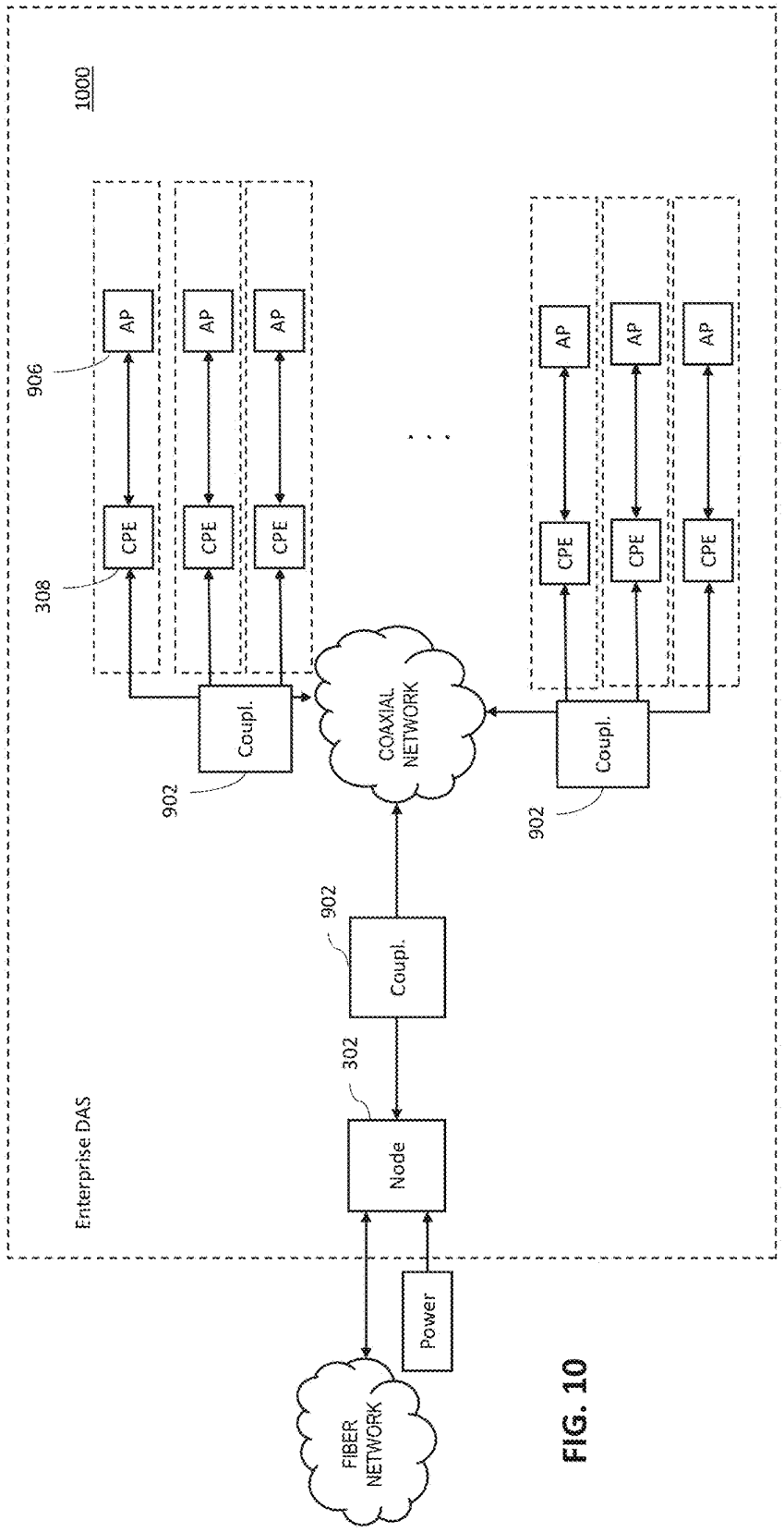

1000
AP
CPE
906
308
902
Coupl.
COAXIAL NETWORK
302
Node
Power
FIBER NETWORK
Enterprise DAS

FIG. 10

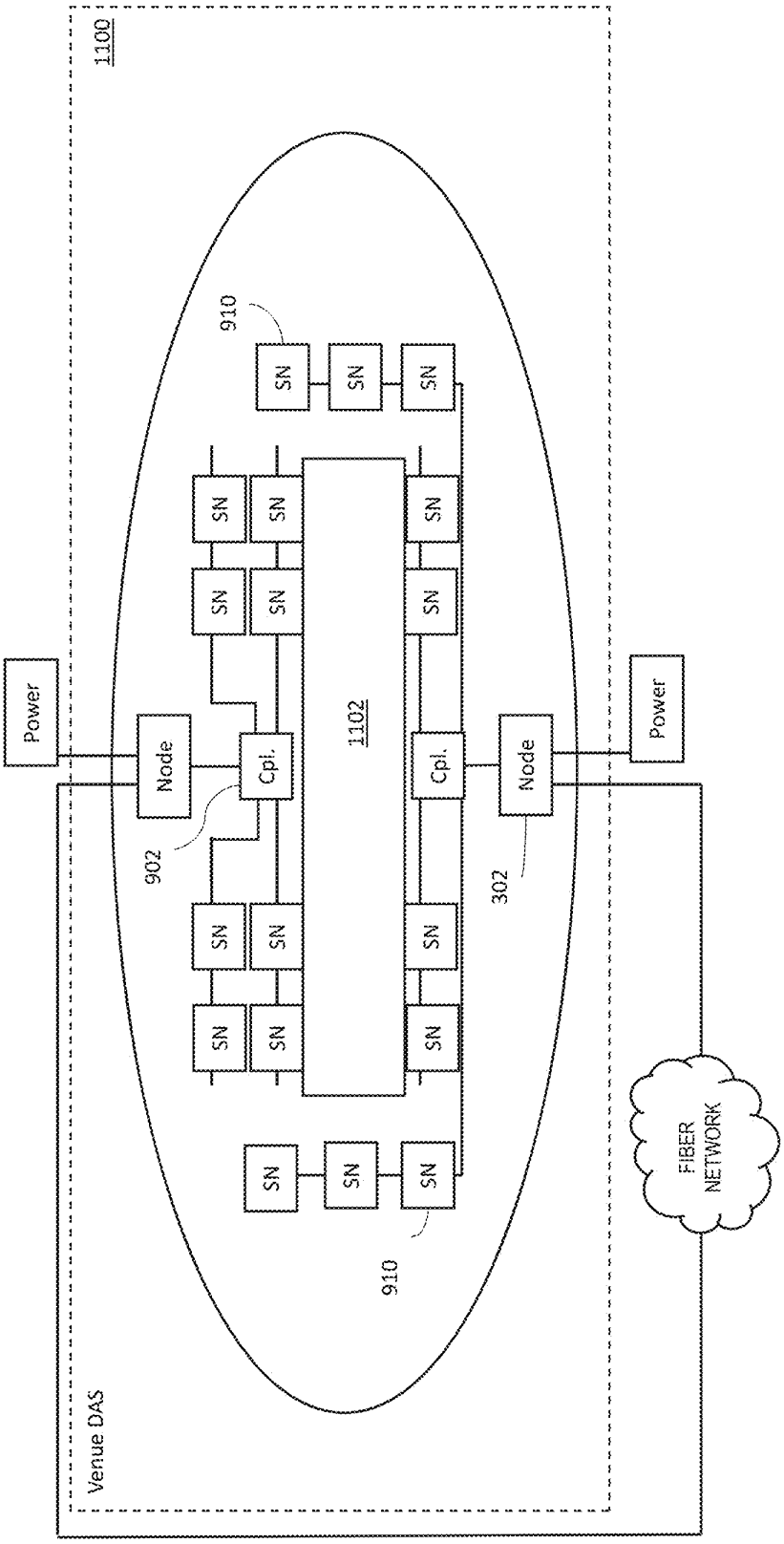

1100
910
SN
1102
Power
Node
Cpl.
902
302
FIBER NETWORK
Venue DAS

FIG. 11

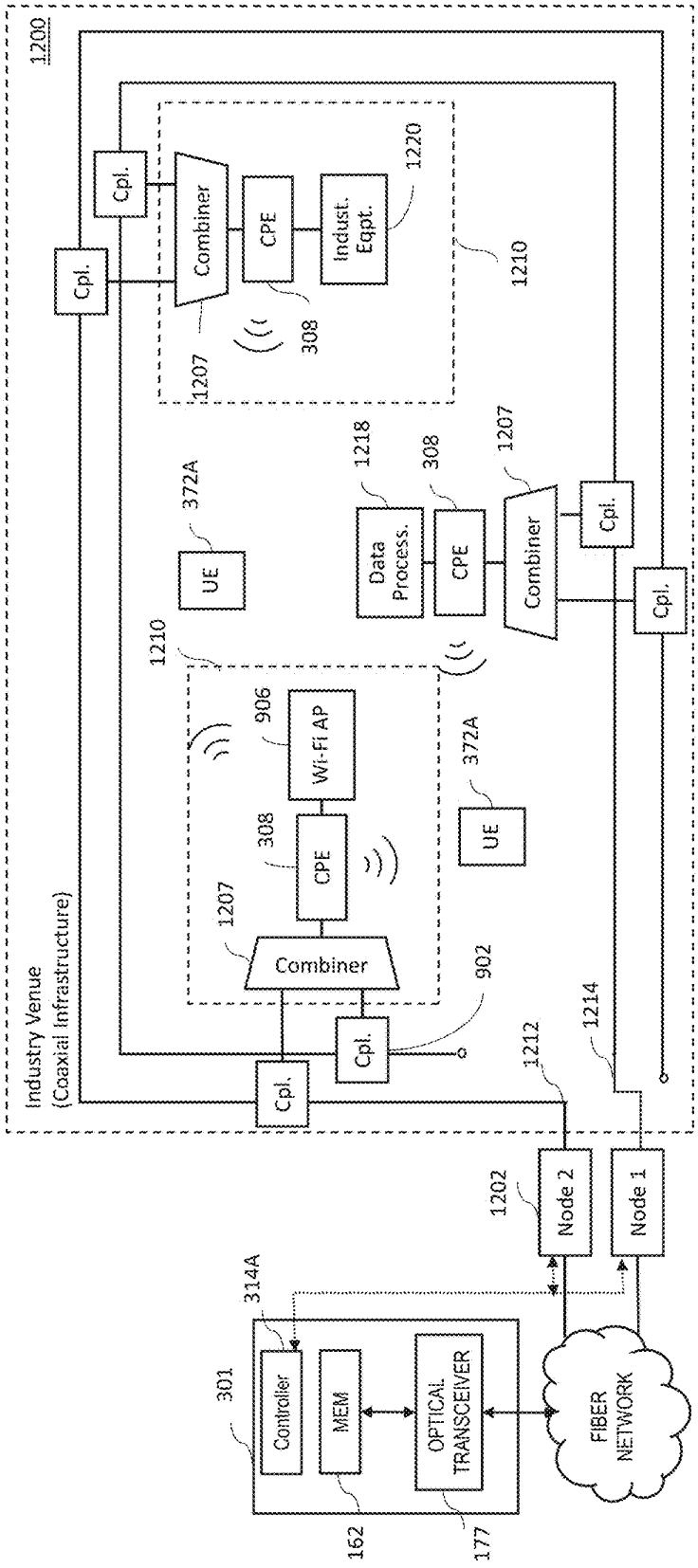

1200
Industry Venue
(Coaxial Infrastructure)
Cpl.
Combiner
CPE
Indust. Eqpt.
1220
1210
1207
308
372A
UE
1218
Data Process.
906
Wi-Fi AP
902
1212
1214
1202
Node 2
Node 1
314A
301
Controller
MEM
OPTICAL TRANSCEIVER
FIBER NETWORK
162
177

FIG. 12

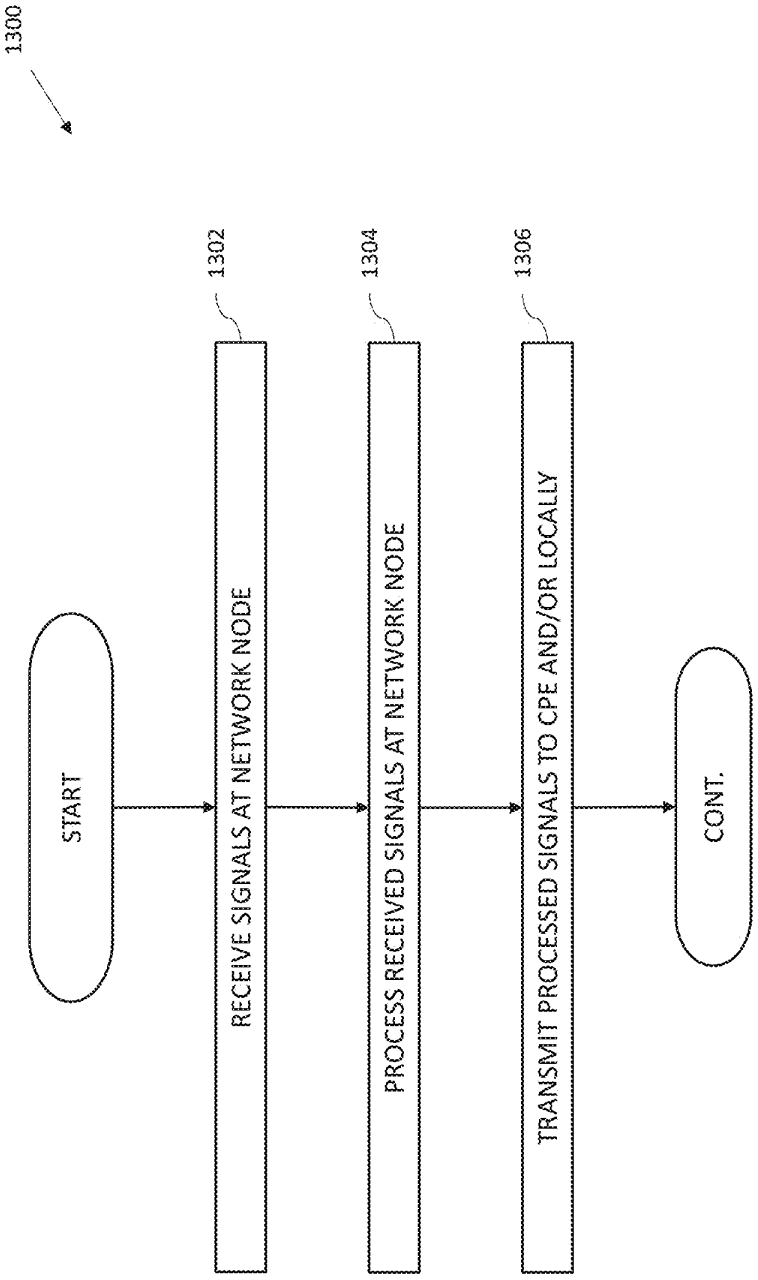

1300
1302
1304
1306
START
RECEIVE SIGNALS AT NETWORK NODE
PROCESS RECEIVED SIGNALS AT NETWORK NODE
TRANSMIT PROCESSED SIGNALS TO CPE AND/OR LOCALLY
CONT.

FIG. 13

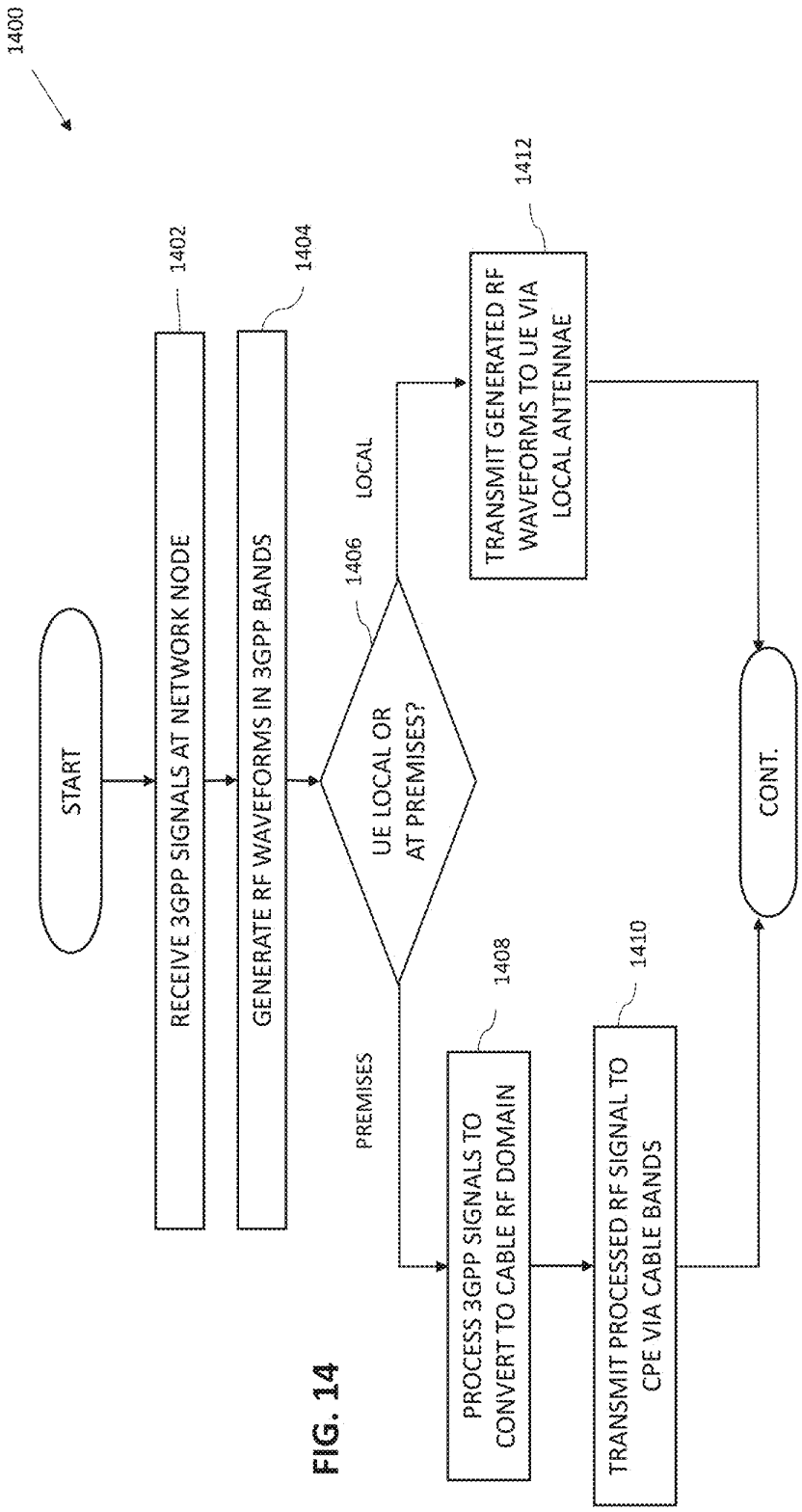

1400
START
RECEIVE 3GPP SIGNALS AT NETWORK NODE
1402
GENERATE RF WAVEFORMS IN 3GPP BANDS
1404
UE LOCAL OR AT PREMISES?
1406
LOCAL
TRANSMIT GENERATED RF WAVEFORMS TO UE VIA LOCAL ANTENNAE
1412
PREMISES
PROCESS 3GPP SIGNALS TO CONVERT TO CABLE RF DOMAIN
1408
TRANSMIT PROCESSED RF SIGNAL TO CPE VIA CABLE BANDS
1410
CONT.

FIG. 14

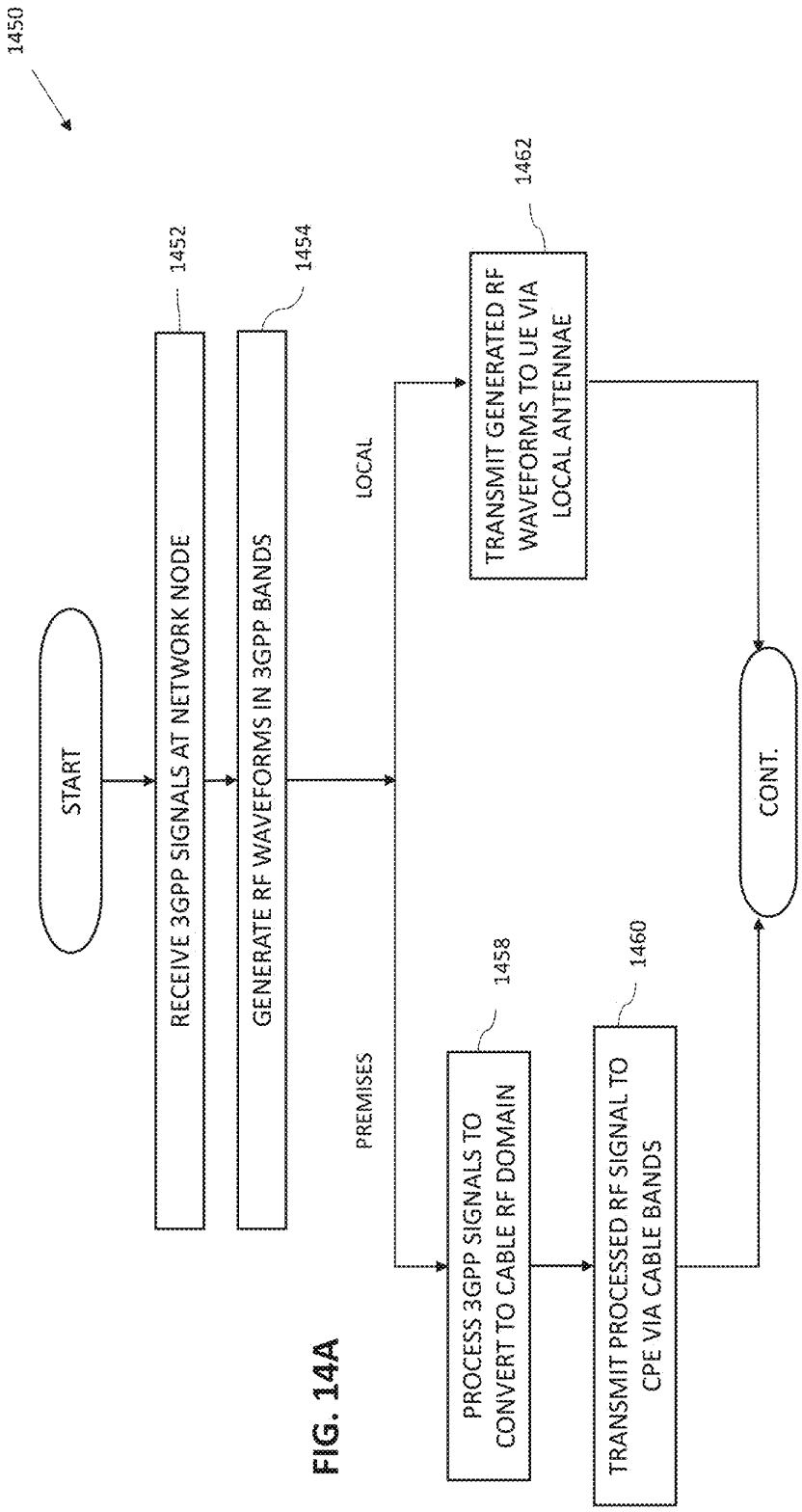

1450
START
RECEIVE 3GPP SIGNALS AT NETWORK NODE
1452
GENERATE RF WAVEFORMS IN 3GPP BANDS
1454
LOCAL
TRANSMIT GENERATED RF WAVEFORMS TO UE VIA LOCAL ANTENNAE
1462
PREMISES
PROCESS 3GPP SIGNALS TO CONVERT TO CABLE RF DOMAIN
1458
TRANSMIT PROCESSED RF SIGNAL TO CPE VIA CABLE BANDS
1460
CONT.

FIG. 14A

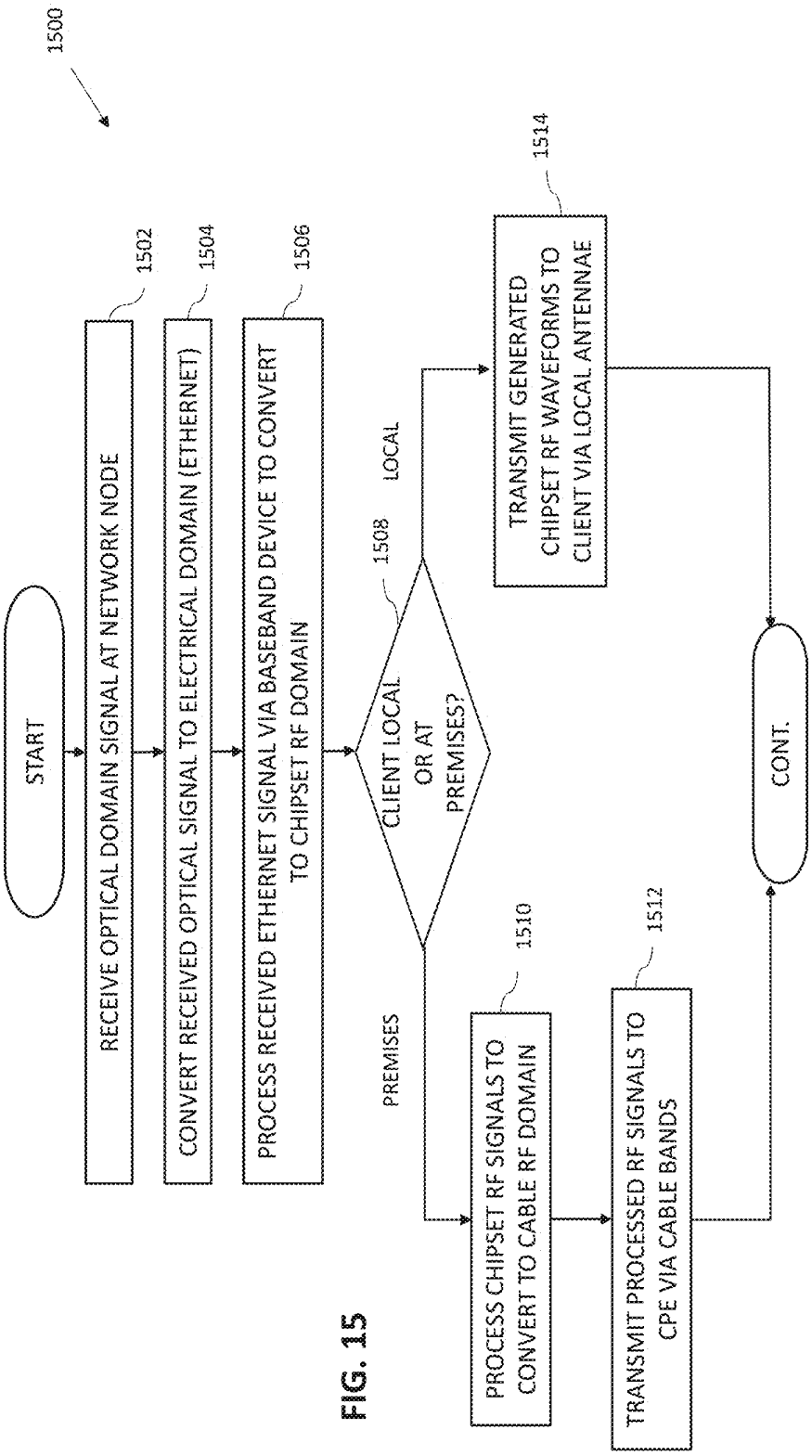

1500
START
RECEIVE OPTICAL DOMAIN SIGNAL AT NETWORK NODE
1502
CONVERT RECEIVED OPTICAL SIGNAL TO ELECTRICAL DOMAIN (ETHERNET)
1504
PROCESS RECEIVED ETHERNET SIGNAL VIA BASEBAND DEVICE TO CONVERT TO CHIPSET RF DOMAIN
1506
CLIENT LOCAL OR AT PREMISES?
1508
LOCAL
TRANSMIT GENERATED CHIPSET RF WAVEFORMS TO CLIENT VIA LOCAL ANTENNAE
1514
PREMISES
PROCESS CHIPSET RF SIGNALS TO CONVERT TO CABLE RF DOMAIN
1510
TRANSMIT PROCESSED RF SIGNALS TO CPE VIA CABLE BANDS
1512
CONT.

FIG. 15

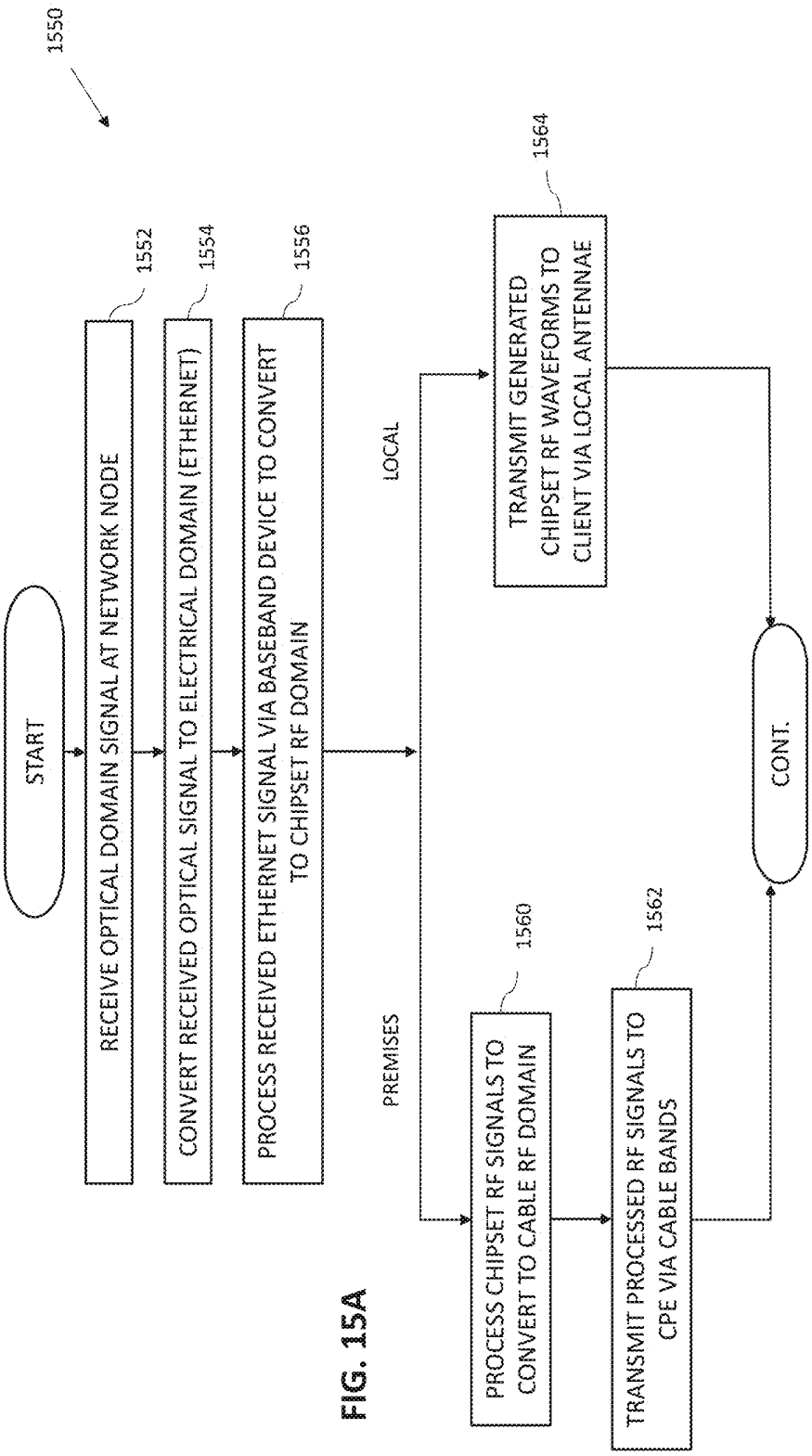

1550
START
RECEIVE OPTICAL DOMAIN SIGNAL AT NETWORK NODE
1552
CONVERT RECEIVED OPTICAL SIGNAL TO ELECTRICAL DOMAIN (ETHERNET)
1554
PROCESS RECEIVED ETHERNET SIGNAL VIA BASEBAND DEVICE TO CONVERT TO CHIPSET RF DOMAIN
1556
LOCAL
TRANSMIT GENERATED CHIPSET RF WAVEFORMS TO CLIENT VIA LOCAL ANTENNAE
1564
PREMISES
PROCESS CHIPSET RF SIGNALS TO CONVERT TO CABLE RF DOMAIN
1560
TRANSMIT PROCESSED RF SIGNALS TO CPE VIA CABLE BANDS
1562
CONT.

FIG. 15A

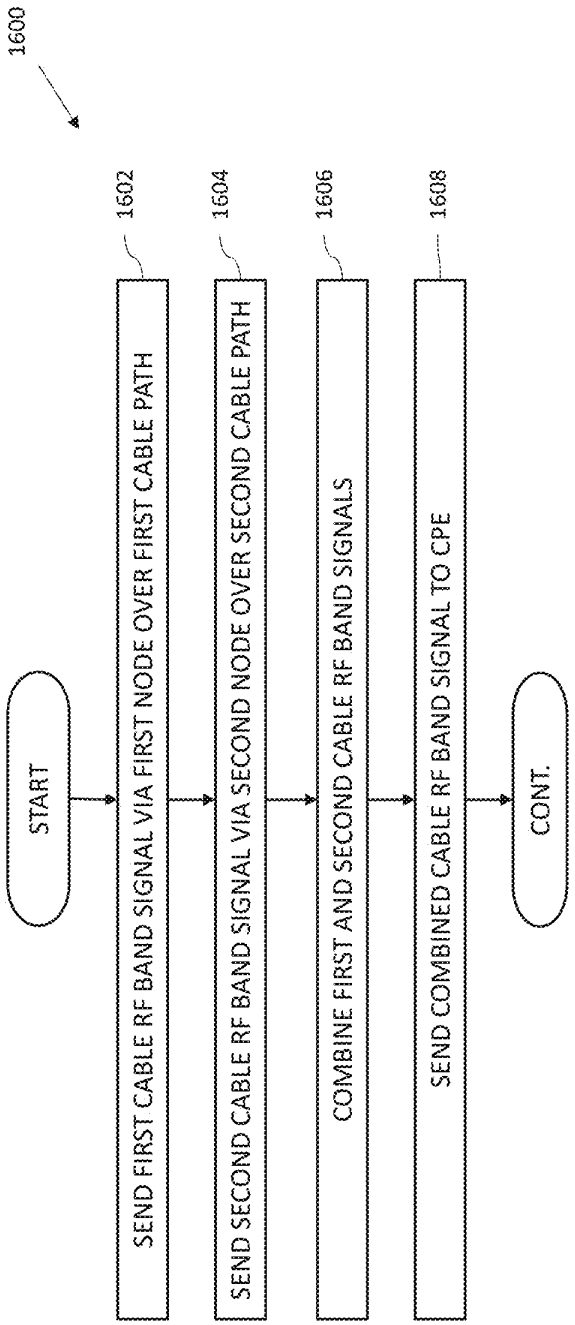

1600
START
1602
SEND FIRST CABLE RF BAND SIGNAL VIA FIRST NODE OVER FIRST CABLE PATH
1604
SEND SECOND CABLE RF BAND SIGNAL VIA SECOND NODE OVER SECOND CABLE PATH
1606
COMBINE FIRST AND SECOND CABLE RF BAND SIGNALS
1608
SEND COMBINED CABLE RF BAND SIGNAL TO CPE
CONT.

FIG. 16

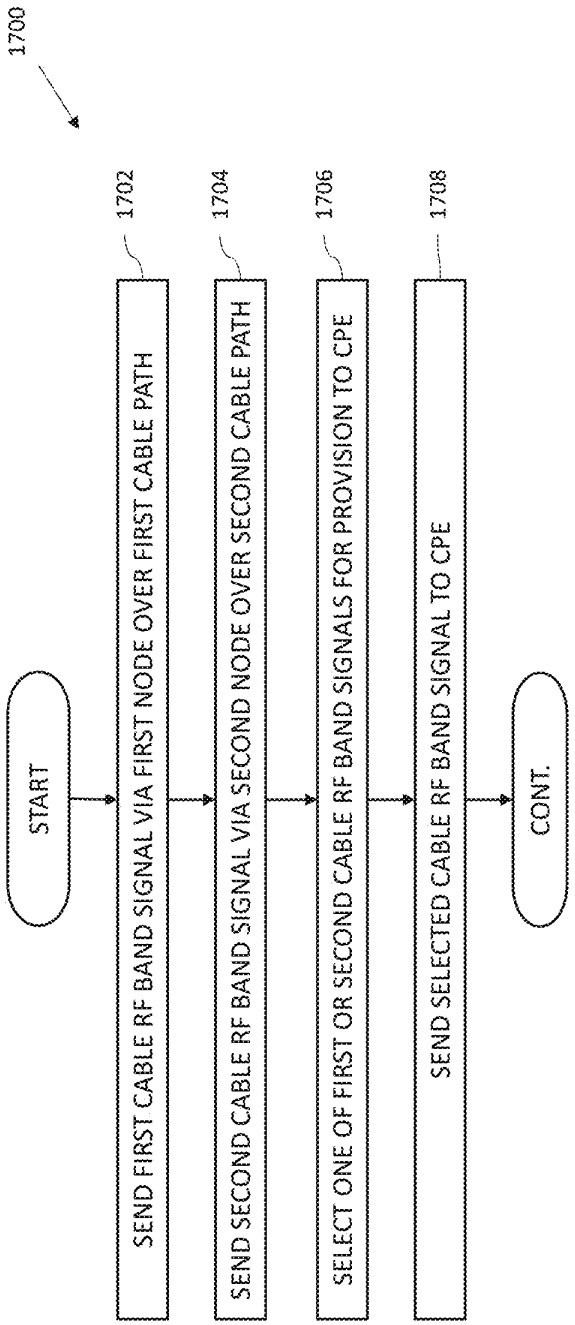

1700
START
1702
SEND FIRST CABLE RF BAND SIGNAL VIA FIRST NODE OVER FIRST CABLE PATH
1704
SEND SECOND CABLE RF BAND SIGNAL VIA SECOND NODE OVER SECOND CABLE PATH
1706
SELECT ONE OF FIRST OR SECOND CABLE RF BAND SIGNALS FOR PROVISION TO CPE
1708
SEND SELECTED CABLE RF BAND SIGNAL TO CPE
CONT.

FIG. 17

NODE APPARATUS AND METHODS FOR PROVIDING HIGH-CAPACITY DATA SERVICES VIA A CONTENT DELIVERY NETWORK ARCHITECTURE

RELATED APPLICATIONS

[0001] This application is generally related to the subject matter of co-owned U.S. Provisional Patent Application Ser. No. 62/658,465 filed Apr. 16, 2018 and entitled "APPARATUS AND METHODS FOR INTEGRATED HIGH-CAPACITY DATA AND WIRELESS NETWORK SERVICES", which is now published as U.S. Patent Application Publication No. 2019/0320322 of the same title filed Dec. 11, 2018, each of which is incorporated herein by reference in its entirety.

[0002] This application is also generally related to the subject matter of co-pending U.S. patent application Ser. No. 16/261,234 filed Jan. 29, 2019 and entitled "APPARATUS AND METHODS FOR ENABLING MOBILITY OF A USER DEVICE IN AN ENHANCED WIRELESS NETWORK," Ser. No. 16/384,706 filed Apr. 15, 2019 and entitled "APPARATUS AND METHODS FOR COORDINATED DELIVERY OF MULTIPLE DATA CHANNELS OVER PHYSICAL MEDIUM," Ser. No. 16/384,561 filed Apr. 15, 2019 and entitled "APPARATUS AND METHODS FOR INTEGRATED HIGH-CAPACITY DATA AND WIRELESS IOT (INTERNET OF THINGS) SERVICES," Ser. No. 16/384,805 filed Apr. 15, 2019 and entitled "GATEWAY APPARATUS AND METHODS FOR WIRELESS IOT (INTERNET OF THINGS) SERVICES," Ser. No. 16/384,701 filed Apr. 15, 2019 and entitled "APPARATUS AND METHODS FOR ENHANCING QUALITY OF EXPERIENCE FOR OVER-THE-TOP DATA SERVICES OVER HIGH-CAPACITY WIRELESS NETWORKS," Ser. No. 16/788,138 filed Feb. 11, 2020 and entitled "APPARATUS AND METHODS FOR PROVIDING HIGH-CAPACITY DATA SERVICES OVER A CONTENT DELIVERY NETWORK," and _____, filed contemporaneously herewith on Apr. 22, 2020 and entitled "PREMISES APPARATUS AND METHODS FOR AGGREGATED HIGH-CAPACITY DATA SERVICES," each of the foregoing incorporated herein by reference in its entirety.

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BACKGROUND

1. Technological Field

[0004] The present disclosure relates generally to the field of data networks and wireless devices, and specifically in one exemplary aspect to an architecture which provides high-speed data service to user premises via a content delivery network using, inter alia, wireless technology.

2. Description of Related Technology

[0005] Data communication services are now ubiquitous throughout user premises (e.g., home, office, vehicles, and even larger venues such as e.g., sports arenas, conference or convention centers, hotels, concert halls, airports, etc.). Such data communication services may be provided via a managed or unmanaged network. For instance, a typical home has services provided by one or more network service providers via a managed network such as a cable or satellite network. These services may include content delivery (e.g., linear television, on-demand content, personal or cloud DVR, "start over", etc.), as well as so-called "over the top" delivery of third-party content. Similarly, Internet and telephony access is also typically provided, and may be bundled with the aforementioned content delivery functions into subscription packages, which are increasingly becoming more user- or premises-specific in their construction and content. Such services are also increasingly attempting to adopt the paradigm of "anywhere, anytime", so that users (subscribers) can access the desired services (e.g., watching a movie) via a number of different receiving and rendering platforms, such as in different rooms of their houses, on their mobile devices while traveling, etc.

Issues with Existing Architecture and Services

[0006] As user appetite for enhanced data rates, mobility and diversity of services has increased over time, service providers have sought new technologies and paradigms for service delivery to compensate. In the case of cable networks, only so much expansion or enhancement is possible under traditional technology models (e.g., use of 800 MHz of spectral bandwidth with limited upstream bandwidth, modulation schemes, DOCSIS protocols, etc.), and even where such enhancement is possible, significant capital and R&D (research and development) expenditures are required to upgrade or adapt these existing technologies and infrastructure to the new required levels of performance.

[0007] As a simple example of the foregoing, consider a multi-dwelling unit (MDU) served by an existing hybrid fiber coax (HFC) network topology (see discussion of FIGS. **1** and **2** below). The network will typically utilize optical fiber to deliver data to a network node, which then converts the optical domain data to RF (radio frequency) signals for transmission over the existing coaxial cable distribution network and to the served customers at the edge of the network (including the aforementioned MDU, which as most legacy structures, is internally wired with coaxial cable serving each individual dwelling unit therein, with the owner of the MDU retaining ownership of the cable installed by the multiple systems operator (MSO) and hence representing a "sunk cost" investment to the MSO). As customers demand increased levels of service (high data rates, more features, etc.) in order to maintain their loyalty/subscription in the face of competing services such as cellular data, fiber, satellite, etc., the cable MSO is often faced with the daunting prospect of upgrading the infrastructure serving such MDUs, which may include addition of fixed wireless access (FWA) infrastructure, replacing of miles of coaxial cable with optical fiber, and similar.

[0008] For instance, to achieve certain capacity targets (e.g., 10 Gbps) over such infrastructure, increased use of optical fiber is needed in certain parts of the infrastructure. Under current HFC network design, services are provided to users via a coaxial cable "drop" to their premises, and groups of such premises are served by common tap-off

points or nodes within the larger architecture (see discussion of cable systems supra). Individual premises "tap off" the cabling or other infrastructure from each node and, depending on their geographic placement and other considerations, may require utilization of a number of different amplification units in order to maintain sufficient signal strength out to the most distant (topology-wise) premises in the system. For instance, a common description of how many amplifier stages are used between a source node and premises is "N+i", where i=the number of amplifier stages between the source node and the premises. For instance, N=0 refers to the situation where no amplifiers are used, and N+3 refers to use of three (3) amplifiers. In some extant cable/HFC systems in operation, values of i may be as high as seven (7); i.e., N+7, such as for service to rural areas.

[0009] As can be expected, use of such amplifier stages introduces some limitations on the data rates or bandwidth (both downstream—i.e., toward the client premises; and upstream—i.e., from the client premises) achievable by such systems. In effect, such systems are limited in maximum bandwidth/data rate, due in part to the design of the amplifiers; for example, they are typically designed to provide services primarily in the downstream direction (with much lower upstream bandwidth via so-called "OOB" or out-of-band RF channels providing highly limited upstream communication).

[0010] Cable modem or DOCSIS-compliant systems utilize DOCSIS QAMs (RF channels) for enhanced upstream bandwidth capability such as for Internet services, but even such technologies are in their current incarnations significantly limited in capability, and moreover have limited flexibility in the allocation of downstream versus upstream bandwidth, especially dynamically. For example, based on the DOCSIS protocols utilized for e.g., a coaxial infrastructure available in the aforementioned MDU served within a managed HFC network, throughput availability for downstream and upstream is in effect "hard-wired" based on how much of an available amount of spectrum is reserved for each direction. Because of this hard-wired availability, as well as the use of the aforementioned taps and amplifier stages, upstream throughput is limited in the foregoing HFC network.

[0011] As alluded to above, one way of achieving higher data rates may require replacement of such amplifier stages (and supporting coaxial cabling) with other mediums such as optical fiber (sometimes referred to as going "fiber deep", which can provide for example higher bandwidth, lower loss, and symmetric operation), microwave dishes at rooftop, and Ethernet cable (which can also provide symmetric operation), including going all the way back to an N+0 configuration throughout the entire network. However, replacement of literally tens of thousands of amplifiers and thousands of miles of cabling with optical fiber or the like is prohibitively expensive, and can take years.

[0012] Higher data rates may be achieved by implementation of DOCSIS 4.0 protocols; this version of the DOCSIS standard supports e.g., two (2) modes of use: (i) extended spectrum, without full duplex (which means separate allocation of downstream and upstream bandwidth, which can result in loss of capacity since the downstream and upstream bandwidth needs may not necessarily be static); and (ii) full duplex. Full duplex or symmetric DOCSIS 4.0, while providing significant enhancement over existing asymmetric DOCSIS systems, similarly requires significant capital investment and technology development, including relating to its supporting ecosystem (which in fact is one salient reason why the 4.0 standard also includes the first (i) mode described above, which in effect amounts to a legacy mode). The high implementation cost (including a long lead time) of continuous research and development for the newer developments in DOCSIS is moreover likely to persist, in part due to fragmented MSO selection of one of the aforementioned modes over the other.

[0013] Hence, replacing large portions of coaxial cable infrastructure with optical fiber, retrofitting to utilize the latest DOCSIS 4.0 technology, adding FWA for high-speed wireless backhaul, or other such upgrades to the existing MSO infrastructure represent (i) a huge CAPEX cost for the MSO (especially in dense urban environments with literally hundreds of closely spaced MDUs), and (ii) in some cases significant amounts of R&D for development of the necessary supporting ecosystem; these expenditures and development-induced latencies ideally would be at least partly avoided if somehow the extant HFC infrastructure could be enhanced or "repurposed" to include higher data rates, more symmetry between US and DS capability, and expanded types of services (such as mobility services).

[0014] Another issue to be addressed is the presence of delivered versus actual capacity "mismatch" with current systems. Even with delivery systems that currently provide a high degree of capability and symmetry (such as optical fiber), extant technologies for utilizing this delivered capacity symmetrically, and to its full capacity, are only now under development and not yet deployed. As such, even with a high US and DS capability available with e.g., optical fiber service, the end-user equipment such as 802.11ac routers can only utilize portions of this capability (and not nearly to its full capacity). Similarly, when considering a coaxial cable, it in theory can provide much higher data rates, and symmetrically, than current delivery paradigms such as DOCSIS 3.1 used by cable modems, and in-band 6 MHz channels (DS) used by DTSBs can provide. Hence, stated simply, the large existing inventory of coaxial cable is physically capable of much better performance than current protocols and end-user components can support.

[0015] As a brief aside, typical wireless access nodes such as Wi-Fi APs have an effective connectivity range on the order of one hundred (100) feet, depending on factors such as the presence or absence of buildings or other structures (and their materials of construction), and other interfering emitters. The optimal location of the wireless interface (e.g., an access point (AP), wireless access point (WAP), router, etc.) is sometimes a three-dimensional spatial problem, as client devices that will communicate with the wireless interface may be located on the same floor of a building or structure (in any azimuth direction), and also on different floors above and below the wireless interface's position. In addition, at any of the locations where a client device is located, other local factors affecting the device's ability to communicate with the wireless interface may also exist, such as radio frequency (RF) signal path loss/attenuation (such as due to interposed materials, instruments, etc.), ionosphere signal reflections and refractions (e.g., atmospheric ducting), and fading (which degrades the radio signals due to rapid fluctuations of the amplitudes, phases, or multipath delays of a radio signal over a short period or short travel distance due to interfering environment). Moreover, interference from other RF or electromagnetic sources such

as other wireless-enabled devices in the same frequency band, non-communication interference sources (e.g., microwave ovens), solar radiation, and so forth can further attenuate or disrupt WLAN and similar signals.

[0016] Additionally, the characteristics of a wireless interface such as an AP (as well as the corresponding client devices) are such that they may have directional RF properties due to, e.g., variances in antenna gain in different directions, obstruction by internal components of the device, etc.

[0017] In the exemplary context of a concert venue (e.g., music hall or the like), the construction of the venue including the stage, electrical or electronic musical instruments or equipment on the stage or proximate thereto, and other RF or electromagnetic sources in the audience or on stage have an effect on the spatial distribution of RF signals around the stage (and the venue generally). For example, the construction of the stage involves the use of different materials such as concrete, brick, dry-wall, wood, glass, metal framing, etc., that each may have different attenuation properties at exemplary radio frequencies used in wireless systems (e.g., 2.4 GHz, 3.6 GHz and 5 GHz). Also, signals at these frequencies create multi-path propagation throughout the venue, especially with other factors of interference and at increasing distances from the wireless interface, and can be quite unpredictable. Thus, all the locations within the venue (including those where user wireless devices may be used) are individually different in terms of the propagation path to and from the wireless interface, and hence signal strength at that location.

[0018] Additionally, even when the placement of wireless interface(s) such as WLAN APs within a venue is optimized for the particular attributes of that venue (e.g., based on construction materials of the building, particular shapes and placement of the building components, etc.), the connectivity and multi-path propagation throughout the venue will be affected by the interfering emitters that are introduced during the performance or event (e.g., by the introduction of an audience or other participants with their own potentially interfering devices), and/or during the pre-staging phase of the performance/event (e.g., instrument set-up, sound checks, etc.). Even at open-seating type events such as auto or trade shows, any modeling or planning the venue operator might perform prior to the event itself may be somewhat obsolete at the time of the event, due to the introduction of vehicles, personal electronic devices, demonstration devices, etc., and in some cases variation of the presence, location, and/or operation of these items over the course of the event duration. Moreover, the characteristics of a given venue may significantly change as a function of the type of event hosted in the venue. As alluded to above, equipment and material placement within the venue may significantly alter the RF propagation characteristics for various frequency bands, such that during one type of event (e.g., a trade show with no assigned seating and comparatively static displays) the RF performance in the desired bands is sufficient at a given location, whereas that same location may have unacceptable performance under during another type of event (e.g., concert with removable seating, stage, etc. added inside the venue, and a higher per-areas user density (and hence user personal wireless device density).

[0019] Based on the foregoing, service providers including the cable MSOs, are faced with the challenge of figuring out how to effectively and efficiently serve user devices disposed at various types of venues, including larger venues as those mentioned above, without incurring high additional cost.

[0020] Accordingly, improved node apparatus and methods of placement and operation thereof are needed to, inter alia, enable optimized delivery of ultra-high data rate services (both wired and wireless) symmetrically, and which leverage extant network infrastructure such as the large inventory of installed coaxial cable and supporting infrastructure in both MSO networks and the premises they serve. Ideally, such improved node apparatus and methods would also enable various network architectures that can be utilized to provide high-capacity data services to a plurality of user premises and venues under varying different configurations.

SUMMARY

[0021] The present disclosure addresses the foregoing needs by providing, inter alia, node apparatus and methods for delivering ultra-high data rate services (both wired and wireless) by leveraging extant network infrastructure via e.g., new wireless technology capabilities.

[0022] In a first aspect of the disclosure, a node apparatus is described. In one embodiment, the node apparatus includes: a first port for interfacing with a first portion of a network topology using at least a first type of network medium for data transmission; a second port for interfacing with a second portion of the network topology using at least a second type of network medium for data transmission; first network interface logic in communication with the first port; first RF integrated circuit (IC) apparatus in data communication with the first network interface logic, the at least one RF integrated circuit configured to at least generate RF waveforms within a first prescribed frequency band; frequency shifter apparatus configured to shift the RF waveforms within the prescribed frequency band to a frequency lower than the prescribed frequency band; and second RF IC apparatus in data communication with the first network interface logic, the second IC apparatus configured to at least generate RF waveforms within a second prescribed frequency band.

[0023] In one variant, the first portion of the network topology includes a fiber-optic distribution portion of the network topology, and the second portion includes a coaxial cable portion of the network topology, such as e.g., a hybrid fiber coaxial (HFC) cable television network topology operated by a multiple systems operator (MSO).

[0024] In another variant, the first RF integrated circuit apparatus includes at least one IEEE-Std. 802.11ax compliant IC or chipset configured to generate at least part of the RF waveforms within a first sub-band of the first prescribed frequency band. In one implementation thereof, the first RF integrated circuit apparatus further includes a second IC or chipset configured to generate at least part of the RF waveforms within a second sub-band of the first prescribed frequency band, the first and second sub-bands being non-overlapping in frequency. For instance, in one configuration, the first and second sub-bands each comprise frequency band below 1.6 GHz, said frequency bands below 1.6 GHz suitable for transmission over a coaxial cable portion of the network topology, the coaxial cable portion including the second portion of the network topology.

[0025] In another implementation, the first IC or chipset is configured to generate the at least part of the RF waveforms within the first sub-band for output via four (4) first ports or

spatial diversity channels, and the second IC or chipset is configured to generate the at least part of the RF waveforms within the second sub-band for output via four (4) second ports or spatial diversity channels.

[0026] In a further variant of the node apparatus, the second RF IC apparatus includes an IC or chipset configured to support at least one of 3GPP Long Term Evolution (LTE) or 3GPP 5G NR (New Radio) protocols. The generated RF waveforms within the second prescribed frequency band comprise e.g., an unlicensed or quasi-licensed spectrum band selected from the group consisting of: (i) NR-U bands, (ii) CBRS bands, and (iii) C-Bands.

[0027] In another implementation, the RF waveforms within the second prescribed frequency band are coupled to the second port via a signal path including at least a second frequency shifter apparatus and amplification logic; and the second frequency shifter apparatus is configured to shift the RF waveforms within the cellular band to a third sub-band within the first prescribed frequency band.

[0028] In another aspect, a simplified or reduced-complexity node apparatus is disclosed. In one embodiment the simplified apparatus includes a single 802.11ax chipset and a single 4G/5G cellular chipset, each coupled to respective DS/US frequency shifter apparatus. In one variant, only the 802.11ax chipset can produce both local (WLAN) waveforms and waveforms for transmission on the coaxial cable (as well as reception of each); the cellular chipset is configured solely for transmission/reception on the cable medium.

[0029] In another aspect of the disclosure, a method of providing a small cell wireless service via coaxial cable infrastructure is described. In one embodiment, the method includes: receiving one or more radio frequency (RF) signals at a network node in data communication with the coaxial cable infrastructure, the one or more radio frequency (RF) signals received via the coaxial cable infrastructure; converting the received one or more RF signals to one or more electrical domain signals; converting the one or more electrical domain signals into one or more cellular RF domain signals via a cellular chipset apparatus of the network node; and transmitting the one or more cellular RF domain signals to a user apparatus within a wireless range of the network node via one or more antenna apparatus of the network node.

[0030] In one variant of the method, the receiving the one or more radio frequency (RF) signals via the coaxial cable infrastructure includes receiving the one or more RF signals transmitted from a premises apparatus within a prescribed frequency band, the one or more RF signals having been down-converted to the prescribed frequency band from a cellular frequency band prior to said transmitting.

[0031] In another variant. the converting the received one or more RF signals to one or more electrical domain signals includes converting the received one or more RF signals to baseband data via a second chipset apparatus of the network node.

[0032] In a further variant, the receiving one or more radio frequency (RF) signals via the coaxial cable infrastructure includes receiving the one or more RF signals as IEEE Std. 802.11ax-compliant waveforms; and the converting the received one or more RF signals via a second chipset apparatus of the network node includes utilizing an IEEE Std. 802.11ax-compliant chipset to convert the IEEE Std. 802.11ax-compliant waveforms to baseband data. The method further includes in one implementation processing the baseband data utilizing at least a MAC (media access controller) process of the network node as part of providing said baseband data to said cellular chipset apparatus

[0033] In another aspect of the disclosure, a method of providing redundancy in data communication via a coaxial cable infrastructure is disclosed. In one embodiment, the method includes: transmitting first signals via a first cable radio frequency (RF) band over a first cable path of the coaxial cable infrastructure; transmitting second signals via a second cable RF band over a second cable path of the coaxial cable infrastructure; processing at least one of the transmitted first and the second signals at a common node; and transmitting the processed signals to premises equipment associated with the common node.

[0034] In one variant of the method, the transmitting first signals via the first cable radio frequency (RF) band over the first cable path of the coaxial cable infrastructure includes transmitting the first signals in a first radio frequency (RF) band that can be supported by the first cable path; the transmitting second signals via the second cable radio frequency (RF) band over the second cable path of the coaxial cable infrastructure includes transmitting the second signals in a second radio frequency (RF) band that can be supported by the second cable path, the second band not overlapping the first band in frequency; and the processing at least one of the transmitted first and second signals at a common node includes combining the first and second signals at the common node. In one implementation thereof, the transmitting the processed signals to premises equipment associated with the common node includes transmitting the combined first and second signals to an RF premises apparatus via a coaxial cable.

[0035] In another variant, the method further includes distributing the combined first and second signals via at least the premises equipment to a plurality of users of the premises, the plurality of users having a number greater than a number of users supportable via use of either the first or second cable path alone.

[0036] In yet another variant, the transmitting first signals via the first cable radio frequency (RF) band over the first cable path of the coaxial cable infrastructure includes transmitting the first signals in a first radio frequency (RF) band that can be supported by the first cable path; the transmitting second signals via the second cable radio frequency (RF) band over the second cable path of the coaxial cable infrastructure includes transmitting the second signals in the first radio frequency (RF) band, the second signals only transmitted during an absence of the first signals; and the processing at least one of the transmitted first and second signals at a common node includes selecting an available one or the other of the first and second signals at the common node. In one implementation thereof, the transmitting the processed signals to premises equipment associated with the common node includes transmitting the selected first or second signals to an RF premises apparatus via a coaxial cable.

[0037] In another implementation, the method further includes detecting a failure of a first distribution node in signal communication with and which supports the first cable path; and based at least on the detecting, cause said transmitting of the second signals.

[0038] In another aspect, a frequency plan for use on a hybrid fiber/optical network is disclosed. In one embodiment, the frequency plan includes a total available spectrum

of greater than 1 GHz (e.g., approximately 1.6 GHz in total), with high-speed symmetric US and DS capability, as well as utilization of portions of the available spectrum for cellular (e.g., 3GPP 4G or 5G) service, and for ISM-band (e.g., 900 MHz) communications. In one variant, the extant capability of IEEE Std. 802.11ax devices (e.g., chipsets) for 160 MHz channel bandwidth is used to generate two approximately 640 MHZ-wide sub-bands each with four (4) 160 MHz channels which can be independent allocated to different users, and to different delivery directions (i.e., US or DS).

[0039] In one variant, the plan includes frequency assets that are allocated to or divided up among two or more discrete node apparatus. For example, in one implementation, two node apparatus are used, each with cellular, high-speed symmetric US/DS, and ISM band capability. In one configuration, all but the ISM band capability is non-overlapping between the two nodes.

[0040] In another aspect, apparatus and methods for converting optical input to coaxial output are disclosed.

[0041] In a further aspect, apparatus and methods for delivering mobility service through an extant network infrastructure without interfering with broadband data service are disclosed.

[0042] In yet an additional aspect, apparatus and methods for utilization of technology adapted for a first wireless paradigm to a wired paradigm (e.g., WLAN 802.11ax technology onto an extant HFC network infrastructure) are disclosed.

[0043] In another aspect, apparatus and methods for enabling transmission of cellular technology (e.g., 4G-LTE/5G-NR) with unlicensed (e.g., NR-U, LTE-LAA, or LTE-U) or quasi-licensed spectrum (e.g., CBRS) are disclosed.

[0044] In a further aspect, apparatus and methods for providing local outdoor cellular or AP functionality via a node is disclosed. In one embodiment, the apparatus and methods utilize a secondary band of wireless chipset capability (e.g., 2.4 GHz for WLAN) for providing the outdoor capability via antenna mounted on the node, the node mounted or disposed in e.g., a publicly accessible place. In one variant, MSO subscribers are given sole access or priority of use of the ad hoc outdoor WLAN or cellular capability.

[0045] In another aspect, methods of retaining value of an MSO infrastructure investment are disclosed. In one embodiment, the methods include repurposing uses of an existing coaxial cable installed base (such as in an MDU) so as to extend its usable lifetime and at least delay (if not obviate) its replacement.

[0046] In a further aspect, apparatus and methods for shifting a frequency of LBT signal are disclosed.

[0047] In yet an additional aspect, apparatus and methods for shifting a frequency of TDD signal are disclosed.

[0048] In an additional aspect, apparatus and methods for shifting frequency of an FDD signal are disclosed.

[0049] In an additional aspect, apparatus and methods for splitting and combining power and signals onto a coaxial cable are disclosed.

[0050] In a further aspect, apparatus and methods for communicating with an external cellular source are disclosed.

[0051] In another aspect, apparatus and methods for providing Wi-Fi AP service are disclosed.

[0052] In another aspect, apparatus and methods for using a controlling entity to control a switch for mapping inputs of signals from a Wi-Fi AP onto ports of a Wi-Fi STA are disclosed.

[0053] In yet an additional aspect, a network architecture implementing one or more of the foregoing aspects of the disclosure are disclosed.

[0054] In yet an additional aspect, a software architecture implementing one or more of the foregoing aspects of the disclosure are disclosed.

[0055] In a further aspect, a frequency shifting architecture is disclosed. In one embodiment, the architecture includes a plurality of frequency shifters to accommodate two or more different multiple access schemes and associated frequency bands. In one variant, a first set of shifters is utilized in conjunction with an 802.11 chipset (operating via LBT and/or CSMA/CD protocols), while a second set of shifters is used in conjunction with a 3GPP chipset (operating via FDD or TDD protocols).

[0056] In another aspect, methods and apparatus for controlling two or more client devices so as to enable utilization of a common bearer medium is disclosed. In one embodiment, the methods and apparatus include use of a controller entity which coordinates switching components within the respective client devices so as to access waveforms associated with different spatial diversity channels encoded on a coaxial cable bearer so as to optimize data rates to each of the different client devices.

[0057] In another aspect, an optical to coaxial cable transducer that can transmit and receive IEEE Std. 802.11 and 3GPP 4G LTE and 5G NR waveforms to multiple CPE through a single coaxial cable is disclosed.

[0058] In still a further aspect of the disclosure, a method for providing ad hoc mobile device broadband is described. In one embodiment, the method includes providing wireless coverage via one or more external (e.g., pole mounted) access nodes.

[0059] In another aspect, an integrated circuit (IC) device implementing one or more of the foregoing aspects is disclosed and described. In one embodiment, the IC device is embodied as a SoC (system on Chip) device. In another embodiment, an ASIC (application specific IC) is used as the basis of the device. In yet another embodiment, a chip set (i.e., multiple ICs used in coordinated fashion) is disclosed. In yet another embodiment, the device includes a multi-logic block FPGA device.

[0060] In another aspect, a computer readable storage apparatus implementing one or more of the foregoing aspects is disclosed and described. In one embodiment, the computer readable apparatus includes a program memory, or an EEPROM. In another embodiment, the apparatus includes a solid state drive (SSD) or other mass storage device. In another embodiment, the apparatus includes a USB or other "flash drive" or other such portable removable storage device. In yet another embodiment, the apparatus includes a "cloud" (network) based storage device which is remote from yet accessible via a computerized user or client electronic device. In yet another embodiment, the apparatus includes a "fog" (network) based storage device which is distributed across multiple nodes of varying proximity and accessible via a computerized user or client electronic device.

[0061] In a further aspect, an optical-to-coaxial cable transducer that can transmit and receive 3GPP 4G LTE and 5G NR waveforms to multiple CPE through a single coaxial cable interface is disclosed.

[0062] In a further aspect, a method of introducing expanded data network services within a network infrastructure are disclosed. In one embodiment, the network includes an HFC cable network.

[0063] These and other aspects shall become apparent when considered in light of the disclosure provided herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0064] FIGS. **1**A and **1**B are functional block diagrams illustrating a typical prior art managed (e.g., HFC cable) content delivery network architecture.

[0065] FIG. **2** is a graphical representation of an exemplary frequency band functional assignment according to an embodiment of the present disclosure.

[0066] FIG. **2**A is a graphical representation of another exemplary frequency band functional assignment according to an embodiment of the present disclosure.

[0067] FIG. **2**B is a graphical representation of yet another exemplary frequency band functional assignment according to an embodiment of the present disclosure.

[0068] FIG. **3**A is a functional block diagram illustrating a first exemplary embodiment of a service provider network architecture according to the present disclosure.

[0069] FIG. **3**B is a functional block diagram illustrating a second exemplary embodiment of a service provider network architecture according to the present disclosure.

[0070] FIG. **3**C is a functional block diagram illustrating a third exemplary embodiment of a service provider network architecture according to the present disclosure.

[0071] FIG. **3**D is a functional block diagram illustrating an exemplary embodiment of a client-side architecture (in the context of an MDU) served by a service provider network architecture.

[0072] FIG. **4** is a functional block diagram illustrating a first exemplary configuration of a network node apparatus according to the present disclosure.

[0073] FIG. **5** is a functional block diagram illustrating a second exemplary configuration of a network node apparatus according to the present disclosure.

[0074] FIG. **6** is a functional block diagram illustrating a third exemplary configuration of a network node apparatus according to the present disclosure.

[0075] FIG. **7** is a functional block diagram illustrating a fourth exemplary configuration of a network node apparatus according to the present disclosure.

[0076] FIG. **8** is a functional block diagram of one embodiment of an IEEE Std. 802.11ax-enabled access device according to the disclosure.

[0077] FIG. **9** is a functional block diagram illustrating a first exemplary use case of utilizing the exemplary node apparatus according to the present disclosure.

[0078] FIG. **10** is a functional block diagram illustrating a second exemplary use case of utilizing the exemplary node apparatus according to the present disclosure.

[0079] FIG. **11** is a functional block diagram illustrating a third exemplary use case of utilizing the exemplary node apparatus according to the present disclosure.

[0080] FIG. **12** is a functional block diagram illustrating a fourth exemplary use case of utilizing the exemplary node apparatus according to the present disclosure.

[0081] FIG. **13** is a logical flow diagram of an exemplary embodiment of a generalized method for providing high-capacity data services over a content delivery network, according to the present disclosure.

[0082] FIG. **14** is a logical flow diagram representing one variant of the generalized method of FIG. **13**, according to the present disclosure.

[0083] FIG. **14**A is a logical flow diagram representing one alternate implementation of the method of FIG. **14**, wherein signals are "broadcast" both locally at the node and transmitted downstream for premises consumption.

[0084] FIG. **15** is a logical flow diagram representing another variant of the generalized method of FIG. **13**, according to the present disclosure.

[0085] FIG. **15**A is a logical flow diagram representing one alternate implementation of the method of FIG. **15**, wherein signals are "broadcast" both locally at the node and transmitted downstream for premises consumption.

[0086] FIG. **16** is a logical flow diagram representing a first embodiment of a generalized method for providing redundancy of data service over a content delivery network, according to the present disclosure.

[0087] FIG. **17** is a logical flow diagram representing a second embodiment of a generalized method for providing redundancy of data service over a content delivery network, according to the present disclosure.

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DETAILED DESCRIPTION

[0089] Reference is now made to the drawings wherein like numerals refer to like parts throughout.

[0090] As used herein, the term "access node" refers generally and without limitation to a network node which enables communication between a user or client device and another entity within a network, such as for example a CBRS CBSD, a cellular xNB, a Wi-Fi AP, or a Wi-Fi-Direct enabled client or other device acting as a Group Owner (GO).

[0091] As used herein, the term "application" (or "app") refers generally and without limitation to a unit of executable software that implements a certain functionality or theme. The themes of applications vary broadly across any number of disciplines and functions (such as on-demand content management, e-commerce transactions, brokerage transactions, home entertainment, calculator etc.), and one application may have more than one theme. The unit of executable software generally runs in a predetermined environment; for example, the unit could include a downloadable Java Xlet™ that runs within the JavaTV™ environment.

[0092] As used herein, the term "CBRS" refers without limitation to the CBRS architecture and protocols described in *Signaling Protocols and Procedures for Citizens Broadband Radio Service* (*CBRS*): *Spectrum Access System* (*SAS*)—*Citizens Broadband Radio Service Device* (*CBSD*) *Interface Technical Specification*—Document WINNF-TS-0016, Version V1.2.1.3, January 2018, incorporated herein by reference in its entirety, and any related documents or subsequent versions thereof.

[0093] As used herein, the terms "client device" or "user device" or "UE" include, but are not limited to, set-top boxes (e.g., DSTBs), gateways, modems, personal computers (PCs), and minicomputers, whether desktop, laptop, or oth-

erwise, and mobile devices such as handheld computers, PDAs, personal media devices (PMDs), tablets, "phablets", smartphones, and vehicle infotainment systems or portions thereof.

[0094] As used herein, the term "computer program" or "software" is meant to include any sequence or human or machine cognizable steps which perform a function. Such program may be rendered in virtually any programming language or environment including, for example, C/C++, Fortran, COBOL, PASCAL, assembly language, markup languages (e.g., HTML, SGML, XML, VoXML), and the like, as well as object-oriented environments such as the Common Object Request Broker Architecture (CORBA), Java™ (including J2ME, Java Beans, etc.) and the like.

[0095] As used herein, the term "DOCSIS" refers to any of the existing or planned variants of the Data Over Cable Services Interface Specification, including for example DOCSIS versions 1.0, 1.1, 2.0, 3.0, 3.1 and 4.0.

[0096] As used herein, the term "headend" or "backend" refers generally to a networked system controlled by an operator (e.g., an MSO) that distributes programming to MSO clientele using client devices. Such programming may include literally any information source/receiver including, inter alia, free-to-air TV channels, pay TV channels, interactive TV, over-the-top services, streaming services, and the Internet.

[0097] As used herein, the terms "Internet" and "internet" are used interchangeably to refer to inter-networks including, without limitation, the Internet. Other common examples include but are not limited to: a network of external servers, "cloud" entities (such as memory or storage not local to a device, storage generally accessible at any time via a network connection, and the like), service nodes, access points, controller devices, client devices, etc.

[0098] As used herein, the term "LTE" refers to, without limitation and as applicable, any of the variants or Releases of the Long-Term Evolution wireless communication standard, including LTE-U (Long Term Evolution in unlicensed spectrum), LTE-LAA (Long Term Evolution, Licensed Assisted Access), LTE-A (LTE Advanced), and 4G/4.5G LTE.

[0099] As used herein, the term "memory" includes any type of integrated circuit or other storage device adapted for storing digital data including, without limitation, ROM, PROM, EEPROM, DRAM, SDRAM, DDR/2 SDRAM, EDO/FPMS, RLDRAM, SRAM, "flash" memory (e.g., NAND/NOR), 3D memory, and PSRAM.

[0100] As used herein, the terms "microprocessor" and "processor" or "digital processor" are meant generally to include all types of digital processing devices including, without limitation, digital signal processors (DSPs), reduced instruction set computers (RISC), general-purpose (CISC) processors, microprocessors, gate arrays (e.g., FPGAs), PLDs, reconfigurable computer fabrics (RCFs), array processors, secure microprocessors, and application-specific integrated circuits (ASICs). Such digital processors may be contained on a single unitary IC die, or distributed across multiple components.

[0101] As used herein, the terms "MSO" or "multiple systems operator" refer to a cable, satellite, or terrestrial network provider having infrastructure required to deliver services including programming and data over those mediums.

[0102] As used herein, the terms "MNO" or "mobile network operator" refer to a cellular, satellite phone, WMAN (e.g., 802.16), or other network service provider having infrastructure required to deliver services including without limitation voice and data over those mediums.

[0103] As used herein, the terms "network" and "bearer network" refer generally to any type of telecommunications or data network including, without limitation, hybrid fiber coax (HFC) networks, satellite networks, telco networks, and data networks (including MANs, WANs, LANs, WLANs, internets, and intranets). Such networks or portions thereof may utilize any one or more different topologies (e.g., ring, bus, star, loop, etc.), transmission media (e.g., wired/RF cable, RF wireless, millimeter wave, optical, etc.) and/or communications or networking protocols (e.g., SONET, DOCSIS, IEEE Std. 802.3, ATM, X.25, Frame Relay, 3GPP, 3GPP2, LTE/LTE-A/LTE-U/LTE-LAA, 5G NR, WAP, SIP, UDP, FTP, RTP/RTCP, H.323, etc.).

[0104] As used herein, the term "network interface" refers to any signal or data interface with a component or network including, without limitation, those of the FireWire (e.g., FW400, FW800, etc.), USB (e.g., USB 2.0, 3.0. OTG), Ethernet (e.g., 10/100, 10/100/1000 (Gigabit Ethernet), 10-Gig-E, etc.), MoCA, Coaxsys (e.g., TVnet™), radio frequency tuner (e.g., in-band or OOB, cable modem, etc.), LTE/LTE-A/LTE-U/LTE-LAA, Wi-Fi (802.11), WiMAX (802.16), Z-wave, PAN (e.g., 802.15), or power line carrier (PLC) families.

[0105] As used herein the terms "5G" and "New Radio (NR)" refer without limitation to apparatus, methods or systems compliant with 3GPP Release 15, and any modifications, subsequent Releases, or amendments or supplements thereto which are directed to New Radio technology, whether licensed or unlicensed.

[0106] As used herein, the term "QAM" refers to modulation schemes used for sending signals over e.g., cable or other networks. Such modulation scheme might use any constellation level (e.g. QPSK, 16-QAM, 64-QAM, 256-QAM, etc.) depending on details of a network. A QAM may also refer to a physical channel modulated according to the schemes.

[0107] As used herein, the term "SAS (Spectrum Access System)" refers without limitation to one or more SAS entities which may be compliant with FCC Part 96 rules and certified for such purpose, including (i) Federal SAS (FSAS), (ii) Commercial SAS (e.g., those operated by private companies or entities), and (iii) other forms of SAS.

[0108] As used herein, the term "server" refers to any computerized component, system or entity regardless of form which is adapted to provide data, files, applications, content, or other services to one or more other devices or entities on a computer network.

[0109] As used herein, the term "storage" refers to without limitation computer hard drives, DVR device, memory, RAID devices or arrays, optical media (e.g., CD-ROMs, Laserdiscs, Blu-Ray, etc.), or any other devices or media capable of storing content or other information.

[0110] As used herein, the term "users" may include without limitation end users (e.g., individuals, whether subscribers of the MSO network, the MNO network, or other), the receiving and distribution equipment or infrastructure such as a FWA/CPE or CBSD, venue operators, third party service providers, or even entities within the MSO itself (e.g., a particular department, system or processing entity).

[0111] As used herein, the term "Wi-Fi" refers to, without limitation and as applicable, any of the variants of IEEE Std. 802.11 or related standards including 802.11a/b/g/n/s/v/ac/ad/ax/ba or 802.11-2012/2013, 802.11-2016, as well as Wi-Fi Direct (including inter alia, the "Wi-Fi Peer-to-Peer (P2P) Specification", incorporated herein by reference in its entirety).

[0112] As used herein, the term "wireless" means any wireless signal, data, communication, or other interface including without limitation Wi-Fi, Bluetooth/BLE, 3GPP/3GPP2, HSDPA/HSUPA, TDMA, CBRS, CDMA (e.g., IS-95A, WCDMA, etc.), FHSS, DSSS, GSM, PAN/802.15, WiMAX (802.16), 802.20, Zigbee®, Z-wave, narrowband/FDMA, OFDM, PCS/DCS, LTE/LTE-A/LTE-U/LTE-LAA, 5G NR, LoRa, IoT-NB, SigFox, analog cellular, CDPD, satellite systems, millimeter wave or microwave systems, acoustic, and infrared (i.e., IrDA).

[0113] As used herein, the term "xNB" refers to any 3GPP-compliant node including without limitation eNBs (eUTRAN) and gNBs (5G NR).

Overview

[0114] In one exemplary aspect, the present disclosure provides improved network architectures, and node apparatus and associated methods for providing enhanced ultra-high data rate services which, inter alia, leverage existing managed network (e.g., cable network) infrastructure. Advantageously, the disclosed architectural components (nodes, amplifiers and counterpart CPE) can be utilized in a variety of topologies, with network nodes disposed so as to support multiple downstream CPE including e.g., wherever an optical waveform is to be converted to a signal to be transmitted via coaxial cable. For instance, in one configuration, a node may be used further back towards the service provider core, such as to support a number of individual customer premises (e.g., homes) served by coaxial cable infrastructure. In another configuration, the node may be used at the very edge of the network to service a number of customers within a residential multi-dwelling unit or MDU (e.g., apartment building or condominium complex), that is wired with coaxial cable yet served by a proximate fiber drop (e.g., FTTC).

[0115] Further, other exemplary configurations can support various types of use cases (including premises-specific ones) such as e.g., providing an outdoor small cell service, a distributed antenna system (DAS) for an enterprise or other such premises, a venue-specific DAS, and additional reliability through redundancy. Numerous other configurations are possible when utilizing the adaptable and application-specific configurability of the methods and apparatus described herein.

[0116] In one embodiment of the architecture, a Hybrid Fiber Coax (HFC) plant infrastructure and 802.11ax (colloquially termed "Wi-Fi 6") protocols are used as bases for provision of standards-compliant ultra-low latency and high data rate services (e.g., with capabilities associated with 3GPP 4G and 5G, and IEEE Std. 802.11 services based on 802.11ax technology). These services may include symmetric or asymmetric US and DS bandwidth which can be dynamically allocated, flexible scheduling of data (to e.g., prioritize real-time data over non-real-time data), and support of cellular, WLAN and PAN (e.g., IoT) services, all via a common service provider. The exemplary use of Wi-Fi 6 technology provides not only the capability for symmetric operation of downstream (DS) and upstream (US) transmissions but also a symmetric capacity, which may not be possible with e.g., use of an 802.11ac router backhauled by DOCSIS.

[0117] Further, various configurations and topologies, made available via the aforementioned technologies and the HFC plant infrastructure, are used for provision of various types standards-compliant ultra-low latency and high data rate services to user devices disposed at edge of a distribution network, as well as within different types of venues, which may otherwise pose various challenges or impediments to the provision of such high level of data services.

[0118] In one variant, an expanded frequency band (approximately 1.6 GHz in total bandwidth) is used over the coaxial portions of the HFC infrastructure. This expanded band is allocated to two or more primary data sub-bands, as well as to ISM and cellular uses. Wideband amplifier apparatus are used to support DS and US utilization of the sub-bands within the network, including by premises devices via re-use of coaxial infrastructure. This allows the entity that installed such coaxial infrastructure to maintain its footprint in its customer's premises and continue to provide additional services without laying any significant amounts of optical fiber or other such alternate solutions.

[0119] In another variant, the foregoing expanded frequency band is divided among and used by two (or more) sub-nodes to provide data services that are better suited to different types of user premises or use cases. Additionally, the division of the expanded frequency band allows the sub-nodes to carry less capabilities/components so as to allow e.g., lower per-unit cost.

[0120] In yet another variant, the use of 802.11ax APs for delivery of ultra-high data rate services allow e.g., 4.8 Gbps data rate services, which can allow for example two (2) users to take advantage of 2.4 Gbps data rate in parallel (instead of allowing one (1) user to get all of 4.8 Gbps due to silicon limitation). In another variant, a plurality of access and modulation scheme, such as an OFDM and TDD/FDD/LBT-based scheme is used to allow for maximal efficiency and flexibility in allocating bandwidth to downstream and upstream transmissions over the HFC infrastructure.

[0121] Moreover, latency within the disclosed infrastructure is reduced by, inter alia, obviating encapsulation and other network/transport protocols normally necessitated through use of e.g., DOCSIS bearers and equipment (i.e., DOCSIS modems and CMTS apparatus within the MSO core.

[0122] Using Wi-Fi protocols such as 802.11ax through HFC also enables broadband service benefits stemming from the rich feature set, vendor diversity and operational reliability that Wi-Fi ecosystem (which is being innovated at a high frequency) has already developed for a multitude of users of Wi-Fi technology in various devices. Furthermore, the exemplary embodiments can help streamline the delivery of broadband services (including increased service velocity) and the roadmap for service improvement by aligning the technology used to deliver broadband data to the customers' premises with the technology used by customers to consume the broadband data (e.g., Wi-Fi).

[0123] The improved architecture also advantageously facilitates mobility support by re-purposing one or more spectrum (e.g., 5-85 MHz) typically used as upstream spec-

trum for DOCSIS for cellular signal extension and distribution (including both at the intermediary network nodes and the end-user's CPE).

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0124] Exemplary embodiments of the apparatus and methods of the present disclosure are now described in detail. While these exemplary embodiments are described in the context of the previously mentioned HFC cable system adapted for use with 802.11ax and 3GPP technology, and network nodes and CPE associated with or supported at least in part by a managed network of a service provider (e.g., MSO), other types of radio access technologies ("RATs"), and other types of networks and architectures that are configured to deliver digital data (e.g., text, images, games, software applications, video and/or audio) may be used consistent with the present disclosure. Such other networks or architectures may be broadband, narrowband, or otherwise, the following therefore being merely exemplary in nature.

[0125] It will also be appreciated that while described generally in the context of a network providing service to a customer or consumer or end user or subscriber (i.e., within a prescribed service area, venue, or other type of premises), the present disclosure may be readily adapted to other types of environments including, e.g., commercial/retail, or enterprise domain (e.g., businesses), or even governmental uses.

[0126] Additionally, while described primarily with reference to exemplary architectures and components set forth in co-owned and co-pending U.S. patent application Ser. No. 16/788,138 filed Feb. 11, 2020 and entitled "APPARATUS AND METHODS FOR PROVIDING HIGH-CAPACITY DATA SERVICES OVER A CONTENT DELIVERY NETWORK," previously incorporated herein by reference in its entirety, the methods and apparatus of the present disclosure are not so limited, and in fact may adapted for use with other architectures and components by one of ordinary skill when given the present disclosure.

[0127] Also, while certain aspects are described primarily in the context of the well-known Internet Protocol (described in, inter alia, *Internet Protocol DARPA Internet Program Protocol Specification,* IETF RCF 791 (September 1981) and Deering et al., *Internet Protocol, Version* 6 (*IPv6*) *Specification,* IETF RFC 2460 (December 1998), each of which is incorporated herein by reference in its entirety), it will be appreciated that the present disclosure may utilize other types of protocols (and in fact bearer networks to include other internets and intranets) to implement the described functionality.

[0128] Other features and advantages of the present disclosure will immediately be recognized by persons of ordinary skill in the art with reference to the attached drawings and detailed description of exemplary embodiments as given below.

Exemplary Network Architecture

[0129] As a preliminary matter, it is useful to understand extant cable system topology and operation so that the various aspects of the present disclosure may be more clearly distinguished and contrasted.

[0130] Under existing paradigms, network operators deliver data services (e.g., broadband) and video products to customers using a variety of different devices, thereby enabling their users or subscribers to access data/content in a number of different contexts, both fixed (e.g., at their residence) and mobile (such as while traveling or away from home). FIGS. **1**A and **1**B are functional block diagrams illustrating a typical prior art managed (e.g., HFC) content delivery network architecture used to provide such data services.

[0131] In such networks, data/content delivery may be specific to the network operator, such as where video content is ingested by the network operator or its proxy, and delivered to the network users or subscribers as a product or service of the network operator. For instance, a cable multiple systems operator (MSO) may ingest content from multiple different sources (e.g., national networks, content aggregators, etc.), process the ingested content, and deliver it to the MSO subscribers via their hybrid fiber coax (HFC) cable/fiber network, such as to the subscriber's set-top box or DOCSIS cable modem. Such ingested content is transcoded to the necessary format as required (e.g., MPEG-2 or MPEG-4/AVC), framed and placed in the appropriate media container format ("packaged"), transmitted via e.g., statistical multiplex into a multi-program transport stream (MPTS) on 6 MHz radio frequency (RF) channels for receipt by the subscribers via RF tuners, de-multiplexed and decoded, and rendered on the users' rendering devices (e.g., digital TV) according to the prescribed coding format.

[0132] Within the cable plant, VOD and so-called switched digital video (SDV) may also be used to provide content, and via utilization of a single-program transport stream (SPTS) delivery modality. In U.S. cable systems for example, downstream RF channels used for transmission of television programs are 6 MHz wide, and occupy a multitude of 6-MHz spectral slots between 54 MHz and 860 MHz. Upstream and "out of band" communications are normally relegated to the lower end of the available spectrum, such as between 5 and 85 MHz. Deployments of VOD services have to share this spectrum with already established analog and digital cable television services such as those described above. Within a given cable plant, all homes that are electrically connected to the same cable feed running through a neighborhood will receive the same downstream signal. For the purpose of managing e.g., VOD services, these homes are grouped into logical groups typically called Service Groups. Homes belonging to the same Service Group receive their VOD service on the same set of RF channels.

[0133] VOD service is typically offered over a given number (e.g., 4) of RF channels from the available spectrum in cable. Thus, a VOD Service Group consists of homes receiving VOD signals over the same 4 RF channels.

[0134] In most cable networks, programs are transmitted using MPEG (e.g., MPEG-2) audio/video compression. Since cable signals are transmitted using a Quadrature Amplitude Modulation (QAM) scheme, available payload bitrate for typical modulation rates (e.g., QAM-256) used on HFC systems is roughly 38 Mbps. For example, in many VOD deployments, a typical rate of 3.75 Mbps is used to send one video program at resolution and quality equivalent to NTSC broadcast signals. In digital television terminology, this is called Standard Definition (SD) television resolution. Therefore, use of MPEG-2 and QAM modulation enables carriage of 10 SD sessions on one RF channel (10×3.75=37.5 Mbps<38 Mbps). Since a typical Service Group

consists of 4 RF channels, 40 simultaneous SD VOD sessions can be accommodated within a Service Group.

[0135] Entertainment-quality transmission of HD (High Definition) signals requires about four times as much bandwidth as transmission of SD signals. For an exemplary MPEG-2 Main Profile-High Level (MP@HL) video compression, each HD program requires around 15-Mbps bitrate.

[0136] Hence, in sum, existing cable systems utilize what in effect amounts to an FDM system with 6 MHz channels and roughly 700 MHz of available bandwidth capacity in total, each of the channels being QAM modulated and delivered to the end user via e.g., a tree-and-branch type of topology, with user's CPE (e.g., digital settop boxes, DOCSIS modems, and gateways) utilizing RF tuners to tune to the appropriate DS channels to receive their respective data or program streams. As previously noted, this approach has limitations on its capacity, and hence can only be expanded so far in terms of available bandwidth (both DS and US), and serving additional customers with additional services.

[0137] Accordingly, a new model is needed. As shown in the exemplary frequency plan **200** of FIG. **2**, various embodiments of the present disclosure utilize two bands **202**, **204** each comprised of four (4) 160-MHz-wide channels **210**, the two bands as supported by each of two (2) 802.11ax-based APs (see discussion of FIGS. **4-5** infra), can each provide a symmetric data service at the rate of 4.8 Gbps. Due to extant silicon limitations in current 802.11ax chipsets as of the date of this disclosure, the entirety of the 4.8 Gbps bandwidth cannot be allocate to a single user; however, such capability is incipient, and the present disclosure explicitly contemplates such configurations. However, even under the existing silicon, two (2) users can each utilize up to 2.4 Gbps in parallel. Therefore, the two (2) 802.11ax APs can provide a very high data rate service by utilizing the two sets of four (4) 160-MHz channels.

[0138] Moreover, the frequency use plan **200** of FIG. **2** includes provision for other functions (in addition to symmetric or asymmetric primary band uses), including support of cellular waveforms provided via 5-85 MHz band **206** (which as noted previously is generally used for upstream data communication for DOCSIS or OOB communication in traditional cable systems), as well as data communication via one or more ISM bands **208** (e.g., at 902-928 MHz).

[0139] As will be described in greater detail below, the cellular band(s) **206** can support transmission of e.g., 3GPP 4G/4.5G/5G waveforms to and from the customer's premises, in effect making the MSO's system a huge DAS (distributed antenna system) for a cellular operator or MNO, or even the MSO itself when acting as a wireless service provider. For instance, in one such model, the MSO may use 3GPP-based technology as an underpinning for providing unlicensed or quasi-licensed service via e.g., NR-U bands, CBRS bands, C-Band, or even mmWave bands to its users or subscribers.

[0140] Similarly, the ISM band(s) **210** within the frequency plan **200** provide a number of different functions to aid in, among other things, CPE control and fault detection by the MSO.

[0141] As shown in FIG. **2**, the overall spectrum utilized by the plan **200** is on the order of 1.6 GHz, roughly twice that of a typical MSO cable band under the prior art. Notably, the portions of the extant HFC architecture leveraged as part of the architectures of the present disclosure are not inherently limited by their medium and architecture (i.e., optical fiber transport ring, with coaxial cable toward the edges); coaxial cable can operate at frequencies significantly higher than the sub-1 GHz typically used in cable systems, and such additional bandwidth is made use of in the exemplary embodiments described herein.

[0142] Further, the foregoing spectrum of e.g., 1.6 GHz in bandwidth can be divided between multiple (e.g., two (2)) sub-nodes to allow, inter alia, a spectrum use plan that can be advantageous in providing data services that are more tailored to user premises and/or applications being served. For example, as shown in the embodiment of FIG. **2**A, the plan **220** allocates approximately 700 MHz of bandwidth to one sub-node (Node **1**) **222** while allocating another approximately 700 MHz of bandwidth to another sub-node (Node **2**) **224**. The division can be used for a multitude of purposes, including e.g., providing high-capacity data services to different parts of one or more user premises, via two or more nodes providing different paths (including combining or alternating such paths to provide e.g., additional reliability through redundancy), as discussed in more detail elsewhere herein.

[0143] As can be seen in FIG. **2**A, one sub-node **222** can be allocated e.g., 640 MHz of bandwidth **226** that can be serviced by one (1) 802.11ax AP, while another sub-node **224** can be allocated another 640 MHz of bandwidth **230**. As discussed further herein, each node can generate and/or provide its own data to be transmitted via ISM band **228**, which is a shared-use channel. Accordingly, each sub-node **222**, **224** can utilize the ISM band **228** as shown in FIG. **2**A, to e.g., send control data. Furthermore, the cellular band(s) **232**, as introduced with respect to FIG. **2** above, can also be divided between the two sub-nodes **222**, **224** as needed by e.g., utilizing one or more carrier signals or bands for each sub-node **222**, **224** (e.g., in 20 MHz wide slices) as shown in FIG. **2**A.

[0144] FIG. **2**B illustrates yet another embodiment of a frequency plan **250** according to the present disclosure. In this plan, there are four (4) nodes **222**, **224**, **252**, **254** which are each allocated a cellular band, two sub-band portions (of the four total comprising the bandwidth **226**, **230**), and use a common ISM band **228**.

[0145] It will also be appreciated that the attenuation associated with any coaxial cable infrastructure is a function of, inter alia, coaxial conductor length, and hence higher levels of "per-MHz" attenuation may be acceptable for shorter runs of cable. Stated differently, nodes servicing (or serviced by) shorter runs of cable may be able to better utilize the higher-end portions of the RF spectrum (e.g., on the high end of the aforementioned exemplary 1.6 GHz band) as compared to those more distant, the latter requiring greater or disproportionate amplification. As such, the present disclosure also contemplates embodiments which make use of selective mapping of frequency spectrum usage as a function of total cable medium run length or similar.

[0146] Accordingly, referring now to FIGS. **3**A-**3**D, various embodiments of an enhanced service provider (e.g., cable MSO) network architecture making use of the exemplary frequency plans of FIGS. **2**-**2**B are shown and described in detail. As described in greater detail subsequently herein, each of the architectures **300**, **320**, **340**, **360** of FIGS. **3**A-**3**D make use of an existing, developed technology "ecosystem" as a basis of its new data and signal processing and delivery capabilities (in both DS and US

directions). This use of much of the existing "last mile" of infrastructure, and existing high-performance wireless components, advantageously obviates much of the previously discussed long development cycles and R&D costs associated with developing components from "the ground up," and accordingly each greatly enhances customer service velocity (i.e., the rate at which new services and capabilities can be added to the system) as well as customer satisfaction and loyalty.

[0147] In a first embodiment illustrated in FIG. **3**A, the improved network architecture **300** according to the present disclosure includes a headend **301**, optical fiber distribution network **303** (e.g., DWDM ring or similar), and a plurality network nodes **302** connected to the network/ring **303** within the MSO network (such nodes which may be e.g., near edge portions of the network, or further towards the core, depending on configuration and the particular portions of the network served). Furthermore, the architecture **300** also includes a plurality of amplifiers **306**, which are used to compensate for transmission losses due to the coaxial medium **305** by amplifying the signal in the downstream and upstream directions as required. The architecture **300** also includes a multitude of served CPE **308**, which are used to process and transmit signals to end users as described in greater detail below.

[0148] As shown in FIG. **3**A, in one embodiment of the network architecture **300**, the network nodes **302** are backhauled by optical fiber, although this is merely illustrative, as other types of backhauls may be used (e.g., RF wireless such as mmWave systems, or Metro Ethernet with twisted copper).

[0149] Also included in the architecture **300** of FIG. **3**A are controller entities or processes **314***a*, **314***b*, **314***c* which are in logical communication with one another via e.g., the distribution network architecture. As described in greater detail below, these controller processes enable, inter alia, control by a headend controller **314***a* of the nodes and amplifiers for configuration and re-configuration of the devices during operation, such as to reallocate frequency spectrum, change modulation/coding schemes (MCS) on the various devices, and enable ISM-band based functionality.

[0150] Returning to FIG. **3**A, a plurality of taps (not shown) and the amplifiers **306** are utilized to distribute signals to the multitude of CPE **308**, which may be disposed as groups of individual premises/customers **310** with respective CPE **308** served by a given amplifier and "branch" of the coaxial topology, or alternatively as groups of CPE **308** within aggregated premises such as MDUs, enterprise or educational campuses or similar **312**. As shown, in the case of the MDUs/campuses **312**, the target premises includes an indigenous coaxial cable network (whether star, tree, or other topology), such as may have been installed at time of construction of the building(s) served. It will be appreciated that any number and topology of network nodes **302**, taps, amplifiers **306**, and CPE **308** can be used to deliver high-capacity data services to the CPE **308** that are disposed at customer premises of residential customers as well as enterprise, educational, government/military, or other types customers.

[0151] The MSO network architecture **300** of FIG. **3**A is particularly useful for the delivery of packetized content (e.g., encoded digital content carried within a packet or frame structure or protocol) consistent with the various aspects of the present disclosure. In addition to on-demand and broadcast content (e.g., live or "linear" video programming), the system of FIG. **3**A can deliver and receive Internet data and OTT (over-the-top) services to the end users via the Internet protocol (IP), although other protocols and transport mechanisms of the type well known in the digital communication art may be substituted. Moreover, as discussed in greater detail below, the architecture also includes provision for cellular service, ISM band service, and WLAN backhaul, as well as supporting low-latency functionality of the user such as distributed gaming and AR/VR application support.

[0152] The architecture **300** of FIG. **3**A further provides a consistent and seamless user experience with IPTV or streaming media over both wireline and wireless interfaces. Additionally, in the IP paradigm, dynamic switching between unicast delivery and multicast/broadcast can be used based on e.g., local demand. For instance, where a single user (device) is requesting content, an IP unicast can be utilized. For multiple devices (i.e., with multiple different IP addresses, such as e.g., different premises), multicast can be utilized where similar content is delivered. This approach provides for efficient and responsive switching of delivery and obviates other more equipment/CAPEX-intensive approaches.

[0153] Moreover, the architecture can be used for both broadband ("Internet") data delivery as well as simultaneous delivery of "content" (e.g., movie channels), and obviates much of the need for a separate infrastructure for "in band" and DOCSIS (and "out of band" (OOB)) transport.

[0154] In certain embodiments, the service provider network **300** also advantageously permits the aggregation and/or analysis of subscriber- or account-specific data. As but one example, device-specific IDs can be cross-correlated to MSO subscriber data maintained at e.g., the network head ends (not shown) so as to permit or at least facilitate, among other things, (i) user/device authentication to the MSO network; (ii) correlation of aspects of the area, premises or venue where service is provided to particular subscriber capabilities, demographics, or equipment locations, such as for delivery of location-specific or targeted content or advertising; and (iii) determination of subscription level, and hence subscriber privileges and access to certain services as applicable. Moreover, device profiles for particular devices can be maintained by the MSO, such that the MSO (or its automated proxy processes) can model the device for wireless or other capabilities.

[0155] FIG. **3**B illustrates another embodiment of the network architecture **320**, wherein both groups of individual premises **310** and MDUs or similar **312** are served. In this embodiment, one or more "local" nodes **302***a* are used to deliver MSO data and signals directly to the MDU **312** and its local (premises) coaxial distribution network without need of an interposed amplifier **306**. For instance, the MDU **312** may have an optical fiber drop (e.g., FTTC or FTTH) node proximate thereto or serving the premises (whether via the MSO as in FIG. **3**B, or a third party service provider network **344** as shown in FIG. **3**C), such that the node **302***a* can be used to directly serve the MDU premises **312**, such as being mounted on a utility pole proximate the premises, or in the case where the node **302***a* serves only the premises, integrated within the premises itself (e.g., in a telecommunications service ingress/egress room or similar).

[0156] In yet other configurations (not shown), the node **302***a* may be associated with a wireless backhaul (e.g., a

roof-mounted antenna/FWA apparatus, such as one utilizing quasi-licensed CBRS spectrum for backhaul).

[0157] It will also be recognized that the node **302***a* may be dedicated to a given premises or MDU **312** (e.g., a "micro-node"), or alternatively be scaled accordingly to serve multiple local MDUs **312** (not shown).

[0158] In the architecture **340** of FIG. **3**C, one or more nodes in direct communication with the MSO optical network **177** serve a plurality of premises and CPE **308** via one or more interposed amplifiers **306**, while one or more MDUs **312** are served by "direct feed" nodes **302***a*, the latter backhauled by a third-party service provider network **344** such as a FiOS or FTTC provider separate from the MSO.

[0159] FIG. **3**D is a functional block diagram illustrating an exemplary embodiment of a client-side architecture **360** (in the context of an MDU) served by a service provider network architecture such as one of those of FIGS. **3**A-**3**C. As shown, the node **302**, which may be backhauled by e.g., an optical fiber network of the MSO or another service provider, acts as both (i) a backhaul for the MDU **312** and its individual subscribers/users **366***a*, **366***b*, **366***c*, as well as (ii) an ad hoc access node for e.g., WLAN clients (i.e., those operating in one embodiment in the unused 2.4 GHz band associated with the 802.11ax chipsets of the node) as well as user mobile devices such as 3GPP-compliant UE (i.e., the node **302** acts as a cellular repeater or DAS of sorts) by virtue of the node's 3GPP functionality described in greater detail below with respect to FIGS. **4**-**8**).

[0160] In terms of MDU premises services, the node **302** may backhaul UE **372** (whether operating in a licensed cellular band or in an unlicensed or quasi-licensed band such as an NR-U or CBRS or C-band), user mobile WLAN devices such as tablets **369**, smart TVs **370** with WLAN capability, and IoT devices such as gateways **379** and/or IoT client devices **378**. Various other served premises configurations will be appreciated by those of ordinary skill, including those described further herein with respect to e.g., FIGS. **9**-**12**.

[0161] It will also be appreciated that the frequency plan **200** of FIG. **2** may be constructed so as to co-exist with other premises media or protocols which may utilize the indigenous cable medium such as e.g., MoCA 2.0, 2.1, 2.5, or 3.0 systems (whether using channel bonding or otherwise). For instance, in one approach, dynamic spectrum utilization (e.g., for the upper band **204**) may be programmed to avoid certain bands which are being utilized or may be occupied by the other systems. In one variant, the controller (discussed below) is informed of such actual occupied or putatively occupied bands by e.g., the MoCa adapter or other such device operative in the premises. In another approach, an LBT or similar medium access approach is used to avoid contention with such systems.

[0162] Moreover, while shown primarily in optical backhaul configurations (e.g., the node(s) **302** acting as the boundary between the optical of RF coaxial domains), the nodes **302** may be adapted to utilize other backhaul.

[0163] In another aspect of the disclosure, an architecture for providing high data rate, low latency coverage to e.g., large indoor spaces such as office buildings, enterprises, universities, MDUs, etc. is disclosed. One implementation of this architecture utilizes one or more of the foregoing network nodes **302** to supply one or more CPE **308** within the enterprise, etc. via HFC infrastructure, such as a star, bus, ring, tree, or other coaxial cable topology within the served premises. The CPE, by virtue of their repeater/extender functions for cellular and WLAN, provides coverage within the structure for both cellular and Wi-Fi, as well as indoor/outdoor mobility, such as via local pole-mounted access node **302** with 4G/5G and WLAN capability. As such, the CPE collectively act as a distributed antenna system (DAS) for cellular and WLAN signals, as do the intermediary network nodes **302** disposed e.g., at or near the premises in some cases.

Exemplary Network Node Apparatus

[0164] FIG. **4** illustrates an exemplary embodiment of a network node apparatus **302** configured according to the present disclosure. As shown, this embodiment of the network node **302** includes, inter alia, a controller subsystem **402**, an Ethernet switch **404**, a cellular source **406**A, two (2) 4×4 802.11ax chipsets **408**, an ISM transceiver **410**, one or more frequency shifters **712**, one or more splitters **414**, diplexers **716**, and 4×4 Wi-Fi antennas **418**, and 2×2 cellular antennas **419**.

[0165] In one variant, the Ethernet switch **404** interfaces with the fiberoptic backhaul via e.g., one or more SFP ports **413**, as well as edge compute apparatus **411** and a cellular source (e.g., of a 4G/5G signal) **406**A such as an LTE or 5G NR-based chipset (e.g., a combination of a cellular (4G/5G) baseband processor such as an xNB (eNB or gNB) modem chip and radio frequency integrated circuit (RFIC), akin to the principal components of a small cell) to the Ethernet switch interfaces with the 4×4 802.11ax W-Fi AP chipsets **408**. As previously referenced, so-called Wi-Fi 6 as available on the 802.11ax Wi-Fi APs **408** can generate carriers of up to 160 MHz of frequency bandwidth (only supported in the 5-GHz spectrum at present).

[0166] In one implementation, any resource which is not used from each of the 802.11ax APs **408** (e.g., 2.4 GHz channels, in that the 160-MHz channels are not supported for data communication at 2.4 GHz), can be used to provide ancillary functionality or services from the node, such as e.g., a Wi-Fi AP service to surrounding Wi-Fi devices (e.g., MSO subscribers who happen to be proximate to the node) via 4×4 Wi-Fi antennas **418** (see FIG. **3**D). Similarly, the cellular source **406**A can provide a local cellular repeater or extender service function (e.g., to local MSO subscribers who happen to be proximate to the node) via e.g., 2×2 cellular antennas **419**.

[0167] Additionally, one or more frequency shifter modules **412** are used within the node **302** to convert the frequency of the signal(s) to be transmitted downstream to that appropriate for the coaxial cable infrastructure. As shown in the embodiment of the frequency plan **200** of FIG. **2**, these bands may include for example 110-750 MHz and 950-1590 MHz bands **202**, **204**, although it will be appreciated that other bands may be used. Multiple frequency shifter modules **412**A-C can be utilized to process signals of different frequency bands, access schemes, and/or types of modulation schemes. For example, the signals received from the 802.11ax AP modules **408** can be of (i) a first frequency band on the cable medium; (ii) OFDM modulation, and (iii) Listen Before Talk (LBT) access type, which in part enable the previously described symmetric capabilities, while the cellular signals from the cellular source **406**A may be of either Frequency-Division Duplex (FDD) or Time-Division Duplex (TDD) access on a different frequency band on the cable (e.g., 5-85 MHz). Due to different operation modes

2012 136:25
202 143:4
2023 1:16 2:21 7:1,5 111:1 162:23
21 25:17 26:24 27:2 103:18
210 114:16,17 118:16
212.836.8689 3:21
222 143:6
224 117:20,22 143:2,3,5,5,15 143:19,20
226 143:14,19 143:21
228 117:20
23 5:15 136:25
25 21:4
250 3:19
27 20:12
28 1:16 2:21 7:1,5 111:1
2:09 147:9
2:22 1:7 2:7
2:31 2:21 160:11,15
2a 157:22 158:3
2b 137:15 138:12,24 143:1 159:14
2c 143:13 159:14

3

3 5:15 23:2,3 29:9,16 31:13 31:17,18 46:22 46:24,25 47:4 65:21 88:23 92:4 103:12 104:24 109:14 142:12 151:8,9 157:5,22 158:1 159:9 162:23
30 23:23 33:7
30th 23:13
312.372.1121 3:11
3300 3:9
35 25:20 26:22
355 66:14
3rd 5:18 65:20

4

4 5:17 29:17 65:3,14,19 68:15,18 69:1 84:20 94:25 105:22 121:17 121:25 122:4 122:13,17 123:16 124:23 125:2 135:5 151:8 152:15 153:24 157:18 158:10
40 24:20 26:23 138:18 152:16 153:25
41 138:18
44 16:23
45 96:19
46 93:17 94:2
47 109:3,16 157:18 158:10
48 120:4
49 157:18 158:11

5

5 5:20 94:8,9 94:12 138:21 151:8
50 109:16
55 102:23
55th 3:19
58 84:20 88:23 92:4 102:23
5890301 1:24
59 102:23

6

6 5:23 119:14 119:18 126:6 126:15
60602 3:10
61 76:23 114:10 117:19 118:2 119:5
62 29:20 84:20 88:23 92:5 117:8
63 120:4
65 5:17 34:25 37:16
68 49:2
682 6:5 10:8 136:5,15,20 146:9,11,11,21 146:22 148:8 148:12
69 46:12 48:14
690 5:23 10:4 119:12,12,22 120:4,8,8,11,19 120:21 121:5

7

7 6:5 125:8 136:5,6,12 138:22 142:12
70 3:9 49:2
7131 162:24
72 49:3
74 49:4 80:1,19 81:1,10,10,16
775 5:15 10:1 22:16 23:1,10 23:21 28:8,23 28:24 29:1,12 33:7 34:6,10 35:4 36:4 37:9 38:12,25 46:14 49:25 52:6 56:2,8,11 66:25 68:20 69:5 71:14,20 72:17 76:12,13 77:6 80:4 84:19 88:22 93:25 95:17

96:6 98:1,22 98:24 99:11,18 100:15 101:7 101:19 102:23 104:21 105:22 111:14 115:16 115:21
79 112:15

8

8 5:6 142:12
8,223,775 9:24
8,284,690 10:3
80 119:11 120:3
83 121:12 122:24 123:3,9 123:17 124:9 124:15,20,24 126:21 127:6
84 130:12
85 136:16

9

9 126:21 127:7 127:11,18,24 128:6,18 129:15,23 135:18
90 65:25 137:12,20 138:17,24
94 5:20 141:3 142:16 149:13 150:19,22 155:11,13,16
95 149:17 155:23 159:4
97 150:10
9:03 2:20 7:2,5

a

a&p 13:23
a.m. 2:20 7:2,5 56:18,21 65:10 65:13
ability 14:24 74:10 88:25 108:18 121:2
able 22:23 38:21 41:13 42:20 55:10,11 55:22 57:25 59:25 61:2 62:2 63:1 82:18,20 91:1 91:10 92:19,20 94:16 95:24 96:2 124:6 143:9,23,25 145:6 147:21 152:11
above 49:1,2,3 49:3 80:3
absolutely 16:2 77:11
academic 19:25
accept 144:18
access 65:4 66:11 93:9 95:1,4,5 100:21 114:15 118:15
accessing 16:13 93:18
accomplish 91:8 108:8
accomplished 106:2
accordance 129:17
accurate 17:17 17:20 18:2 105:10 112:13 118:1 149:7
accurately 17:8 17:11 143:24 144:25
accused 12:24 61:2 78:10 133:22
achieve 93:3
achieved 41:21
acronym 93:9 93:12 95:4
action 1:7 2:7 162:18,19
actual 16:20 24:8
actually 13:9 16:3,5,19 24:3 24:5 30:14 35:9 57:22 60:22 66:10 92:1 93:13 113:18,24 117:1 124:9 126:6 135:19 143:7,11 147:23 149:11 151:13 152:6 155:14 159:14
add 85:22 119:12 126:11 139:11
added 17:18 99:7
adding 86:4,6 86:17 87:7
addition 85:11 85:13,21 152:11
additional 13:12 17:24 29:19 85:14 87:7 116:6 117:18 118:12 132:15
addressed 40:15
addresses 136:15
adds 126:6
adjective 71:10
adjust 146:8
administered 8:2
adopt 57:18
adopted 62:13 62:24 63:10
adopting 57:16

adopts 57:24
advanced 25:5 25:11,17 26:6 27:3,8
affect 47:21
affecting 92:13
agree 7:13 23:22 28:6 30:10 44:6 47:2,6,13,23 52:14,23 53:10 53:24 54:15,21 54:22 81:21 86:4,22 87:22 90:5 97:13 100:20 101:2 106:8,14,21 108:14 113:11 126:9 128:2 133:2 143:22 144:17 151:24 152:4,14 157:8 159:5,24
agreed 47:12 48:4
ahead 62:9 94:23 157:17
air 147:18
alleged 26:11 37:21
allor 3:6 5:6 7:18,18 8:6 15:9,14 23:6 26:21 33:15 34:16 35:21 36:14 40:17 42:19 48:3 49:9 54:10 56:22 62:22 65:6,17 77:13 78:23 82:2 83:22 88:12 93:7 94:15,24 98:17 110:9 111:11 112:14 116:9 119:17 124:17 134:6 136:9 147:10 157:20 160:4
allow 58:18 120:12,12 121:2 132:16
allowance 116:18
allows 76:7,18
almeroth 1:14 2:17 5:4 7:6 8:1,8 56:23 65:18 111:6,12 147:11 160:8 160:13 161:8 161:20
alternative 154:18
ambiguity 37:4 37:23 46:5 47:18 48:23 59:22 132:24
amended 116:14,18
amount 120:24
analogous 114:12
analysis 28:4 36:8,9 58:1,5 61:17 63:11 137:2 146:17 149:15 155:13
annotated 46:13 80:4 137:15 138:18
answer 6:14 9:8,14 11:2 22:11 28:1 33:12 50:12 56:3 60:22 61:5,6 69:16 69:17 71:22 74:7,10,16 75:14 76:5 77:12 79:18 86:17,20 88:15 91:6 98:18 99:13 101:15 101:16,18 102:15,17,20 105:10 120:16 134:3,5 146:25
answered 31:14 77:4,10 77:11 79:21 81:24 102:11 123:7 157:16
answers 9:6 62:11,12
antecedent 150:9 151:20
anymore 160:4
apologize 62:7 94:21 157:23
appear 26:19 130:19 161:11
appearance 7:16
appearances 3:1 4:1 7:17
appeared 22:18
appearing 2:18 3:2 4:2
appears 25:25 89:16
appendices 21:23,24
appendix 16:21 17:5 21:25 22:7 24:1,15 25:15,16 26:22 34:17,22,22,23 35:12 56:24 95:6
apples 71:23,25 72:15
applicable 68:3 70:3 120:19
applicant 72:19 73:22 76:18 79:9,15 113:7 113:15,23 114:1,5,5,9,11 114:18,23

116:21 117:7 117:17 118:3,5 118:9,11 119:4 119:6
applied 39:22 119:23
applies 60:23 69:14 100:11
apply 22:20 35:2,7 40:19 41:7,22 42:5 42:16 45:22 53:22 61:2 72:12 75:1,19 75:25 100:24 120:10
applying 36:3 41:2 43:11 48:9 53:12,15 54:4 58:23 69:25 74:8 75:3
appropriate 45:2 114:10
april 1:16 2:21 7:1,5 111:1
architecture 52:8
argued 125:20
argument 60:15 119:7 150:6 157:12
arguments 118:22
arm 24:24 25:3 25:9,23 26:6 27:20,24 28:6 28:16,20,23 29:9,15,23 31:15 32:1,6,8 32:19,20 46:22 46:24,25 47:4 55:2,3 109:4 109:18,25 110:8
arm1 29:17 30:11,14,20,24 85:18 109:11 112:4
arm2 29:17 30:11,14,20,25 85:19 109:11 109:12 112:5
arm3 29:18
arm9 31:20,24 32:24 103:15 108:23 109:12 109:19,23 110:5
arm940 103:22
arnold 3:16 7:23 13:2
arnoldporter.... 3:22
art 27:19 28:7 28:12,22 31:9 36:25 37:7,13 41:12 42:16 43:5,9 44:24 46:9 58:8,19 59:18 60:4 61:15,19 62:20 63:5 67:15,21 69:2 76:21 81:7,19 83:19 84:16 94:2 95:21 104:12 104:19 105:15 113:17 115:7 115:16 116:8 116:25 117:5 120:9,19 144:2 144:17 148:6 150:4,18 151:10,16 155:10 156:20 156:25
articulate 128:23
articulated 101:5
asb 114:16,17 118:16
aside 69:6,7 114:24 151:19
asked 10:23 21:15 68:19 77:10 78:20 81:24 92:18 99:10,11,25 102:13,21 123:7 131:1
asking 25:12 32:5 36:12,15 50:10 69:22 71:18 73:5 75:4 77:21 79:17 82:4 87:5 91:20 92:2 96:15 98:18 99:8 100:5 101:6 102:18 122:6 130:4,6,9 132:13,20 137:6 143:8 159:7
aspect 60:14 104:4
assign 154:3
assigned 137:23 158:12
assignment 14:8
associated 56:7 97:18 100:13 128:11 131:20
assume 79:17 134:12 136:20 141:9,10
assumed 23:12 23:21 119:25 136:23
assuming 122:6 142:8
assumption 79:20 137:1
assumptions 79:24

attached 15:7 15:12 17:4 23:4 65:15 93:20 94:13 119:15 136:7 161:12
attempting 35:2 41:7 42:16 58:8 115:9
attendees 3:2 4:2
attorney 3:18 7:16 9:15 162:19
attorneys 3:8 13:3,23
attributing 117:22
audio 7:12
available 22:17
aware 116:10
axis 159:15

b

b 21:25 34:22 140:2,18,19
back 56:20 58:14 60:21 80:13 99:12 111:12 116:12 117:15,17 127:2 129:8 133:4 134:1 144:11 146:11 146:24 147:8 154:22 156:4
background 27:4,13
band 159:15
bands 138:10
barbara 1:15 2:20 7:1 111:1
based 30:25 31:21,24 32:4 32:6,9 38:22 52:1 69:18 79:8 98:22 103:15,22 105:15 108:23 109:12,20,24 110:5 121:3 122:16 133:13 137:9 146:16 148:18 150:2,5 151:23 152:1,2 152:7,8,12,15 154:25 155:5,7 155:7 156:21 156:22 157:1
bases 31:12
basically 29:17
basing 23:19
basis 62:7 76:25 114:22 141:20 150:9 151:20
bates 23:7
bears 23:7
beginning 2:20 7:16 15:22
behalf 2:17 7:19
believe 10:13 11:10 12:13,22 13:17,20,24 14:3,17 17:4 17:10,13,20 18:7 21:11 29:13 33:2,25 39:10 44:2 61:5 94:11 98:20 102:14 108:22 109:2 109:13 113:1 121:14 131:8 132:9 136:25 139:1 148:8,25 151:15
believed 58:9
benyacar 3:17 7:22,22 12:3 26:15 33:10 34:14 35:19 36:11 40:7 42:9 48:1,7 54:1 62:6 65:4 65:8 77:10 78:14 81:24 83:14 88:9 92:15 94:20 98:15 112:11 115:22 119:24 123:7 134:2 147:4 157:15 160:7
best 12:16 149:22 154:18 156:9,11,13
better 130:10
beyond 32:7 91:20
bit 19:1 28:19 30:22 118:7 123:21 126:17
bits 147:19
block 29:3,4,24 52:7 76:4 103:7 104:1,1
blocked 104:13
blocks 76:4 103:3,8,10,11 103:25 104:6 104:15,17 105:2,12,19 117:20
board 38:5 45:17 80:17 83:24 105:7
boards 59:17 83:13
bottom 120:22 157:5 158:1
boundaries 38:22,24
box 29:25 30:8 30:15 40:6 46:20,24,25 47:1,10,10,13 47:15 49:10,13 49:17 52:11

54:11 55:2
59:5,6 60:2
80:7,11,14,16
81:2,3,3,17,18
81:21,22 82:4
87:11 99:21
boxes 29:25
46:17 58:5,15
59:16 61:8
81:12
break 56:16,23
110:11 147:3
breaked 147:11
briefly 62:14
broad 44:12
88:18 116:1
broadband
20:4
broadcasting
95:12
broader 28:19
brooks 77:1
113:8 114:16
114:19,22
116:21,22
117:9 118:22
brown 4:5 7:7
build 141:21
154:6
bus 40:9,10,25
63:23 76:24
111:19 112:7
112:17,22,25
113:6,8,12,12
113:13,14,19
114:6,7,18
115:1,11
118:16,20
bypass 55:10

c

c 22:7 24:1 25:8
25:15,16 26:22
34:17,22,23,23
35:12 56:24
67:7 70:20,25
72:9 140:18
cable 18:5,10
18:21 19:2,16
19:20 20:3,19
24:6 29:25
30:4 39:2,7,20
40:23,24 41:1
42:12,23 50:15
50:16,24 51:2
51:15 52:8
54:12 58:23
59:12 60:10
63:24,25 64:1
67:10,11 68:9
72:4,6 76:14
77:6,18,25
78:2,4,10,12
79:2 80:7,15
81:4,22 82:12
83:3,6 85:1,5,8
85:15,17,18,24
86:7,19,23
87:6,8,18,21
89:1,8,20,23,25
90:1,15,17,20
90:24 91:4,7
91:22 92:10
100:1 102:25
103:1 105:6
106:5,6,16,19
106:19,23,23
107:2,4,7,11
108:17,20
111:20,25
112:7 113:20
115:1,11
117:14,22
119:8 133:1,4
133:8,11,19
134:1 137:18
137:23 138:3
138:20 139:2,8
139:14,21,22
140:1,4,8,13,15
140:17,19,20
144:22,24
145:3,8,19,21
147:16 153:4
153:17 154:2,3
154:10,14
california 1:15
2:20 7:1 111:1
162:2
call 27:14
29:18
called 29:25
123:20
calling 150:15
calls 99:23
caption 7:10
carrier 138:22
carriers 138:21
carry 35:14
38:15 39:16
41:4 57:12
59:4 60:25
case 7:10 10:14
10:16 12:21
13:10,11 18:8
18:14 72:2
79:18 123:15
138:1,2,6,9,9
138:11,15
139:2,7,15,17
139:19 140:12
140:14,20,23
141:6,8,15,16
141:20,22,23
142:2,5,21,23
143:8,9,10,16
144:1,4,6,7,19
145:7 147:24
148:1,19 149:6
149:9,11,20,22
149:22,25
150:3,5,13,16
150:17 151:3,7
151:8,11,13,17
151:23 152:1
152:22 153:1,5
153:7,9,10,14
153:16,17,20
154:6,6,10,11
154:12,17,18

155:1,5,8,12,15
156:7,9,9,10,11
156:18 159:2
159:20 162:15
cases 11:6,8,11
11:11 13:6,13
13:13 17:19,22
18:3,9,17
19:19
certain 37:17
109:4 115:17
116:8 117:6
146:15 156:24
certainly 18:23
26:2 28:9,12
43:6 52:21
74:24 97:16
104:16 108:7
certainty 34:10
35:6 36:5 37:2
38:8 41:13
47:22 49:7,18
50:13 57:20,21
58:12,20 61:16
63:6,7 73:24
79:12 152:9
156:23
certified 2:22
162:1,3
certify 162:4,17
cetera 137:4
138:22
challenge 96:6
115:9
change 119:3
channel 145:15
148:1
characteristics
32:7
characterizati...
36:13,21 71:3
71:5 80:24
90:25 97:23
112:13 120:25
characterize
19:21 33:4
89:16
charter 1:8 2:8
7:11,23 11:16
12:14,18 13:3
13:8,16 14:1,2
18:14,23 19:4
19:11,16 23:8
check 116:12
117:16 127:4
145:20 146:24
checking 61:9
chicago 3:10
chip 38:5 45:17
74:3,13,18,24
75:5 84:23
85:1,5,12,14,21
85:23 86:5,11
86:13,14,15,24
86:25 87:6,8
87:12,14,19
88:2,6,6,13,14
107:19
chips 76:8 85:9
85:10,17 86:2
86:3
choose 94:4
circuit 34:3,8
34:12,20,25
35:3,10,13,24
36:3,20 37:5,8
37:10,12,14,19
37:20,24 38:2
38:4,6,12,19,22
38:24 39:2,3,7
39:8,15,18,21
40:2,3,12,13,22
40:24 41:3,5
41:10,11,12,15
41:16,18,19,23
42:7,7,11,13,14
42:21,25 43:2
43:3,9,17,25
44:3,9,13,16,20
45:3,7,9,15,17
45:19,25 46:11
47:7,13,14,15
47:19,24 48:5
48:10,19,20,22
48:25 49:12
50:2,7 51:1,2,5
53:8,11,13,14
53:16,18,19,20
53:22,25 54:4
54:6,8 55:18
56:5,25 57:6,7
57:10,17,19,23
58:10,16,16
59:3,11,13,21
60:25 61:21,23
63:4 66:1
80:13,16 81:7
81:14,15,19
83:12,13,13,17
83:18,24 84:7
101:11 113:9
113:10 115:15
115:20
circuitry 72:10
72:22,25 76:3
76:16 77:2,8,9
79:4
circuits 35:18
36:1 38:4 41:5
43:19,22 44:11
44:23 45:1
47:17 48:11,17
53:13,18 54:6
54:7 59:7,16
59:23 63:14
72:21,24 73:12
73:20 74:3,6
74:13,14,17,24
75:5,11,21
76:8 77:3
79:12 83:24
105:8 115:14
circular 50:19
citation 26:24
148:10
cite 24:11 26:22
155:25

cited 12:1 21:13 119:5
city 161:15
civil 1:7 2:7
claim 9:20 14:11 22:4 27:15 35:7 36:10,17 37:1 37:4 38:17 39:1,10,11,13 40:4,8,21 41:7 41:14,17,20 42:18 43:21 46:9 48:12 55:9,23 56:13 57:14,22 58:18 58:20,21 59:8 59:9,10,15 60:1,4,6,11 62:23 63:1,21 64:11 67:9,22 67:25 68:16 69:3,6 72:3,12 73:6,15,16,22 73:25 74:9,22 75:3 76:12,13 77:5,18,22,25 79:3 81:14 82:8,11,18,21 83:2,9,11 84:5 84:15,16,17 102:2,7,8 107:10,13 108:3,5,7 111:16,18 112:16,19 113:1,3,11 114:7,20,25 116:7 118:20 121:4,5,7,11,14 122:1,5,16,24 123:3,4,17 124:18,25 125:20 126:2,6 126:9,10,11,13 126:14,15 127:11,23,24 128:2,6,9,10,18 129:8,15,21,23 130:3,7 134:12 134:14 135:16 135:18,18 137:23 142:20 144:3 148:12 149:2 150:13 151:24 152:5 152:13,24 153:10,13 154:23,23 155:4,21 158:17,24 159:5,24,25
claimed 57:22 84:8
claiming 37:5 37:19 81:15
claims 26:1 35:5 36:4,6 37:8,18,18,19 38:7,10,18 40:1,4 43:4 45:5,23 46:7 46:11 47:22 49:8,19 61:2 61:13,16,20,22 62:1,17,19 63:8,11 75:1 76:17 79:11 81:20 82:25 83:16 96:12,18 97:12 101:19 102:5,15 110:4 113:13,18 114:3 115:8 116:13,18,22 117:2,2,4 126:21 127:6 127:11,18,18 130:18,18 131:16 132:3 132:16 133:21 136:1,4 141:19 146:14 147:1 148:8
clarification 18:16 100:4
clarity's 145:11
clause 112:20 113:5 115:10
clear 46:8 48:13 50:25 60:3,6 63:16 64:9 73:15,23 76:17,20 79:11 96:7,21 102:2 107:14 113:24 114:21 117:5 118:2,18 137:1
clearly 81:4 101:4
close 149:8
cm 158:22
cm's 158:15,16
cma 138:20,20
cmac 117:21,24
cmb 138:22 140:1
cme 30:5,8,12 30:19 54:12,15 80:17,22 107:19 112:23 113:6 114:12 118:12,17
cms 158:12,14
cmts 133:1,4,8 133:19 137:23 148:16 158:18
collaboration 20:24
collaborations 19:22 20:2
colleagues 7:20
collected 153:4
collection 139:21
collisions 95:11
color 71:25
column 29:16 29:17 31:13,17 31:18 84:20

88:23 92:4 102:22 103:12 103:18 104:24 105:22 109:14 120:4,23 125:8 131:11,14,17 132:20 152:15 153:24 157:5 157:18,22 158:1,10 159:9
combination 35:15 42:1 43:13 61:24 139:12 142:24
comcast 18:24 19:11,13,16
come 19:9 58:14 125:24 125:24 130:16 145:15
comes 70:18 153:1 156:21
coming 116:20 122:14,16,20
committees 17:24,25
commonly 22:4
communicate 77:14,19 78:1 78:11,16,18 79:5 98:4 133:3
communication 16:7 18:5,11 20:4,20 78:3 124:7 159:22
communicati... 1:5,8 2:5,8 7:10,11,19,24 18:22 145:19
companies 19:17,19,23 20:9
compare 129:21 130:6 147:18
compared 143:19
comparing 71:23
comparison 71:24
complete 21:11 72:4
completely 64:2,7 67:9,11 67:22 68:8,10 69:2 72:20 79:14 83:20 89:24 90:18 92:24 113:22 113:24 115:13
completion 162:15
component 152:18
components 35:16 42:2 43:13 50:5 61:24 74:5 76:21 80:17 117:18
composed 53:13
composite 138:1,2,13 139:1,6,12,21 140:22 141:21 142:22,23 144:7,20,23 148:17 149:5 149:11,14,18 149:19,20 150:1,4,12,12 150:15,16 151:13,20,22 151:25 152:18 152:23 153:7 153:15,20 154:6,9,24 155:15,18 156:2,3,5,7,17 156:18 158:13 158:19,21,25 159:2
comprising 129:20,25
computer 5:18 5:20 15:23 16:12 22:8 24:2 25:7,17 27:23 34:19 35:23 38:14 45:15,17 56:25 60:24 61:23 62:25 65:19 94:10 100:22
concept 88:16 92:3 104:16
concluded 160:15
concludes 160:12
conclusion 131:3
condition 92:25 144:14
conferences 17:25
confirm 16:19 16:21
confusing 123:21
confusion 123:9
connect 113:6
connected 74:18
connecting 72:10,25 76:16 77:8 79:4 113:20 115:1
connection 156:14
connects 40:25 63:23 111:19 112:22
connor 7:21
consider 32:17 33:13,16 51:4

64:12 74:5 83:25 84:4 101:10 153:12
consideration 116:23
considered 33:14 45:19 51:1 72:19 75:6 115:6 116:5 117:19 118:24 159:19
considering 73:6
consistency 68:22
consistent 37:15 47:15 67:18 68:19 80:19 104:18 104:20 106:10 107:9,12 121:17,24 131:25 133:8 135:10 159:13
consists 35:23 35:25
constitute 41:16,23 43:22 52:3
constitutes 41:15
constraint 53:5 55:21 91:15
constraints 55:20 78:7 91:9
construction 9:20 14:11,16 22:4 25:24 27:16 36:10,17 39:23 40:20 60:24
construe 38:11 57:5,10
construed 39:15 61:21
contact 14:2
contained 53:19 89:21 90:16 138:17 161:13
containing 141:11
contains 49:11 50:16
contemplated 146:13
contend 20:17
content 19:5,6 19:7 131:22
context 21:12 26:10,19 27:5 27:18 28:21,23 32:21 33:19 34:5 35:3 36:4 37:8,20 40:2 43:15 44:4 45:2,9,11,23 48:14 56:7,7 64:10 66:25 67:4,23 68:1 69:3,4 70:17 72:16 73:6,9 73:21 74:8,21 75:16,17,25 76:11 77:15 78:20 80:12 81:11 85:16,17 88:19,21 91:16 95:16 96:23 98:1,12,13,21 99:11,14,22 100:8 101:8,19 115:16 116:2 122:5 125:7 133:1,24 141:18 144:6,9 147:16,17 149:23 150:25 152:13 153:6 153:13 154:19 155:10 158:17
contexts 70:22 100:11
continued 4:1 6:1 61:10
continues 42:12
contrast 130:6
control 93:10 95:1,4,5
controller 25:7 31:3,6 51:20 52:3 55:2,11 55:13,15 76:23 82:19,23 83:8 85:19 96:7,12 96:14,24 98:9 98:10,14,19,25 99:3,7,9,13,17 99:19,21,24 100:1,2,5,9,11 100:13,17,20 100:25 101:1,2 101:6,14,22 102:3,9 103:5 103:11,18,21 107:18,21,25 108:10 114:15 118:15
controllers 100:6,7
conveyed 92:3 104:23
copy 80:4
copyright 11:11 12:24,25 65:22
core 32:20
corner 140:1
correct 17:1 23:20 25:1 37:12 40:6 44:23 80:8 84:23 86:11 88:7 97:22 106:17 114:2 117:16 124:20 124:24 134:23 140:22 161:13

corrected 17:3 161:13
corrections 161:11
correctly 125:18
corresponding 148:20 151:18 154:3
cost 85:7,9
counsel 12:2,8 22:1,9
couple 11:10,11 13:12 17:22,24 21:22 29:21 92:19 111:15 142:15
course 16:14 19:6
court 1:1 2:1 7:7 8:25 9:7 10:25 38:11 39:22 42:4 57:10,16,18,24 60:23 61:21 62:12,24
cover 15:22 113:18 130:19
covered 159:5
covers 146:12
cox 19:3,11,16
create 46:5 47:22 67:6 86:7,19 113:16 115:5 121:2
created 135:13
creates 36:5 45:11 49:23 57:19 82:16 83:8,21 84:16 100:19 114:2 118:19 135:17 152:9,10 156:23
creating 129:5
creation 132:5 132:8
cross 145:16
csr 1:23 162:25
curious 18:19
current 18:8 35:14 38:16 39:16 41:4 57:13 59:4 61:1 85:10,16 87:5
cv 1:7 2:7 17:4 17:8,14 18:12

d

d 67:7 70:20,25 72:9 140:18
data 24:6 29:4 39:1,6,17 40:5 40:9,10,21,25 41:1 42:22 46:21 47:3,5,7 47:11,24 49:11 50:1,6,16 51:1 51:10,11,13 55:12 59:10 63:23,23 64:4 72:6,10,22,25 76:15,16 77:7 77:8,9,19,25 78:4,12 79:2,4 82:22 89:1,7 89:22 90:16,23 91:2,24 92:11 95:11 97:18 106:3,3,21 107:16,23 108:17 111:19 111:19 112:7,8 112:17,22,25 113:6,8,12,12 113:13,14,19 113:20 114:6,7 114:14,18,19 115:1,2,11,13 117:12 118:14 118:15,17,20
date 23:10,11 23:13,13,20,23 33:6 65:22 94:11 119:23 120:2 136:20 137:3,6 162:20
dated 162:23
david 3:17 7:22 12:12 160:5
david.benyacar 3:22
day 161:14
december 120:2
decides 57:10
declaration 5:13 9:19,22 10:13 11:25 12:1,2 14:5,7 14:16,20,23 15:10 16:21 17:1,19,21 20:12 21:5,8 21:10,13,14,17 21:19,24 22:10 23:9,16,17 24:2,12,21 25:15 26:7,8 26:14,17,20,23 27:5 28:5 33:25 34:7,18 35:1 36:7,9 40:15 45:14 46:13 53:10 60:20 64:15 80:2 109:2 112:16 119:12 119:21 136:14 136:19 137:13
declare 161:8
decouple 89:1 93:3
decoupled 89:24 90:19 92:24
decoupling 88:17 89:7,15 90:4,4,6,9 92:7 92:8,18,22

93:2,5
defendants 1:9 2:9 3:15
define 33:18 38:21 39:6 45:25 97:3 100:9 132:2
defined 27:11 103:25 110:7
definiteness 61:18 62:18
definition 20:13,16 24:4 24:8 25:14,19 25:22 26:2 27:2,6,8,9,10 27:18 33:24 34:5,12,19,24 35:3,8,11,20 36:2,3,23 37:3 37:11,16,22,24 38:13,14,18,23 41:3,12,24 42:5,17 43:11 44:14 46:3 48:10 53:8,12 53:15,22 56:25 57:11,17,18,24 57:25 58:23 61:22 62:5,13 63:4 64:17,20 64:22,25 66:1 66:4,16,24 67:3,13,17,20 68:1,7,11,14,17 68:25 69:7,13 69:19,23 70:1 70:11 71:12,15 71:16,20 75:14 75:18 76:6 81:13 93:14,21 94:4,25 95:8 95:25 97:4 100:10,24 101:1 115:25 131:8
definitions 24:12 26:14,17 26:20 27:22 34:8 35:18 37:12 38:1 44:11 46:3 62:24 63:9 64:12 95:25 116:1
degree 44:8
delivery 19:5
demonstrates 37:3,23 81:13
depend 32:14 59:2 84:11,12 143:10
dependent 26:1 126:6,10
depends 28:20 32:13,18,21 33:12,14 51:4 54:3 55:20 60:13 69:17 74:25 75:18 88:19,21 95:15 98:11,13,21 99:14 100:8,8 101:10,12 105:5 146:6,19
depicted 76:3
deponent 1:15 2:19 5:3 26:16 33:11 34:15 36:12 40:8 42:10 48:2,9 54:3 62:10 77:11 78:15 81:25 83:15 88:10 92:16 98:16 110:12 112:12 115:24 119:25 123:8 134:3 157:18 160:9
deposed 8:10 11:4 17:20
deposition 1:13 2:16 5:10,11 6:4 7:6,9 9:6 15:4 16:14 110:17 160:14 162:14
depositions 8:15
describe 49:8 51:9,17 84:22 85:3 94:7 106:14 109:4 137:25 150:21 152:11
described 27:5 29:13,19 30:15 31:15 45:12 50:21 51:13,22 51:23 52:7,16 53:25 54:17,18 55:6,14 56:1,2 80:14 83:10 84:18 85:25 86:23 87:9 94:1 95:25 96:4 99:17 100:18 101:25 103:12 104:8 104:11 105:20 106:11,12,18 106:22,24 107:7 108:5 109:5,17 110:6 112:4,5 113:11 114:22 122:18 132:22 133:15 135:24 136:1,3 143:3,13 144:5 146:21 149:19 149:24 153:19 153:23 154:20 156:6 159:3
describes 31:10 84:25 100:15 103:18 105:23 108:11 125:5 133:9 135:4 141:19 146:23

describing 32:1 32:9 37:5 45:3 47:18 52:24 85:13,16 87:7 87:17 88:25 89:7 90:3,22 91:17,19,22 92:5,9,22 103:9 104:22 108:16 121:25 145:5 146:10 155:14
description 25:13 32:23 43:2,24 78:17 80:15 86:15 91:20 94:6 108:8 109:21 118:18 138:16 157:4
descriptions 26:18
design 91:6
designed 25:10 60:15
designing 98:2
detail 109:19 111:14
details 150:22
determinations 147:25
determine 37:1 41:13 44:15 58:19 61:3,7 61:15 62:2 63:1 95:23 121:21 131:5 137:2 143:5 147:22 158:3
determined 14:8 108:6 120:14 128:4,8 130:20 135:15 135:19
determines 61:18 128:10 152:19
determining 33:20 62:19 128:21 129:5,6 134:9
develop 58:8 147:24
developed 20:10 28:2
developing 14:25 20:3
deviate 104:10
device 66:19 67:5 69:10 100:21
devices 72:10 72:22 73:1 93:20 100:21
diagram 52:7 76:4
diagrams 104:14
dictated 129:9 129:12,22 135:16
dictionaries 21:15,22,23 22:3 27:17 93:15
dictionary 5:18 5:21 21:25 22:1,8 24:2 25:17 26:3,5 26:25 27:23 34:20 38:14 39:23 53:9 56:25 57:12 60:24 61:23 62:25 64:12,21 64:25 65:20,25 66:5 67:4 68:18 69:8,19 71:21 93:21 94:4,10 100:10 131:7
difference 85:9 98:8 128:19,23 130:2,23 143:15 147:22
differences 130:25 131:4
different 9:23 19:15,23 24:5 27:25 29:21 32:17 37:6 38:1,1 42:23 44:15,23,25 45:18 46:5 47:20,21 48:10 48:19,19 49:5 60:2 68:23,25 72:14 74:21 78:18 97:13,17 97:18 102:2 116:4,5 125:14 125:17 130:5 133:16 143:20 152:18,19
differentiation 126:10,15
differently 42:23
difficult 34:11
direct 114:14 118:14
directed 9:22 10:11 107:16 120:7,9
direction 162:11
directly 14:1,2 55:12 82:22 107:23
disagree 36:16 36:21 57:16 71:3,5 107:12 152:20
disclose 114:20
disclosed 47:24 83:5,7
discloses 26:11
disclosure 79:10

discussed 99:17 115:19 128:15
discusses 155:4
discussing 24:24 86:4 152:17,17 157:2
discussion 30:5 68:2 128:16 135:11 148:4,8
distinct 66:18 69:9,20 72:3
distinction 63:17 96:11 120:11
distinguished 116:22
distinguishing 77:1
district 1:1,2 2:1,2
divide 96:8
divided 67:8 103:2,7
dividing 67:14
division 1:3 2:3
divorced 76:10
dne 29:5,8 52:12,14,16,18 52:21,24 53:4 53:6,11,16,23 53:25 54:6,6 85:13 86:5 112:22 113:6 114:13 118:11 118:17
docsis 19:7 23:24 24:4,8 31:2,3,6 51:20 51:21 52:3,4 55:2,3,10,13,15 55:16 82:18,19 82:23 83:7,8 85:18,19 89:25 90:20 96:7,11 96:11,13,14,19 96:21,23 98:8 98:9,24 99:2,3 99:4,7,18,20 100:16,18 101:21,22 102:3,3,9,9 103:1,3,4,5,10 103:10,17 104:2 107:18 107:21,21,24 108:9 133:9,22
doe 60:15
doing 13:20 19:18
double 117:16 127:4 145:20
downloaded 16:9 94:17 119:19 136:11
downloading 15:16,21
dr 7:6 8:8 12:2 56:23 58:5,14 65:18 111:12 116:6 118:5,24 147:11 149:21 156:8 160:8,13
draft 14:19
drafting 14:23 14:25
draw 48:17 49:10,17 58:5 58:14 59:5 61:8
drawing 59:16 60:3
drawn 47:10 47:11 81:12
drive 67:6,7,7 68:4,5 70:4,6,8 70:9,14,19,20 70:20,25,25 71:1 72:8,9,9
drives 68:5 70:3
due 15:15
duly 111:7 162:8
dustin 4:5 7:7
dynamic 120:13

e

e 16:13 140:18
e.g. 158:13,16
earlier 11:4 12:17 31:14 48:4 60:22,23 86:17 109:10 111:23
earliest 120:1 136:23
easier 15:17
eastern 1:2 2:2
edition 5:18,21 65:20 94:10
education 17:9
eight 12:6,10
either 23:18 53:12 54:5 58:9 62:24 63:9 107:6
electric 42:1
electrical 35:14 35:16 38:15 39:16 41:4 44:8 50:4 57:13 59:4 60:25 61:24
electromagne... 146:1
element 111:18 112:17 114:7 148:25 149:1,4
embedded 89:19 90:14 101:11
embodiment 56:2 86:1,1 106:15,18 107:4 110:7 125:21 131:24
embodiments 125:12

employee 19:21 162:18
ended 53:3 100:16 152:9
engaged 12:14 13:16
engel 3:7 7:21
engine 29:5 30:1,4 39:1,2,7 39:8,17 40:21 40:24 41:1,1 42:13,22,24 46:21 47:3,5,7 47:11,25 49:11 50:1,6,16,17 51:2,2,10,11,14 51:16 54:12 55:12 59:10,12 63:24,25 64:4 67:11 68:9 72:6,7 76:14 76:15 77:7,7 77:18,19,25 78:1,4,4,12,13 79:2,3 80:8,15 81:4,22 82:12 82:22 83:3,6 89:1,2,8,8,22 90:17,21,23,24 91:2,3,4,11,23 91:24 92:10,11 102:25 106:4,6 106:16,21,23 107:2,4,7,11,17 107:24 108:17 108:17,20 111:20,20 112:1,7,8 113:20,21 115:1,2,12,13 117:13,14,23
engineering 44:9 100:24
engines 43:8 50:18 67:16 72:5 90:23
entire 46:25 89:18 90:13 103:1
entropic 1:5 2:5 7:10,19 23:7
envision 56:8
equipment 20:9
equivalency 157:9,12
equivalent 95:5 155:3
error 154:15
errors 17:1
especially 14:3 21:11 40:2 43:18 67:23 69:4 73:18 96:22
essential 25:5
essentially 56:13 98:5 148:11
establish 40:11 154:12
established 33:19
establishes 40:9
estimate 12:7
et 137:3 138:22
ethernet 97:15 97:21 98:5,6
evaluate 73:9 144:14
evaluating 75:19 136:22
evidence 21:16 50:21
exact 159:3
exactly 25:8 52:19 82:5 91:19 153:19 158:8
examination 5:3 8:5 111:10
examined 8:2 111:8
examiner 116:10,16 117:11,22 118:6,9
example 21:24 38:25 49:1 61:12 62:16 70:18 71:8,17 72:9 76:20 78:17 92:23 102:3,6 118:16 128:4,13 129:2 135:5 144:11 147:13 151:6 156:11
examples 41:9 51:12,21,23 53:5 76:22 131:9,25 138:19
except 43:4
excerpts 5:17 65:19
excluded 146:16
executed 161:14
exemplary 43:7 51:17 52:24 98:25
exercise 60:3
exhibit 5:11,13 5:15,17,20,23 6:5 15:4,5,6,10 15:11 16:4,5,9 16:19 20:11 23:2,3 34:18 34:18 65:3,14 65:19 66:6 68:15,18 69:1 94:8,9,12,16 119:13,14,18 136:5,6,12
exhibits 5:9 6:3 65:5

exist 58:18
existed 36:24
existence 49:21
exists 49:23
expect 70:21
experience 17:12 20:1 21:21 44:8
expert 19:18 20:25 59:2
experts 13:15
explain 72:18 80:11 81:2,17 81:18 82:10 133:25 150:15 157:13
explanation 33:22 80:16 82:15
explicitly 83:16 128:6
extent 26:16 64:14 150:24
extrinsic 21:16

f

faced 50:15
fact 35:5 40:14 49:10,15,21 82:15 99:5 100:14 112:6 112:25 121:14 126:6
factor 105:6
fade 145:16
fair 9:3,9,17 16:1,15 25:19 27:6,7,9,21 31:16 32:11,19 32:24 33:7 44:1 48:6 49:14,15 53:1 58:2 59:1 63:2 63:12 66:6,24 68:21 86:20 89:3 94:6 95:8 101:20 108:25 112:2,10 127:15
familiar 23:24 74:2 75:22 76:3 88:16 104:13
familiarity 75:24
families 32:16 32:18
family 32:10,12 32:25
far 126:16
federal 162:14
fi 97:15,22
field 20:19 21:2 21:21
figure 28:25 46:14 52:6,7,9 52:18,20 53:25 54:11 55:1 80:4,20 81:12 82:14 87:10,10 99:22 104:18 104:23 106:12 107:8 112:1,4 113:12,14 114:16 117:9 118:13 121:17 121:25 122:4 122:13,17 123:16 124:23 125:2 135:5 137:15 138:19 139:24 143:1 143:13,13 151:3 157:4,22 158:3 159:14
figures 47:16
figuring 144:8
file 15:15 22:22 118:21,25 119:2
filed 17:21 21:10 136:24
filing 23:13
financially 162:17
find 16:25 17:2 26:24 27:7 61:12 62:16,23 93:15,15 152:22 159:19
finding 144:13
fine 30:6 137:5
finish 9:13,14
firm 7:22
first 9:23 14:19 18:14 24:6 29:3 38:13,22 39:2,17,23 40:3,12,19,22 41:5,10,15,19 41:23 42:6,10 42:14,21 50:2 50:6,25 57:6 57:25 58:10,16 59:11 62:4 79:1 83:12,17 102:21 113:9 115:3 120:16 121:18,19 122:7,8,9,21 123:12,13,24 124:8,14,15,19 124:24 126:3 126:22 127:7 127:12,18,22 127:24 128:20 129:9,12,17,22 129:24 130:21 134:16,18 135:16,19 136:2 141:3,4 142:15 145:24 149:15,16 150:6 152:10 154:1,7 155:23
fit 61:12
five 46:17 139:14,21,22 140:14 142:6

fix 22:20
fixed 120:12,23
flexibility 120:24
fly 34:2
focus 59:20 87:10 128:18
focusing 37:25 149:4
folder 15:5 119:18
follow 16:12
following 151:23
follows 8:3 93:5 111:8
foregoing 161:10 162:5,7 162:11,13
forgot 15:22
form 26:15 33:10 34:14 36:11 40:7 42:9 48:1,7 54:1 78:14 83:14 88:9 92:15 98:15 105:6 112:11 115:22 129:11 129:12,20,22 129:25 130:19 134:2 135:15 135:19
formal 27:10 27:16 28:14 33:24 34:1
format 120:18
formed 64:1
formerly 56:9
forming 21:20
forms 16:6
formulated 14:9
forth 36:7 162:6
forward 55:12 107:23
forwarded 82:21
four 46:16 99:2
fourth 65:24
frequencies 138:4,13 139:9 139:20 140:24 142:4 143:12 143:17,18 154:8 158:7 159:17,20,23
frequency 138:10,14 139:13,18 140:18,20,23 142:3 143:11 153:18 154:11 158:6,10,23 159:13,16
friday 1:16 2:21 7:1 111:1
full 24:6 102:17
function 23:24 50:18 52:15 64:3 68:9,13 70:10,11 71:1 85:8 90:22 95:14 99:3,4 106:5 119:8
functional 52:7 103:3,6,7,9,11 103:25 104:6 104:17 105:2 105:12,19,23 108:12,15,16
functionality 56:9 58:13 85:15 89:20,23 89:25 90:14,18 90:20 91:4,8 92:13,23 93:6 94:7 96:8 97:17 98:4 100:9,12 103:2 104:10 107:22 108:9 117:23
functionally 108:19
functioning 78:2,9 91:12
functions 25:9 31:6 43:6,7 50:20,21,23 51:6,7,8,10,18 51:22,24 52:2 52:4,17,19,20 52:22,24 53:6 63:25 66:20 67:10,12,16 69:11 70:4,9 72:5,5 73:17 74:17,19,25 75:20 79:13 83:20 91:22,24 92:9,11 93:2 93:18 95:22,24 96:4,21 97:1,8 97:14 99:1,2,6 100:16,17 104:14,17 106:3 108:13 108:19 115:12
further 92:21 103:2 109:19 162:13,17
future 10:23

g

gates 3:5 7:18
general 32:8,25 33:3,4,5,8,13 33:17,20,23 88:18
generally 11:25 19:15 20:6 29:22 57:9 95:7 110:7
generate 121:22 126:19 133:13 135:6 154:1
generated 126:7,12

129:16 135:8
generates 124:3 128:5
generating 135:5 148:15 148:15 158:18
generation 128:11 131:20
getting 150:14 157:13
give 9:6 11:19 20:13 34:1 60:16 64:22 65:1 73:2 78:5 91:5,13 98:22 101:9 105:9 126:17
given 37:5 38:13 60:18 73:18,22 76:18 79:14,22 101:20 160:12 162:12
giving 8:15 76:6
go 7:13 8:19,22 16:18 18:13,17 20:11 60:21 62:9 65:6,24 66:10,14 81:9 93:15 94:23 116:12 117:15 129:8 135:3 146:14,23 157:17
goals 122:18
goes 103:24 131:23 144:15 154:16
going 8:19 9:14 10:4 14:10 15:3,9 16:13 56:17 57:5 59:5 65:9 80:13 99:13 119:11 121:21 122:12 134:21 138:5 142:9,19 144:10,14 147:5 153:8,25 156:12 157:15 160:11
good 7:4 8:8,9 8:14,17 12:7 34:4 56:15 110:10
graph 137:17
great 15:19 16:8,11 111:14 136:14
ground 8:20
group 137:21 138:4,7,11 139:15,23 140:17 144:23 145:4,6,9 154:4,5,10,15 156:13 158:13 158:14,20,22
groups 137:24 148:17,22 151:19,22 158:19 160:1
guess 27:1 69:17 70:15 72:2 155:2 157:10
guidance 44:17 45:4 53:21 54:8 58:17 83:18 84:5,7 99:1 128:25
guides 19:13

h

half 42:4
handed 50:24
handled 107:20 119:7
happened 116:20
hard 9:12 67:6 68:4,5 70:3,4,6 70:8,9,14,19,25 71:22 72:8 105:14 115:3 118:7
hardware 68:12 85:7 105:3,4,5
harmonic 145:18
head 9:7 64:22 65:1
heading 108:12
hear 8:23,25 156:14
heard 145:24
held 7:9
help 43:8 67:20 72:18
hereto 15:8,13 23:5 65:16 94:14 119:16 136:8 161:12
hey 123:24
high 100:23
higher 19:1
histories 72:17
history 40:16 63:20 74:9 79:9 114:25 116:15 118:21 118:25 119:2
hold 94:20
holders 13:1
home 64:2 67:12 68:9 72:5 89:20,23 90:15,17 115:12
hour 110:15
hours 12:6,10 14:22,24 15:1
hundreds 35:25 38:3
hypothetical 55:19,20,21 56:6 73:3,11

74:23 75:2,20 76:1 77:17 79:21,23,25 91:14 93:1 98:2 101:9 115:5 132:14 133:23 137:20 138:3 139:8,14 139:23 145:2

i

idea 120:17 122:11 123:23 152:7
identification 15:7,12 23:4 65:15 94:13 119:15 136:7
identified 14:7 26:17 37:15 45:1,13 76:22 113:7 114:11 114:12 118:11 118:12 126:2 131:2 133:11 133:22 138:5
identifies 17:19 98:25
identify 18:13 18:17 23:15 41:4,10 49:12 80:21 145:6
identifying 131:2 139:10 140:12 143:17
ignore 115:4 153:9
ignores 49:20 96:10
ignoring 42:3 152:25
illinois 3:10
illustrated 63:20
image 24:23
impact 41:22 116:24
impacting 91:3
implement 56:9 58:13 59:18 77:22 78:7 79:19 91:14 96:3 97:14,17 104:9
implementati... 89:18 90:13 103:14,21 109:22,23
implemented 39:1,3,17,21 40:22,23,24 42:13,24 50:1 50:6 55:5,7,17 55:21,25 56:9 59:11,13 80:22 84:12 87:19 101:22 102:4 102:10,14,18 104:7 105:12 106:24 107:5 107:19
implementing 40:22 42:22 52:8 84:25 85:5 96:25 97:8 105:1,19 107:21
implements 32:20 97:21,22 98:4 102:25
implications 92:21
implies 41:6
important 118:10
importantly 118:1
impossible 34:11 56:13
inaccurate 80:23
include 25:10 27:2 43:10 44:13 46:10,24 47:12 50:14 131:12 132:15 134:9,21
included 21:16 21:19,22,23 24:3,23 25:14 26:3,9 27:17 27:22 33:25 34:19,24 46:13 46:16 47:3 53:9,10 64:15 66:5,6 94:5 95:6 114:17 130:21 132:4 132:11 146:16 155:13
includes 42:11 46:3,22 50:2,7 52:14 53:11 54:16,20 59:11 59:13 81:22,25 114:16
including 24:14 26:4,7 131:21
inclusion 87:11
incompatible 112:21 113:5
incomplete 73:11
inconsistent 71:20,25
incorporated 7:11
incremental 85:7
indecipherable 88:5
indefinite 38:18 39:18,24 39:25 42:8 46:1 57:14 60:19 62:1,23 63:12 108:4 112:9,20 113:2 113:3 114:25 135:18 149:2

indefiniteness 31:12 36:23 58:3 61:11 62:15 64:16 73:15 79:16 80:24 82:24 83:21 114:3 116:11,13,17 118:19 150:7 152:10
independent 126:11
independently 91:1,10 93:4
index 5:1 6:1
indicate 32:9
individual 137:18
industry 19:20
inform 43:8 67:14 69:1 81:6,18
information 6:10 101:17 132:4,11,15,21 133:3,18 134:1 134:4,9,20 135:2,9,10,13 135:21
infringe 58:9 58:24
infringement 11:19,20 12:23 12:25 36:9 58:1,4 61:3,7 61:17 62:3 63:11
initial 125:4
initialed 161:11
initially 121:8 121:16 123:5
ink 161:11
innovate 120:22
input 14:10
inserting 150:11
instances 56:8
instruction 6:14 25:6
intend 10:19 48:24
interchangea... 148:11
interconnected 35:16,25 38:4 42:2 43:14 61:25
interested 162:18
interesting 145:2
interface 24:7
interference 145:16 146:1,3
interpret 37:7 104:25
interpretation 154:19
interpreted 48:15 88:13 115:15
interpreting 123:11
interrupted 88:11
intrinsic 64:11 67:24 69:4 72:18 73:6,18 115:4,5
introduce 15:3 22:16
introduced 15:16 65:18 116:6 145:14
introducing 65:3 94:8,9 136:5
invention 26:12 37:21 44:7 45:12 52:21 55:6,14 56:1 67:19 83:5 96:12 101:24 104:8,11,22 105:18 106:11 106:24 107:7 110:8 112:3 120:8 121:1,4 121:25 122:17 122:18 125:5,7 141:18 146:13 147:1 149:24 149:25 154:20
inventors 48:24
involve 18:9 20:2
involved 10:16 11:9,12,15 14:11 18:9
involvement 55:13 82:23 102:6 107:17 107:24 108:9
ipr 11:12 19:13
iprs 11:15
issue 36:4 39:5 39:11 40:14 80:20 82:16 97:24 100:19 116:16 117:21 135:18
issued 116:10
italicized 118:3
item 152:19

j

jason 3:7 7:20
jason.engel 3:13
job 1:24
jrg 1:7 2:7
judge 57:4 68:22
july 136:25

k

k&l 3:5 7:18
katherine 3:6

kathleen 13:19
katie 7:18
katy.allor 3:12
kevin 1:14 2:16 5:4 7:6 8:1 111:6 160:13 161:8,20
kind 16:7 20:1 20:7 27:9 28:4 28:20 29:18 34:10 35:8 36:3 53:3 62:12 71:6 72:15 73:10 74:7 80:18 96:10 100:4,6 101:8 114:12 118:4 120:23 121:24 122:17 123:16 138:16 138:23 147:20 149:15 154:7 154:16 156:10 158:25
kinds 19:16 97:18 131:13 145:16 146:7
klgates.com 3:12,13
knew 51:7
know 8:16,22 9:1,5,5,15 11:2 13:9 19:24 20:4 30:20,23 31:5 37:7,10 44:3 50:22 57:3,4 58:22 59:18 66:11 68:4 71:23 73:19 78:9,10 83:4 96:3 98:14 104:17 111:24 116:17 117:25 118:4 119:1 128:6 136:10 145:10 146:20,22 149:2,21 152:16 156:8 159:21
knowledge 10:22 21:21
known 28:7,9 28:11,12,13 33:8 34:12
kramer 58:5,14 116:6 118:5,24 149:21 156:8
kramer's 12:2

l

l 3:6
label 22:19,21 54:12 81:6 99:22
labeled 29:4 30:8 31:2 52:12 81:4 137:17 138:12
lack 79:10
language 40:20 59:15 60:7 63:21 69:6 72:13 75:1 83:11 107:10 107:13 120:7 122:1,25 123:3 124:1,25 127:5 127:12 128:3 129:9 130:3 151:17,25 152:5,24 153:10 154:23 154:23 155:7 158:24
large 15:17
larger 53:20 54:8
law 3:8,18
layer 19:1 97:19 103:4 104:2 127:25 147:21 159:22
lead 131:3
leads 35:4 49:18 79:15
left 140:1
level 35:23 38:2 38:6 45:2,5,16 46:7,8,10 47:14 48:14,19 48:24 51:4 54:3 81:14 84:7,12 94:3 97:11 100:23
levels 38:1 44:15,17,25 45:10,18,22 46:4,5,6,8 48:12 116:4,5 116:6
light 64:11 74:9 113:14
likely 60:13 141:9,10
limitation 77:23 82:8,15 107:16 112:19 114:23 123:12 150:7,8
limitations 56:12 61:9 83:2 115:11 137:22 151:11
limited 110:2,5
limits 147:1
line 29:20 31:18,18 84:20 88:23 106:1 107:2 143:2,5 143:14,15 153:25 157:18
lines 92:4 102:23 105:23 120:3 125:9 131:11 152:16 158:10
link 97:19
list 18:20 19:10 21:7,9,11 53:3

146:12
listed 18:1,4,11 30:11 108:24 131:14 137:6
litigated 10:21
litigation 11:21
little 8:22 9:12 19:1 28:19 30:22 73:8 115:3 118:7 123:21 126:17
live 162:3
llc 1:5 2:5 7:10 7:20
localizing 106:2,5
locate 22:1
log 65:5
logical 68:5 69:14 70:3,4,5 70:8,10
logically 66:18 69:9,20 145:3
long 12:4,8 77:23 131:15
look 10:15 20:14 21:4 24:1 29:3 31:7 38:25 40:20 41:24 46:12,20 52:6 57:1 63:21 65:21 66:7,9 69:7 76:13 79:23 84:19 88:22 91:7 95:9 100:14 105:22 111:16 112:15 117:8 118:21 121:5 125:8 126:14,20 127:11 129:8 129:15 134:14 138:8 139:13 142:18,19 143:1 144:3,18 147:2 148:12 149:10 150:22 150:24 151:2,7 152:6,16,24 155:13
looked 10:17 27:15 30:14 60:12 119:1 126:15
looking 18:20 29:12 30:19 31:13 49:24 57:6 58:22 105:15 121:11 149:15,25 153:15 155:7 155:22
looks 16:23 17:16 30:17 67:4 143:16
lot 8:16 44:15 115:19 116:4
lots 37:6,25 53:17 54:5,7
lowest 142:7,11 142:13 144:8
lunch 111:13
luncheon 110:16

m

m 1:22 2:22 162:25
ma'am 8:11 20:22
mac 51:21 52:4 55:3,16 82:19 83:7 85:19 93:8,12,18,25 94:5,7 95:1,8 95:17,22,24 96:4,6,11,14,14 96:15,16,19,21 96:25 97:2,3,5 97:6,8,14,21,22 98:9 99:4 100:18 101:21 102:4,9 103:4 103:10 107:21 108:22
machine 25:6 25:11 162:9
made 79:15 109:14 113:16 116:21 137:1 161:10 162:9
madison 3:9
mails 16:13
major 85:9
make 9:13 15:24 56:12 60:16 70:12,16 90:25 125:6 130:12 142:24 147:25 149:23 152:12 155:21
makes 46:1 108:3 116:7 140:25 154:19 156:14,17 157:12
making 142:15 155:3
manufacturing 20:8
map 31:3 95:5 125:1
mapped 117:12
mark 15:9
marked 15:4,6 15:11 16:9 23:2,3 65:14 94:12 119:14 136:6
marshall 1:3 2:3
matched 70:9
materials 12:1 12:5 14:6 21:7 21:12
matter 12:15 13:4,16,23 14:4

mean 25:22 29:11,15,21 31:25 37:6 38:2 39:15 49:16,19 57:20 60:14 61:22 63:14 64:7,10 64:24 71:7,8 71:25 73:3,12 74:25 77:22,23 85:25 88:14,20 89:12 93:2,9 93:13 100:7 105:5,5,7 121:24 130:4 137:5 143:10 145:4,11 148:2 149:8 150:3 151:16 152:24 153:21 154:16 156:14 158:8
meaning 27:24 28:3 48:20 65:2 76:11 81:3 96:20 98:12 115:20 142:17,18 148:6 150:18 150:23
meaningful 142:25 153:13
meanings 47:21 81:9
means 34:9 47:19,19 54:23 58:20 61:23 64:23 69:22,23 71:15,16,16 73:19,24 80:18 93:8,25 108:13 126:10 141:17 144:4,19 152:6 155:9 160:3
meant 28:17 50:1 67:22 82:11 129:18
measure 143:24 147:14
measured 139:22 146:18 146:20 157:6 158:4
measurement 135:22
measurements 133:3 134:21 135:2,9,22 146:10
measuring 145:1 147:12
media 95:1,4
medium 93:9 93:19 95:5
meet 12:8 44:20 55:8,23 59:19 60:1,10 79:24 82:8,20 83:1 102:5 107:15 131:15 145:7
meeting 56:12 114:23
meggs 7:21
melissa 1:22 2:22 7:8 162:25
members 138:6
memorized 23:17 145:23 146:14
memory 66:19 67:5,8,14 69:10 72:3,10 72:22,25 76:23 114:14 118:15
mention 146:3
mentioned 13:7
message 129:3 129:4 132:5 143:4
messages 132:14
met 12:2
metric 148:2,4 148:5,9,18 149:6,15,16 150:2 151:25 154:1,24 155:19,20,22 155:24 156:18 157:10 158:9 158:20,22,25 159:6,18
metrics 148:20 151:18,21 153:2,3,3,15 155:9 157:3,7 158:5,9,16 159:10
microprocess... 33:1
microsoft 5:17 22:7 24:2 25:17 27:22 34:19 38:13 53:9 56:24 57:12 60:24 61:23 62:25 65:19 66:5 67:4 69:19 71:21
mind 13:13 18:20 19:9 37:14 70:18
minimum 154:13
minimums 143:2
minus 15:2
minute 65:7
misremember... 116:14
missing 17:14 21:9
misstates 48:7 54:1 115:22
mixed 70:9
mode 41:1
model 78:12 79:2 81:4

modem 29:25 30:4 39:2,8,21 40:23,24 42:12 42:24 50:15,16 50:24 51:2,16 52:8 54:12 58:23 59:12 60:10 63:24,25 64:1 67:10,11 68:9 72:4,6 76:14 77:7,18 77:25 78:2,4 78:10 80:8,15 81:22 82:12 83:3,6 85:1,6,8 85:15,17,18,24 86:8,19,23 87:6,8,18,21 89:1,8 90:1,21 90:24 91:4,7 91:23 92:10 100:1 102:25 103:1 105:6 106:5,6,16,19 106:19,23,23 107:2,4,7,11 108:17,20 111:20 112:1,7 113:20 115:1 115:12 117:14 117:23 119:8 133:1,4,8,12,19 134:1 137:18 137:23 138:21 140:1,5,8,13,17 140:19,20 144:22,24 145:3 153:4 154:2,10

modems 138:3 139:2,8,14,22 139:22 140:15 145:8 153:17 154:3,5,14

modified 138:23

modify 71:10

morning 7:4 8:8,9

move 140:4

multiple 45:25 46:2,4,7 81:8 85:23 135:25 142:4

music 13:1 19:3

mute 62:6 119:24

n

name 7:7 13:18 22:22 162:21

necessarily 8:17 93:5 101:2

necessary 82:10

need 9:6,16 32:22 44:20 63:18 78:11 82:7 100:4 126:12

needed 17:3 95:10 117:19 143:4

needs 9:8 95:14 101:4

negative 142:9

neighborhood 15:1

neither 162:17

network 39:1,7 78:1 93:20 107:23 108:17 120:17 156:13

networking 29:4 39:17 40:21 41:1 42:22 46:21 47:3,5,7,11,24 49:11 50:1,6 50:16 51:1,10 51:11,14 55:12 59:10 63:24 64:3,4 67:12 68:9 72:5,6 76:15 77:7,19 78:4,12 79:3 82:22 89:2,7 89:22 90:16,23 91:3,24 92:11 106:3,4,21 107:17 111:19 112:8 113:21 115:2,12,13 117:13

never 116:10

new 3:20,20 5:20 94:10

newton 34:22

newton's 21:25

nod 9:7

node 121:8,8 121:15,15,18 121:19 122:2,3 122:5,7,8,10,22 122:22,23 123:5,5,10,12 123:13,14 124:8,10,12,14 124:19,20 125:1,3,4,17,24 125:25 126:1,8 126:13 128:5,8 128:13 130:21 134:7,8,16,18

nodes 120:17

noise 141:24 145:12,13,14 145:18,21,22 145:24 146:2,4 146:7,12,15 147:24

noises 146:7,10

non 11:20 44:12 142:9

normally 17:17

north 8:13

note 7:12 162:3

noted 161:11

notice 5:11 15:5
noticing 7:16
number 19:22 35:15 123:3 142:7,8 144:12 159:10
numbered 118:12
numbers 142:9 151:7
numerous 157:16

o

oath 8:2
object 26:15 33:10 34:14 36:11 40:7 42:9 48:1,7 54:1 62:7 78:14 83:14 88:9 92:15 98:15 112:11 115:22 134:2 157:15
objection 35:19 62:8 77:10 81:24 123:7
objections 7:14
objects 9:15
observation 62:4,10
obviously 22:3
occur 95:11
offered 25:24 28:4 79:7 131:8
offering 10:19 27:16
office 11:13
oh 26:22 35:22 129:18 142:12 149:21 156:8 157:21
okay 8:7,18 16:17 17:6 18:23 22:22,25 29:2,6 30:7 56:14 66:8,13 66:15 79:6 87:25 88:24 94:18,22 110:1 110:9,12 111:17 122:7 123:1 126:5 134:25 136:13 137:14 138:25 140:16 141:1 142:12 146:5 147:4 153:25 155:17 157:24 160:4,9
once 15:15 49:20 143:3
ones 13:7 15:25 18:14 19:9,10
open 15:24 16:3,5 22:24 53:3 94:17 100:16 119:19 136:11 152:9
opened 16:10
operate 78:8
operating 90:24 91:23 92:10
operation 92:25 93:3
opined 31:8
opinion 11:20 22:15 23:10,20 28:2,5 34:2 38:17 39:12,16 39:22 45:24 57:13 60:18 61:1 63:10,13 72:8 79:7 83:1 96:5 99:16,20 101:20,21 102:8,12 108:22 111:24 112:6,15 113:23,25 114:24 115:18 119:3 121:12 121:13 123:2 125:2 130:15 130:23 141:14 149:1 159:10
opinions 10:11 10:19 14:9,25 21:20 31:12 80:24 137:9
opposed 20:7 92:24 101:11 154:11,17 155:20
opposite 83:5
option 108:5,6
oral 9:6
oranges 71:24 72:1,16
order 44:20 58:15 63:18 93:3 143:5 153:12
ordinary 27:24 28:3 65:2 96:20 142:17 142:18 144:17 150:23
original 99:12 162:14
outcome 57:3
outside 13:7,22
overall 105:6
overlap 31:9 100:17
overlapping 51:24 99:5
own 48:15 114:25

p

p.m. 2:21 110:14,16,18 111:2,4 147:6 147:9 160:11 160:15

packet 89:24 90:19 107:20
packets 55:11 82:21 107:16 107:23
pads 59:17
page 5:10 6:4 8:21 16:18,20 16:20,23 24:7 24:17 25:20 26:24 27:2 34:17,23 44:21 65:21,23,24,25 66:10,14 94:25 114:17 138:18
pages 1:25 15:24 24:3,5 25:17 26:5
paper 147:15
para 26:24
paragraph 20:12 21:4 24:20 26:23 34:25 37:16 46:12 48:14,18 48:21 49:2,2,3 49:4 76:23 80:1,3,19 81:1 81:10,10,16 93:15,17 94:2 96:19 105:16 106:12,20 109:3 112:15 114:10,10 117:8,19 118:2 119:5,11 120:3 121:12 122:24 123:9,17 124:9 124:20 126:21 127:6 130:12 136:16 137:12 137:20 138:17 138:24 141:3 141:25 142:16 149:13 150:10 150:19,22 155:11,16,23 159:4
paragraphs 26:18 109:8,16
parallel 62:11
parameter 131:5
parameters 121:22 123:25 124:4 126:22 126:23 127:8,8 127:13,14,19 127:22,25 128:4,7,11,17 128:20,21 129:6,10,13,18 129:23,25 130:20,22 131:9,12,13,19 132:1,6,9,19,22 135:7,17,20,23 135:23,25 136:3 154:13 159:21,22
parentheses 29:9 124:11
parenthetical 114:15
parse 118:7
part 12:9 20:16 21:13 37:22 39:6,7 46:25 47:5 51:19 53:13,19 54:8 55:18 56:4 59:6 60:1 63:19 72:17 73:14 76:18 84:9 88:2,10 92:4 108:3,19 113:3 114:11 115:3 117:3 118:11 120:16 139:11 145:13 148:18 149:10 149:17 150:2,6 152:1,8 154:17 154:25 155:5 155:23 156:21 156:22
participants 2:18
particular 13:13 25:24 27:14 32:1,6 32:20 34:5,8 35:17 42:3 43:15 61:25 72:13 76:11 100:12 120:10 131:7 133:10 138:19 139:18 146:23 147:19 158:6
particularly 41:17
parties 7:13
partition 66:16 66:24 67:3,6 67:13 68:2,18 70:14,19 71:4 71:9,10,13,19 72:2 108:19
partitioned 64:2,8,13,17,20 64:21,23,23 65:2 67:9,12 67:23 68:8,10 69:3,18 71:1 72:11,20 73:17 79:14 83:21 108:13 113:22 113:25 115:14
partitioning 67:16 68:20 69:14,15 70:3 70:5,24 71:6 72:4 105:24 108:12,15,16
partitions 68:13 71:7
parts 70:15 84:3 118:12

party 162:19
passage 104:5 105:11 107:9
passages 159:8
past 12:19
patent 5:15,23 6:5 9:23 10:1,3 10:4,7,8 11:6 11:13 12:23 22:16 23:1,10 28:8,23 29:1 29:12 33:7 34:6,10 35:4 36:25 37:9 38:12,25 41:20 44:16 46:14 47:18 49:25 52:6 56:2,11 57:5 66:25 69:5,7 71:14 71:20 72:17 76:12,13 77:6 80:4 84:19 88:22 93:25 95:17 96:6 98:1,7,22,24 99:11,18 100:15 101:7 101:19 102:23 104:21 105:22 111:14 115:16 115:21 119:12 119:13,22 120:4,8,8,11,20 120:21 121:5 131:10 132:1 134:11 135:12 136:5,15,21,22 141:19 144:19 145:5 146:9,12 146:21,23 148:12 149:19
patent's 68:20
patents 9:23 10:12,15,20 12:1 14:4,6 33:19
path 35:13 38:15 39:15 41:3 57:12 59:3 60:25 72:22,25 76:16 77:9 79:4 114:19 118:14 124:7
paths 72:10 114:14 118:17
pattern 121:3 124:6 133:11
patterns 147:19
payload 131:22
pc 70:19
pdf 16:5 34:18 65:21,24
pdu 55:11
penalty 161:9
people 28:12
perform 25:9 35:17 42:2 43:14 52:15,17 57:25 58:4 61:25 95:22,24 96:22
performance 157:6 158:4 159:21
performed 31:7 64:3 67:11
performing 50:18,20,22,23 51:18 53:4,7
performs 52:19 52:25
period 28:7,16 93:25
perjury 161:9
person 27:19 28:22 36:25 37:6,13 41:12 42:15 43:5,8 44:24 46:8 58:7,18 59:17 60:3 61:15,18 62:20 63:5 67:15,21 69:1 81:7,18 83:19 84:15 94:2 104:11,19 105:14 113:17 115:6,15 116:8 116:25 117:5 144:2,17 148:6 150:3 151:10 151:15 155:9 156:13,19,25
perspective 104:23
pertains 162:13
ph.d. 1:14 2:17 5:4 8:1 111:6 161:8,20
phi 103:4 104:2
phone 119:20
phonetic 18:25 19:14
phrase 28:16 31:24 32:4 148:2 152:25
phrases 42:10 130:24
physical 69:14 70:4,6 71:4 93:19 105:3,4 105:5 127:25 147:21 159:22
physically 66:21 69:12,20 80:22
pick 138:14 139:15 142:5
piece 68:12
place 7:13 162:6
placed 80:18
places 29:21
plain 27:23 28:3 65:1 96:20 142:17 142:18 150:23

plaintiff 1:6 2:6 2:18 3:4 7:19 12:25 60:16
planning 10:24 11:15,19
plans 11:1,17 11:22
please 7:12,15 7:17
plural 106:7
pluralities 135:25 136:4
plurality 121:22 123:25 126:22,23 127:7,8,13,13 127:19,22,25 128:4,7,11,17 128:21,22 129:6,9,12,17 129:22,24 130:22 131:19 135:17,20,23 136:2 137:24 148:16,21 158:19 159:25 160:1,1,3
plus 15:2 21:1 21:21
point 10:17 31:17 71:18 80:14 81:16 83:4 109:1 118:10 126:3,4 141:16,25 142:15 145:5 150:9 152:21 154:22 157:4 157:11
pointed 109:11 109:13 118:15 132:19 153:24 159:9
pointing 31:14 112:1
points 148:10 149:3
portal 89:19 90:14
porter 3:16 7:23 13:3
portion 66:18 67:8,25 69:9 89:6 91:16 102:6 105:1 118:3,20 136:14 151:11 157:25
portions 70:24 72:3 118:25
posita 20:13,17 23:23 27:7,24 28:15 29:11 30:19 33:16,23 36:18 37:9 42:20 44:6 45:6,8,15 49:24 50:17 64:24 67:18 70:2 74:12 75:9,12,22 76:2 88:20 93:24 95:16,23 96:3,16 97:2,3 99:25 101:13 104:5,13,25 131:6 133:25 141:7 148:3
position 25:23 27:11 28:14 33:2 69:13 76:14 77:6 79:2 113:19 121:7
positions 149:5
possibilities 45:25
possibility 54:20 87:18
possible 37:11 37:24 45:10 81:8 106:14 107:23 116:5 142:7 144:12
possibly 104:11
potentially 18:17 19:8 104:18 133:12
practice 8:16
predefined 120:18
predetermined 120:13,23 135:14
prepare 11:24 14:5
prepared 34:1 119:21
preparing 16:25 17:2 21:8 23:9 136:19
prepositional 152:25
present 10:24 12:11 67:24 95:15 113:1
presumes 79:6
pretty 8:14 17:17 26:8 76:20 100:23 114:21 118:1 118:18
prevent 95:10
previous 28:1 78:20 89:13 132:25
previously 15:4 79:22 111:7
prior 76:20 116:18 120:9 120:19 162:8
priority 23:11 23:13,20,22 33:6 119:22 120:2 136:20 137:3
probably 13:12 28:13 29:5

33:4,14 100:24
101:10 114:9
probe 120:13
120:13,24
121:2,9,16,18
121:19,20,21
121:23,23
122:9,10,13,14
122:15,19,20
122:21 123:6
123:19,20,23
123:24 124:2,3
124:4,5,8,9,12
124:13,15,16
125:2,12,14,14
125:22 126:7
126:12,19
127:19,21,24
127:25 128:1,5
128:12,25
129:2,12,16,20
129:22,24
130:1,19
131:18,21,22
132:5,8,10,11
132:15,21
133:2,6,7,9,11
133:14,16
134:8,9,17,19
134:22 135:3,6
135:8,14,15
147:18
probes 120:18
problem 36:5
41:11 49:23
51:19 63:19
73:14 82:24
83:21 84:14
98:7 113:17
114:3 118:19
124:22 152:10
problematic
31:11 41:17
43:20
problems 35:4
45:11 83:9
proceeding
7:15 20:14
proceedings
11:12 17:15
162:5,7,9,15
process 20:8
57:4 120:25
processed 19:7
processing 18:5
18:11,21 20:20
processor
24:24 25:4
27:20 28:17,20
29:16,19,23
30:15 31:3,20
31:21,25 32:2
32:7,8,19,20,23
33:13,17,20,23
42:11 45:6,9
47:2,4,12 48:5
49:12 50:2,7
51:21 52:5,15
52:17 54:16,18
55:5,8,15,16,16
55:22 56:10
58:25 59:6,7
59:12,14,21
60:10,19 81:23
82:5,6,7,8,17
82:19,20 83:7
83:8 85:12,19
85:22 86:5,6
86:13,18 87:1
87:7 95:18,22
95:24 96:4,7
96:11,14,15,17
96:20,22,25
97:2,3,5,6,7,20
97:22 98:3,3,6
98:9 99:4
100:18 101:3
101:11,14,21
102:4,4,10,14
103:4,10,12,15
103:16,23
104:3,7,10,22
105:7,13,21
106:4,6,15,22
107:2,5,10,14
107:20,22
108:10,14,23
108:24 109:13
109:17,18,20
109:24,25
110:2,6,8
117:12,13,23
119:7
processors 25:9
28:6 30:11,13
31:2,15 32:10
32:10,11,12,15
32:17 33:9
54:19,24 55:1
55:18 56:4,10
59:9 60:2,7
76:25 82:1,3,5
82:6,12,16
83:2,6 85:23
86:3,10,16,24
87:6,12,15,20
87:22 88:6
96:9 97:14,17
99:6 101:23
102:10,16,19
104:1 106:25
109:4 111:25
111:25 112:4
product 61:3
products 78:11
professional
162:3
profile 138:1,2
138:9 139:7,19
140:25 141:8
141:10,17,21
141:22 142:2,4
142:21,23
143:24 144:2,5
144:7,19
147:24 148:5,9
148:19 149:6,9
149:11,16,19
150:3,5,16,17
151:12,14,18

151:23 152:1 152:18,23,23 153:1,5,7,9,10 153:14,16,20 154:7,7 155:1 155:8,12,15,20 155:22,24 156:2,19 157:3 157:10 158:7,9 158:13,16 159:2,10
profiles 150:13 152:17 156:4,6
program 17:23 17:25
prosecution 40:16 63:20 72:17 73:23 74:9 76:19 79:9,15 113:7 113:15,16 114:1,24 116:15
prospective 131:6
protocol 19:2 95:10,15
protocols 97:19
provide 27:18 33:22 44:17 45:4 75:25 84:15 93:23 99:1 130:10 133:24
provided 25:15 35:11 37:11 43:16 57:11 71:9 82:15 90:1,20 96:1
providers 19:16
provides 27:4 44:3 128:25
providing 26:10 27:12 32:22
provisional 120:1,1 136:23 137:3
ps 89:19
purple 80:7 81:3,3,21
purpose 24:14 32:25 33:3,5 133:2,6
purposes 23:12 119:25 136:22
put 14:16 69:6 80:7 99:25 119:20
putting 114:24

q

qualify 20:17
qualifying 28:10
question 8:24 9:14 11:2 27:1 30:22 31:14 33:12 34:4 35:9 36:17,22 36:22 39:20 40:18,19 41:2 41:6 46:2 48:2 50:3,9 56:6 58:3 60:9,21 60:22 61:5,6 61:10,14 62:14 62:18 64:16 68:3,6 69:16 69:21,25 70:7 70:12,15 71:22 72:23 73:9,10 74:11 75:14 77:4,5,16,20 78:15,20,21 79:1,6,19,24 84:4,10 87:16 87:17 88:4 89:5 91:5,18 92:1,8 96:10 96:13 98:18 99:10,12 101:4 101:6,15 102:21 105:9 122:12 127:3,5 127:17 128:19 130:2,11,14 132:7,12,18,24 132:25 133:16 133:20,24 134:5,10,18 140:8 144:15 146:25 156:3 157:16 159:7
questions 78:24 111:15 160:5,7
quick 8:19
quiqley 13:19
quite 15:17 44:12
quote 118:2
quoting 120:3

r

r940 85:11
range 37:23,24 158:7
ratio 141:24 143:23 145:12
reach 154:14
read 25:21 31:19 35:12,19 35:22 38:14 41:25 42:20 43:12 45:5 63:22 66:17 69:8 85:4 89:14,17 90:7 90:10,10,12 92:5,16 93:17 95:9 102:24 103:13,19,20 105:11 106:1 109:21 112:18 113:4 123:9 125:11,18 128:6 129:15 129:19,19,23 131:17 134:15 135:5 139:5

141:5 148:14 158:2,11 161:9
reading 28:15 28:22 37:9,13 43:1 104:5 120:15 151:10 157:23
real 70:1 117:21
really 27:12,15 28:20 30:17 33:11,18 34:1 34:4 36:9 69:22 70:12 73:5 86:14 97:9 116:23 134:10 142:1 151:2 154:18 155:23 156:1
reason 24:11 24:18 26:4,6 55:4 116:21 137:19 138:8 138:16 149:1 155:6
reasonable 23:25 34:10 35:6 36:5 37:2 41:13 49:7,18 50:13 57:21 58:12,19 61:16 62:21 63:7 73:24 79:12 97:1 104:25 152:9
reasonably 115:17 116:7,8 117:6
reasons 36:6 83:9 113:8 117:7 149:12 155:16 159:3
recall 13:20 14:13,18 21:18 22:2,5,12 24:19 25:25 64:14
receive 133:12 143:24
received 124:6 133:13 147:20 147:23
receiver 121:21 122:14,20,21 123:21,22,23 124:5,12,15 125:2,15
receives 122:10 124:2,16 134:7
receiving 121:8 121:15,18,20 122:2,5,6,8 123:5,10,12,13 123:13 124:8 124:10,18,20 134:16,19 143:4 144:24 144:25
recent 18:3
recess 56:19 65:11 110:16 147:7
recitation 86:20
recites 112:16
recognize 42:17
recollection 12:16 23:12 51:12 52:16 117:15 128:15
recommend 15:16
record 7:5,14 56:17,20 64:11 65:7,9,12 67:24 69:5 72:18 73:7,18 77:12 110:13 111:4 115:4,5 147:5,8 160:11 162:8,12
recorded 7:6
recording 7:12
red 46:17,20
redirect 160:6
reduced 25:6
reduces 120:24
refer 9:25 10:4 10:8 22:23 29:5 30:4 90:7 97:2 123:11
reference 28:15 30:24
referenced 24:17 28:10 34:25
references 29:15,23
referencing 21:12 67:10 68:8 72:2,4
referred 30:21 30:23 124:11
referring 20:24 21:1 47:9 50:12 68:11,12 68:15,17 81:17 85:23,24 86:1 87:12 106:13 107:6 108:18 124:19,22 142:1,22 158:25 159:1 160:2
refers 32:25 104:6 142:20 159:25
reflect 17:8,11
regarding 9:19 13:23 118:22
regardless 63:4
registered 162:2
rejection 116:17
rejections 116:11

relate 18:20 93:18
related 19:2,5,8 48:15 99:2 101:7 148:17 148:20 149:5 149:14,18 150:2,5 151:18 151:21,25 153:2,3,14 154:1,24 155:9 155:19 156:2,3 156:6,17,18 157:2,3,10 158:20,21,25 159:2,6
relates 14:3 40:15 67:24 82:25 86:16 87:1 92:25 100:12 116:25 118:20 150:7,9
relating 10:20 18:10 108:22
relationship 86:12 87:15 157:14
relative 85:10 162:18
relevance 19:14
relevant 17:15 18:15,18 69:1 70:11 119:9
relied 21:20 26:13
rely 93:21 100:21
remember 10:18 13:24 14:14 25:7 147:15
remote 1:13 2:16
remotely 2:18 3:2 4:2 7:9
removing 56:7
renders 112:19
reordering 97:9
repeat 8:24 9:2 48:2 72:23 89:5 92:1 121:10 127:3
reported 1:22
reporter 2:23 7:7 8:25 9:7 162:2,3,3
representing 7:23 12:25 13:3
reproduced 117:9 118:13
request 121:9 121:18,20 122:9,10,13,15 122:19 123:20 123:22 125:4 125:13,22 126:7,12,19 127:21,24 128:25 129:2 131:18 132:10 132:11,15,22 134:8,17,19
requested 6:10 162:16
requesting 122:2,23 124:12 130:21
requests 121:16 123:6 127:20 147:18
require 83:12 113:13 126:22 127:7 131:16 132:16 133:22
required 41:21 43:22,23 53:23 60:7 73:16 81:20 84:13 85:14 96:10 97:11 98:4 154:13
requirement 40:10 41:18 55:10 59:19,20 77:24 82:10 83:16 87:2,4 112:21 113:5 123:4 126:7
requirements 44:21 55:9,23 73:10 74:22 82:20 102:1,5 107:15 121:3 131:16 145:8
requires 45:1 59:8,10 76:7 102:8 121:7,15
requiring 46:7
researcher 19:25 21:2
resolve 123:18 132:24
respect 17:22 23:10 26:11 27:9 28:10 30:23 31:5 33:24 37:4,17 38:9,12 39:6 39:12,20,25 41:14 42:18 43:5,21 46:6 46:10 48:23 49:6,8 51:6,13 51:15,24 53:23 55:9 56:1 57:21 58:7 59:16,22 61:6 61:11,14 62:15 62:19 63:7 67:22 72:20 73:4 75:10 77:22 79:17 81:9 82:9,17 84:9 86:12 87:11,24 88:5 92:20 94:1

102:1 103:17 104:9,21 106:23 115:10 115:20 119:4 119:22 120:16 120:21 124:18 125:21 126:18 128:20,22 132:7 133:20 146:20 148:7 149:14 156:23 156:24
respective 158:15
respectively 31:4
responsive 134:20
rest 47:16 79:18 80:19 103:19 109:24 118:21,22 123:25 126:20 153:10
restate 78:21
result 89:14 92:6,17 113:21
resulting 117:2
results 37:16 38:8 133:13
resumed 110:17 111:10
review 104:3 162:15
reviewed 11:25 14:6 21:8
reviewing 12:4
revolve 64:17
revolves 116:3
right 9:20,25 10:5,9 11:3,18 13:21,25 15:20 28:18 30:3 34:21 48:24 49:14 53:2 59:9 63:3 68:2 71:2 85:20 86:9 90:2 102:16 107:11 108:12 109:15 112:24 116:11 116:19 125:23 126:18 131:17 139:11 140:10 144:21 151:5 160:10
risc 25:5,6,11 25:18 26:6 27:3,8 31:21 31:24 32:11 103:15,22 108:24 109:13 109:20,24 110:6
row 18:24 19:13
rpr 1:22 2:22 162:25
rules 8:20

s

s&r 138:1,2,6,9 138:9,11,14,15 138:21 139:2,7 139:13,15,17 139:19 140:14 140:19,21,23 141:6,7,8,10,15 141:15,16,20 141:22 142:2,3 142:3,21,23 143:4,23,24,25 144:1,4,6,19 145:1,3,7,10,11 145:13 146:18 147:12,14 148:2,4,5,17,19 148:19 149:5,6 149:9,11,14,18 150:2,3,5,13,16 150:17 151:11 151:13,17,18 151:21,23,25 152:1,17,18,22 152:23 153:1,2 153:3,7,9,10,14 153:14,20 154:1,6,24 155:1,5,8,8,12 155:15,18 156:2,3,6,17,18 157:2,3,9,10 158:7,7,13,16 158:20,21,25 159:2,6,10,10 159:12,18
sake 145:11
santa 1:15 2:20 7:1 111:1
saw 28:16 97:6
saying 9:2 26:13 28:11 32:8 40:9 48:14 52:18 60:6,8 62:1 67:17 77:1 83:23 87:3,21 98:3,5 108:21 110:3 112:3 118:6,8 139:24 140:18 141:2 141:21 142:6 143:3 144:1 150:17 151:22 152:6 153:8,22 153:25 156:5
says 24:8 29:17 31:18 32:5 34:7 35:12 38:14 40:5 41:3 43:12 44:14 59:15 63:22 66:17 69:8 71:16 80:19 81:1,16 82:16 83:15 85:4,21 89:10 89:13,14,17 90:12 91:19,25

92:16,23 93:2 96:19 102:24 103:13,20 104:4 106:1,1 106:9 107:10 109:21,25 112:16,18 122:9 123:9,12 124:11 125:9 127:21 128:6 129:15,23 131:17 133:21 134:14 135:16 138:18 142:20 144:19 146:16 148:14 149:10 151:17,20,25 154:24 155:4 158:1,8,11
scenario 72:13 84:18 86:22 87:13
scenarios 100:25
scope 14:8 35:5 35:7 36:6 37:1 37:18 38:7,9 40:1 41:14 42:18 43:9,21 44:13,19 46:9 47:21 49:19 50:11 57:21 58:17,21 60:4 61:13,16,19 62:17,19 63:1 63:8 73:16,25 76:17 79:11 81:19 84:16,17 97:12 108:5,7 117:1,2,4 130:7
scopes 49:5
search 21:15
second 10:3 38:22 39:3,21 40:2,13,24 41:5,11,16,18 41:23,24 42:3 42:7,13,14,16 42:24 43:11 54:11 57:7 58:10,16 59:13 61:22 62:5,11 83:12,17 84:9 95:9 113:10 121:22 124:3 125:1,3,24 126:1,8,13,22 127:8,13 128:3 128:7,8,10,13 128:17,22 129:6 135:19 141:4 150:8 154:16
secret 11:11
see 19:11 24:9 24:16 29:8 30:2,9,14,16,24 31:22 46:18,23 52:10,11 54:13 60:12 64:5 65:23,25 66:2 66:3,22,23 77:24 80:5 89:9,10 91:25 92:16,22 94:16 95:2 105:18,25 109:6,8 111:18 111:21 120:5 123:4 125:16 125:18,21 126:3,14,24,25 127:9,10,12 129:11 130:5 136:17 141:12 146:15 147:2 148:23 152:5 158:6
seeing 76:3 141:7 144:2 155:2
seemed 76:24 114:21
seems 74:20 78:18 99:5 100:23 126:18
seen 22:13
sees 151:11
selecting 141:20
self 53:19
send 55:11 121:2 123:22 123:22
sending 120:23 147:17
sends 121:8,16 123:5 124:4
sense 33:4 70:13,16 71:11 88:18 125:6 142:13 149:23 152:12 154:19 155:21 156:15 156:15,17
sent 19:7 120:18 123:20 130:20 132:6 133:7 134:1 147:19
sentence 89:13 89:14,16,17 90:3 95:9 120:10 124:15 124:24 126:3 131:2 138:17 141:4,5
sentences 91:21 142:16
separate 14:24 39:4,9 40:3,5 40:10 41:18 42:14,15 43:19 49:6 51:3,6 55:16 58:11,16 59:7,8,24 63:15,18 66:21 68:4 69:12,20 72:21,24 73:4

73:13,20 74:6 74:8,15,17,19 74:24 75:6,10 75:16,17,19,20 76:4,9 77:2 78:24 79:13 83:13,19,25 84:2,5,6,11 101:23 102:10 102:16 104:14 104:15 105:2 106:18 115:4 115:14
separated 40:5
separately 90:24 91:12,23 92:10,12 155:4
separateness 40:12 41:21 43:23 75:8 76:1,7 84:13 87:2,4
separation 73:17 113:9
september 23:13,23 33:7
sequence 135:12
series 76:4
service 17:23 24:6 89:19 137:20,24 138:4,6,11 139:15,23 140:17 144:22 145:4,6,8 148:17,21 151:19 154:4,4 154:10 156:12 158:12,14,19 158:20,22 159:25
services 90:14
serving 17:23
set 25:6 36:6 38:3 45:17 48:17 52:2,3 52:22 100:16 105:8 124:3 125:20 140:14 141:18 142:2 142:14,24 143:2 144:9,10 144:13,23 145:22 151:3,6 151:19 153:5 153:17 154:5 162:6
setting 151:19
shake 9:7
shape 71:25
share 16:4 72:9 72:21,25 76:15 77:8 79:3,7
shared 76:21 76:24 77:2 93:19 114:19 118:17
shares 118:14
sharing 73:5 114:13,14
shoot 22:19
short 147:3
shorthand 2:23 162:1,10
show 82:6,7 104:14 113:14 138:19 140:8 141:25
showed 15:21
showing 47:6,8 52:21 54:23,24 55:2 127:12
shown 49:1 52:15,19 82:14 85:15 122:13 128:14 138:24 158:3 159:13
shows 15:19 48:18 54:25 65:21 82:4,5 113:12 138:12 139:25 159:15
sic 147:11
signal 8:22 18:5,10,21 20:20 135:9 141:24,24 143:22 145:12 145:16 147:21
signals 147:17
signature 16:22 16:24 162:24
significance 32:3
significant 113:17 154:15
similar 127:23 130:13,14,16 130:17,18
similarities 131:1,3
similarity 148:9
simply 87:5,17 96:15
simultaneously 95:13
single 35:24 38:2 55:5,7,22 56:10 58:25 68:5,12 70:14 74:3,13,18 75:5 82:7,19 83:24 84:22 85:1,23 86:10 86:24 87:19 88:6 104:7 105:13,20 106:4,7,15 108:13
singular 106:7
sit 11:2,18,22 14:12
sitting 13:21,25 14:17
six 12:9 46:17 46:17

size 15:15 71:25
skill 27:19 28:12,22 36:25 37:7,13 41:12 43:5,9 44:24 46:9 58:7,19 59:17 60:4 61:15,19 62:20 63:5 67:15,21 69:2 81:7,19 83:19 84:15 94:2 104:12,19 105:14 113:17 115:7,15 116:8 116:25 117:5 144:2,17 148:6 150:3 151:10 151:16 155:9 156:20,25
skilled 42:15
small 85:7
smallest 144:12
soc 74:5,12 75:4,10,23,24 76:9 86:14
socs 74:2
software 91:2 91:11 92:12 93:4
solid 143:14
solutions 20:5
somebody 58:5
somewhat 31:11 50:19
songs 13:1
sony 19:3
soon 15:19
sorry 11:20 15:3 21:23 34:23 35:22 37:23 68:14 70:13 86:2 89:4 91:25 94:23 99:10 102:23 108:2,3 121:10 129:18 138:20 140:12 141:4 144:25 150:12 157:21 157:21 158:1 159:21
sort 16:12 92:24
sorts 47:16,20 48:10 49:17 100:7
source 146:3
sources 145:15 145:21,22 146:7,13,15
space 19:23
speaks 26:8
specialized 25:8 48:16
specific 31:2 44:12 52:22 75:13,18 77:24 98:12 132:18 134:11 148:6
specifically 10:18 14:12,14 14:18 21:18 22:2,5,12 24:17,19 25:23 27:12 29:18 87:1 149:24
specification 24:7 26:11 29:14,22 30:16 30:25 31:8,10 37:14 38:6 42:21 43:1,16 43:25 44:2,5 45:4,12 51:17 52:2,23 53:15 53:21 79:10 80:10,21 81:2 89:6,21 90:15 91:17 99:18,23 100:15 101:25 102:15 104:3 105:1,17 108:24 109:5 109:11,25 125:8 128:15 133:21 135:4 135:24 136:1,3 142:20 144:3,5 146:24 151:12 152:21 153:6 153:20,23 154:21 155:3 155:10,14,25 156:4,16 157:11
specifications 49:24 51:9 84:22
specificity 32:22 97:11
specified 127:19 132:10 135:7
specifies 128:3 131:19
specify 41:20 129:1,3
specifying 127:22,24 128:20 134:20
spectrum 159:16
spend 12:4 14:23
spent 14:22,25
spoken 13:15 13:22
sprint 12:23 13:10 18:23
stack 19:2
stand 77:12
standalone 85:8,17 87:6
stands 25:6 145:12
start 22:15 61:9 117:3 139:25

started 135:11 150:20
starting 103:18
starts 136:15
state 7:15 161:15 162:2
stated 48:4 72:19 101:17
statement 28:19 109:14 130:13 152:14
statements 79:14 113:16 116:22,24 118:4
states 1:1 2:1 128:3
stations 95:12
status 147:25
stenographic... 1:22
step 70:6 137:17 140:13 140:15 155:11
steps 20:8 155:19 159:1,3
stop 122:11
storage 66:19 67:5,8 69:10
street 3:9,19
structure 79:23
stuff 16:13
sub 138:4,10,13 138:14,21,22 139:9,13,18,20 140:7,18,20,23 140:24 142:3 143:11,12,17 143:18 153:18 154:8,11 159:13,15,20 159:23
subject 14:4 21:23
subscribed 162:21
subsystem 100:22
successfully 143:9
sued 12:23
sufficient 40:11 79:24 82:10 134:4 145:7
suggest 99:5 153:21
suggested 14:15 22:9
suggesting 22:6
suite 3:9
summarize 62:14 150:21
summary 121:1
support 26:18 137:3 152:22
supported 156:16
supporting 159:9
supports 151:12
suppose 33:12
supposed 37:20 39:9 46:10 53:4,6 81:8,15 107:3 120:22 135:12,16
sure 9:13 13:10 15:24 25:12 28:2 32:5 57:2 61:7 65:8 68:22 69:16,21 70:10 71:7,9 71:17,23 72:12 91:19 98:23 99:22 128:23 130:4,8 146:9 150:14 157:8 159:7
surrounding 47:13
suspect 18:14 108:4
sworn 111:7 162:8
system 41:7,8 58:8 59:18 60:10,12 61:12 62:16 77:21 78:3,7,16,17 79:20,23 85:1 85:6,18,25 87:8,18,22 88:5 91:15 98:2 100:1 132:14 133:23 133:23 145:19 145:22 146:6 146:19,21,22 147:13 156:15
systems 18:6,11 20:3,4,21 41:9

t

table 90:19
take 7:13 147:3 156:11
taken 2:17 25:23 27:10 28:14 33:2 48:13 110:16 162:5
talk 9:12 142:1 145:16
talked 13:18 112:17 149:12
talking 20:23 32:15 46:11 48:12 56:24 68:23,24 72:14 106:20 109:10 111:13,23 124:13,14 134:11 144:7 145:10 147:12 150:4 151:13 156:1,7 158:15 158:17
talks 29:15 131:12,24

132:1 157:5
task 35:17 42:3 43:15 61:25
tasks 42:23,23 48:16
taught 56:11
tdmi 31:21,24 32:24 103:15 108:23 109:12 109:20,24 110:5
teaching 107:3
teachings 104:21
technical 10:24
technologies 19:25
technology 18:10 20:7
telecom 21:25
television 18:5 18:10,21 20:20
tell 75:7 81:14 97:10 115:19 124:6 134:12
telling 36:19
tells 123:23
ten 12:6
tend 51:23
term 25:24 27:11,14 28:24 33:18 34:9 36:18,24 38:11 39:24,25 42:6 42:6 43:3 44:3 44:4 60:19 69:2 70:16,21 73:4,21,24 74:1,20 75:10 75:13 86:25 88:19 90:6 93:8,22 95:21 96:18 97:6 99:15,21 104:2 116:1 131:5 132:2 141:8 142:16 144:3 148:7 150:13 155:8,18 156:19
terminology 123:16
terms 14:10,15 17:17 25:13 26:9 31:9 32:21 57:5,6 70:8 72:14 75:4 97:10,25 98:11 103:25 116:20
test 58:3 75:7 76:1
testified 8:3 107:13 111:8
testifying 1:15 2:19 162:8
testimony 48:8 54:2 115:23 116:3 160:12 161:12 162:12
testing 109:3
texas 1:2 2:2
thank 88:4 160:9
theoretically 97:16
thing 8:25 15:22 16:7 48:22 121:17 123:14 124:16 125:6 145:18 150:5 155:6 156:17,20
things 13:1 17:17 21:1,19 37:6 43:1 47:16,20 48:11 68:23,25 72:15 76:23 78:18 97:15 101:24 117:18 119:1 145:17 149:3 157:1
think 12:9 15:1 17:16 18:1,24 19:3,10 21:18 22:2,4,11,12 23:25 24:13 25:7,20,22 26:2,8 27:4,10 27:17,25 28:9 28:11,13,22 29:14 30:25 31:7,8,11,13 34:7 35:2 36:2 36:3 37:15,25 39:11 40:8,14 40:18 42:15 43:3 44:24 45:8,13,16 47:4 48:13 49:15 51:22 52:21,23 54:23 54:24,25 55:23 56:3,15 63:16 64:9,23 67:1 67:14,20 68:24 68:25 72:14,16 73:14 74:10,23 75:12 77:4 78:6 80:23 83:4,4,15 84:25 87:10 89:13 92:2 93:4,14 94:2 96:2 101:4 104:12,19 105:11 106:9 106:10 107:1,9 108:2,11,21 109:3,9,16,17 110:4,10 112:12 113:15 116:3,14,20 117:3,4,16,17 117:25 118:1,8 118:19 119:6,8 119:24 122:4 122:16 125:17 127:23 128:14

128:14,16,24 130:16 131:11 131:25 133:8 133:15 135:11 141:2 144:15 144:17 145:20 148:4,5,10 149:2,4,12 150:11,20 152:10 153:24
thinking 118:9 118:9
third 10:7 125:24 126:1
thought 17:3 60:17 72:19 73:2 78:5 79:22 91:6,13 94:6 99:10 101:10 116:12 116:19 126:18
three 9:22 10:12,20 16:3 20:21 29:25 44:7 46:16 82:6 86:2,2,3 86:10,24 87:12 87:15,19,22 103:3,7 104:6 104:15 105:2 105:12 140:9
threshold 33:20
tie 87:14
tied 96:13
time 7:15 12:9 17:18,21 21:10 28:7,16 36:25 44:6 49:16 56:15 67:19 70:1 93:25 102:21 110:10 137:9 162:6
times 8:12 11:5 13:12 92:19 140:9 157:16
today 7:20 8:20 9:19 11:24 16:14,25 17:2 17:15 115:19
today's 160:12
together 100:1 140:24
told 14:25 50:20 68:21 134:4
top 25:20 29:4 46:20 52:11 64:22 65:1 139:25
totality 116:24
trade 11:10
transcribed 162:10
transcript 161:10 162:11 162:14,16
transistors 45:18 59:17
transitions 138:18
transmission 93:19 128:12 131:21 134:22 154:13
transmit 121:23 143:9 156:12
transmitted 125:4,13 132:21 133:18 147:23
transmitter 121:19 123:24 124:2,9,13,23
transmitting 122:12 125:22 135:8 144:25
traverse 116:21
tried 33:11,18 91:6 146:25
true 134:7 143:1 161:13 162:11
try 18:13 97:25 123:17 147:22 147:24 150:21
trying 24:16 34:9 35:7 39:8 62:7 71:14 75:1 77:24 94:21 121:12 123:2 127:4 137:8,25 146:8 149:8 151:3 154:12 159:19
turn 17:5 24:20 25:16 28:25 34:17 80:1 94:19 102:22 109:6 119:11 137:12 141:3 152:15 156:4 160:5
turned 39:10
turning 155:18
tutorial 10:25
tv 19:20 20:3 145:21 147:16
two 12:22 24:5 27:21 30:11,13 30:13,18 37:11 40:11 43:1,7 43:18 46:16 54:19,21,24,25 56:4,10 59:8 59:23 60:1,7 63:14 68:4,23 68:24 70:15 72:21,24 73:12 73:19 76:22,24 78:18,24 81:25 82:3,5 83:2,5 83:23 84:3 86:7,18 87:6 90:23 95:11,25 96:8 99:6 101:24 106:25 109:8 111:24

111:25 112:4 128:24 130:7 136:4 155:3,19 160:3
tying 86:25 146:11
type 12:21 30:15 32:1,6 32:12 85:11
types 11:8 33:8 44:23 71:7 97:13 146:10
typical 70:21
typo 107:6

u

u.s. 9:23 10:3,7 11:13
ultimately 21:20 118:10 119:3
unbounded 74:23
uncertain 73:8 118:6
uncertainty 37:17 38:9 42:17 46:6 49:22 50:8 62:21 84:17
unclear 44:19 45:20 47:8 48:11 52:1 55:8 95:21
under 20:17 61:22 78:7 91:8,15 96:4 109:20 161:9 162:10
undergraduate 44:8
underlying 19:25
undersigned 162:1
understand 8:23 28:24 34:9 36:18,19 37:10 39:8 42:21 43:20 44:9,10,11,25 45:2,6,8 49:25 50:3,4,9,10,11 50:17 57:3,8 61:19 67:18,21 68:6,15 69:23 70:2,7 71:14 77:15,20 78:19 78:22 91:18 93:8 94:3 96:16 97:7,12 97:25 98:10 100:2 101:13 104:6,20 105:15,18 113:18 115:7 117:1 121:13 123:2,8 130:16 132:12 138:10 141:2 144:4,18 149:9 150:1 151:16 156:5 156:25 157:8
understandable 116:7
understanding 25:3 26:10 31:1 35:4 38:7 40:1 43:6 44:22 63:17 64:9,19 74:12 75:9,12 76:11 80:13 81:10 89:11 90:8 93:24 95:17 96:23 98:8,22 99:2,8 101:5 103:6 105:17 115:6 117:11 127:17 137:9 141:17
understood 27:20 28:17 44:4 45:5 52:18 117:4 122:19 137:11 156:19
unit 66:21 69:12
united 1:1 2:1
unreasonable 37:17 38:8 47:22 57:19,20 63:6
unreasonably 156:24
upgrade 91:2 91:10 92:12
upgrading 93:4
use 15:17 22:10 23:11 29:23 38:7 44:18 53:8 63:5 68:20 70:16 71:10,19 104:2 106:10 107:1 122:23 123:16 153:8
used 20:10 22:4 22:13 26:20 28:24 43:3 50:5 69:3 70:8 70:22,23 71:13 73:21 74:8,21 76:25 97:25 127:5 128:25 132:2 147:14 148:7,11
uses 44:2 73:25 99:21 129:9
using 41:11 73:3 74:20 86:25 89:15 90:6 97:5 106:25 120:12 124:5 155:24 162:9
usually 145:14 160:3

v

v 18:24 19:13
vague 30:22 97:23 101:9,15 101:17 105:4,9 132:7 133:20 135:10
vagueness 97:24
value 138:6 139:16,17,20 140:23 142:11 142:13,25 143:8,16 144:8 151:22 158:10 159:12,18
values 138:14 139:13 141:18 142:3,14,24 143:6 144:9,10 144:13 151:4,4 151:6
variety 145:15 145:21
various 20:9 74:2,13 75:5 75:11
veritext 15:25
version 46:14 66:12 138:12 138:23
versions 32:17
versus 7:11 14:25 18:23,24 33:21 73:10 78:16 88:2 96:23 148:5 149:16 155:22
viable 108:5,6
video 7:6,12
videoconfere... 2:19
videographer 4:4 7:4 56:17 56:20 65:9,12 110:13 111:4 147:5,8 160:10
videotaped 1:13 2:16
view 45:15
villagran 1:22 2:22 7:8 162:25
virtual 88:16 90:4,6,8 92:6,8 92:17,21
virtually 88:25 89:7,15
volume 1:17 2:17 5:5 161:21
vs 1:7 2:7

w

wait 94:20
walked 159:1
want 15:24 18:17 22:15 32:22 58:10,11 60:21 66:9,9 66:10 75:19,25 127:4 129:21 130:8,16 153:9 154:5
wanted 58:6,15 61:8 97:3 157:4
way 11:1,17,22 48:16 55:22,25 58:24 60:14 65:5 70:21 74:11 84:1,10 97:4 101:7,16 104:11 123:19 125:20 128:24 132:1 146:23
ways 49:17 81:11
we've 23:1,1 40:23 47:12 115:18 137:22 140:4
web 15:24
webster's 5:20 94:9
welcome 111:12
went 56:23 111:13
west 3:9,19
whereof 162:20
wholly 112:13 154:25
wi 97:15,22
widely 28:7,11 28:13
windows 16:3
wireless 147:16 148:1
wish 17:1
witness 19:18 20:25 162:20
witnesses 162:7
word 32:3 88:13 107:1 122:23 150:11
worded 130:10
words 89:10 91:21 92:2 97:9 106:10 130:5
work 17:11,23 19:18 20:23,24 20:25 22:14 78:16 95:12 155:12 156:15
worked 12:18 13:2,6,9,10,11 19:20 20:6,9 20:19 147:15
working 19:23 19:24 21:2
works 123:19
world 5:20 70:1 94:10
worst 138:1,2,5 138:8,9,11,15 138:20,21 139:2,6,15,17 139:19 140:12 140:13,14,19

140:20,23
141:6,8,15,16
141:20,22,23
142:2,5,21,22
143:7,9,10,16
144:1,4,6,7,19
145:7 148:19
149:6,9,11,20
149:25 150:2,4
150:13,16,17
151:3,8,11,13
151:17,23
152:1,22 153:1
153:4,7,9,10,14
153:16,16,20
154:6,6,10,11
154:17,25
155:5,8,12,15
156:7,9,18
159:2,19
write 14:19
written 108:7
wrong 65:5
wrote 119:4

x

x 159:15

y

yeah 27:25
36:15 51:19
87:10 115:24
150:12
year 12:17
years 20:21
44:7
york 3:20,20

z

zero 141:7,15
141:24,24
142:8,10,19
143:2,23 144:1
144:11,15,16
144:23,24
145:3 151:1,5
151:7 153:11
156:14
zeros 141:11
zoom 8:21 9:11
15:23 16:4

Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

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EXHIBIT 10

The Institute Dictionary of Electrical and Electronics Terms

Sixth Edition

Published by the
Institute of Electrical and
Electronics Engineers, Inc.

The IEEE Standard Dictionary of Electrical and Electronics Terms

Sixth Edition

Standards Coordinating Committee 10, Terms and Definitions
Jane Radatz, Chair

This standard is one of a number of information technology dictionaries being developed by standards organizations accredited by the American National Standards Institute. This dictionary was developed under the sponsorship of voluntary standards organizations, using a consensus-based process.

ISBN 1-55937-833-6



When the IEEE Standards Board approved this standard on 10 December 1996, it had the following membership.

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Assistance was provided by the IEEE Standards editorial staff.

How to use this dictionary

The terms defined in this dictionary are listed in *letter-by-letter* alphabetical order. Spaces are ignored in this style of alphabetization, so *cable value* will come before *cab signal*. Descriptive categories associated with the term in earlier editions of IEEE Std 100 will follow the term in parentheses. New categories appear after the definitions (see Categories, below), followed by the designation of the standard or standards that include the definition. If a standard designation is followed by the letter s, it means that edition of the standard was superseded by a newer revision and the term was not included in the revision. If a designation is followed by the letter w, it means that edition of the standard was withdrawn and not replaced by a revision. A bracketed number refers to the non-IEEE standard sources given in the back of the book.

Acronyms and abbreviations are no longer listed in a separate section in the dictionary; rather, they are incorporated alphabetically with other terms. Each acronym or abbreviation refers to its expanded term, where it is defined. Acronyms and abbreviations for which no definition was included in past editions have been deleted from this edition of IEEE Std 100.

Abstracts of the current set of approved IEEE standards are provided in the back of the book. It should be noted that updated information about IEEE standards can be obtained at any time from the IEEE Standards World Wide Web site at http://standards.ieee.org/.

Categories

The category abbreviations that are used in this edition of IEEE Std 100 are defined below. This information is provided to help elucidate the context of the definition. Older terms for which no category could be found have had the category "Std100" assigned to them. Note that terms from sources other than IEEE standards, such as the National Electrical Code® (NEC®) or the National Fire Protection Association, may not be from the most recent editions; the reader is cautioned to check the latest editions of all sources for the most up-to-date terminology.

Catego

AE
AHDL
AMR
AP
ATL
BA
BT
C
CAS
CE
CHM
COM
CS
DA
DEI
DESG
DIS
ED
EDU
EEC
ELM
EM
EMB
EMC
GRS
GSD
IA
IE
II
IM
IT
IVHS
LEO
LM
MAG
MIL
MM
MTT
NEC
NESC
NFPA
NI
NIR
NN
NPS
ODM
OE
PA
PE
PEL
PQ
PSPD
PV
QUL
R
RA
REM

values: logic "0" or logic "1." A data bit may convey control, address, information, or frame check sequence (FCS) data. (EMB) 1073.3.1-1994, 1073.4.1-1994

(2) The smallest signaling element used by the physical layer for transmission of packet data on the medium. One of the PDUs for the physical layer (the other is the arbitration signal). (C/MM) 1394-1995

data block *See:* block.

data-break *See:* direct memory access.

data breakpoint A breakpoint that is initiated when a specified data item is accessed. *Synonym:* storage breakpoint. *Contrast:* code breakpoint. *See also:* dynamic breakpoint; epilog breakpoint; programmable breakpoint; prolog breakpoint; static breakpoint. (C) 610.12-1990

data broadcall An operation wherein participating slaves capture the data that are placed on the data lines by the responding slave during a read cycle. (C/MM) 1096-1988

data broadcast An operation wherein participating slaves capture the data that are placed on the data lines by the active master during a write cycle. (C/MM) 1096-1988

data buffer register A register in a central processing unit or peripheral device capable of receiving or transmitting data at different data transfer rates. *See also:* input buffer register. (C) 610.10-1994

data bus A bus used to communicate data to and from a processing unit or a storage device. *See also:* bidirectional bus. (C) 610.10-1994

data cache An area of high-speed buffer storage, used to store data and operands. *Contrast:* instruction cache. (C) 610.10-1994

data card A punch card that contains data to be used by a computer program. *See also:* source data card. (C) 610.10-1994

data carrier Material that serves as a data medium or to which a data medium is applied and that facilitates the transport of data; for example, a punch card, a disk, or a plastic card with a magnetic surface that serves as the data medium. *See also:* data medium. (C) 610.10-1994, 610.5-1990

data cell *See:* storage cell.

data certification The determination that data have been verified and validated. *See also:* data producer certification; data user certification. (C/DIS) 1278.3-1996

data chain *See:* composite data element.

data chain bus A connection by which electrical signals are transmitted and/or received at multiple circuit elements. (C) 610.10-1994

data channel *See:* input-output channel.

data channels (test pattern language) All memory devices have one or more (up to 16) independent data inputs or outputs. Each of these is called a data channel. (C/TT) 660-1986w

data character A character used for packet payload or packet header. A data character represents one of the values of a byte, i.e., 0–255 (decimal). Only N_chars are used as data characters. *See also:* link character; normal character. (BA/C) 1355-1995

data characteristic (software) (software unit testing) An inherent, possibly accidental, trait, quality, or property of data (for example, arrival rates, formats, value ranges, or relationships between field values). (C/SE) 1008-1987r, 610.12-1990

data circuit A circuit used to transmit data. *Synonym:* duplex circuit. (C) 610.7-1995

data circuit-terminating equipment (DCE) (1) A device that provides the signal conversion and coding between the data terminal equipment (DTE) and the network carrier facility. Note that in the context of an ITU-T X.25 network, for example, the DCE performs functions at the network end of an access line to the network. (COM/C/LM) 802.9a-1995, 8802-9-1996

(2) A device that interfaces between the data terminal equipment (DTE) and the line. (C) 610.7-1995

data code *See:* code.

data collection station *See:* data input station.

data communication equipment (1) The equipment that provides the functions required to establish, maintain, and terminate a connection, as well as the signal conversion, and coding required for communication between data terminal equipment and data circuit. (COM) 168-1956w

(2) An equipment that transmits data from one point to another. (C) 610.7-1995

data communications (1) **(data transmission)** The movement of encoded information by means of communications techniques. (PE) 599-1985w

(2) A data transfer between data source and data destination via one or more data links. (C) 610.7-1995

data compaction Any technique used to encode data in order to reduce the amount of storage it requires. *Contrast:* data compression. (C) 610.5-1990

data compression Any technique used to reduce the amount of storage required to store data. *Contrast:* data compaction. (C) 610.5-1990

data concentrator A concentrator that permits a common transmission medium to serve more data sources than there are channels available within the transmission medium. (C) 610.7-1995

data connection The interconnection of two or more data circuits by means of switching equipment to enable data transmission to take place between DTEs. *See also:* virtual data connection. (C) 610.7-1995

data conversion To change data from one form of representation to another; for example, to convert data from an ASCII representation to an EBCDIC representation. (C) 610.5-1990

data converter A device whose purpose it is to convert data from one representation to an equivalent representation. (C) 610.10-1994

data coupling A type of coupling in which output from one software module serves as input to another module. *Synonym:* input-output coupling. *Contrast:* close coupling; common-environment coupling; content coupling; control coupling; hybrid coupling. (C) 610.12-1990

data cycle (A) **(FASTBUS acquisition and control)** The portion of a FASTBUS operation in which a master either sends data to or receives data from an attached slave. It begins with the master causing a data sync transition and terminates with the master receiving a data acknowledge transition from the slave. (B) A period in which data are valid and are acknowledged. This occurs when acknowledge is asserted at the end of a transaction and on intermediate acknowledges during a block transfer. 1196-1987

data deciphering key A key used for the decipherment of an (N)-layer SDU. (It is not used to decipher other keys.) (C/LM) 802.10-1992

data declaration source statements Source statements that reserve or initialize memory at compilation time. (C/SE) 1045-1992

data definition A description of the format, structure, and properties of a data item, data element, or data structure. (C) 610.5-1990

data definition language (DDL) (A) A language for describing the organization of data within a database. *Note:* In some software, the logical organization is described; in some, both the logical and physical organizations are described. (B) A language used to describe the logical structure of a database. *Synonyms:* data description language; database description language; schema definition language; schema language. *Contrast:* data manipulation language. *See also:* database manipulation language. (C) 610.5-1990

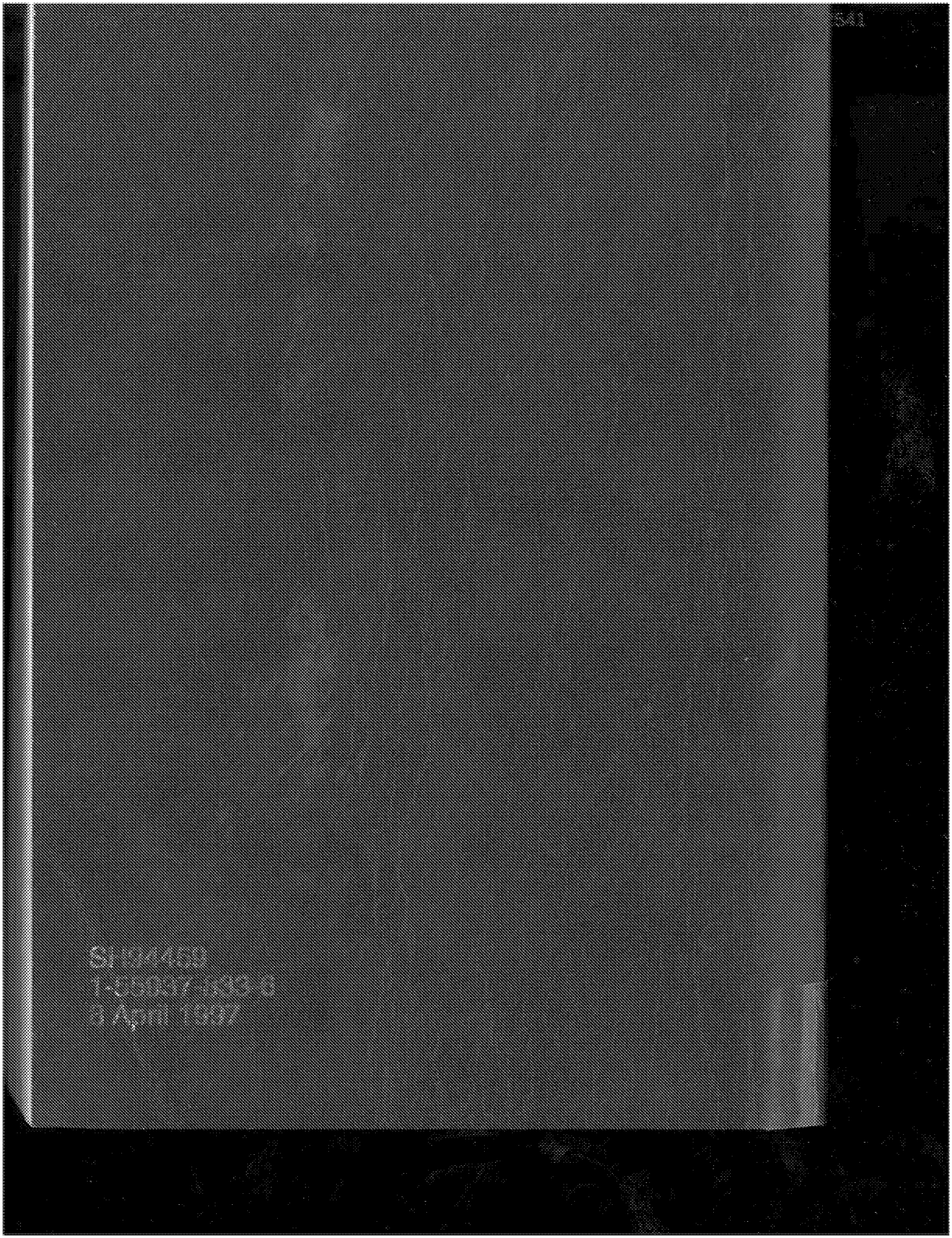


EXHIBIT 11

From: Boardman, Albert
To: Lenning, Nicholas F.; Reisner, Daniel; Dacus, Deron (EXTERNAL); Benyacar, David; Brown, Melissa; Baker, Donna; Mayers, Carolene; Long, Betsy; DeWitt, Amy
Cc: EntropicKLG; wh@wsfirm.com; andrea@wsfirm.com
Subject: RE: Entropic v. Charter: Claim construction meet and confer
Date: Tuesday, March 28, 2023 3:22:39 PM
Attachments: image001.png

External Sender:

Counsel,

Having now had the opportunity to review the supplemental infringement contentions Entropic served on March 10, 2023, we have served our supplemental Rule 4-2 disclosure. In response to your email of this past Friday, you will note that Charter still does not contend that any proposed term is governed by 35 U.S.C. § 112(6).

We are available for a meet and confer tomorrow, Wednesday, March 29 at 3:00 CT, 4:00 ET. We would appreciate it if you would circulate an invite.

Best regards,

Albert Boardman
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Subject: Entropic v. Charter: Claim construction meet and confer

External E-mail

Counsel,

Please provide your availability for a meet and confer next week for the purposes of narrowing the issues and preparation of a Joint Claim Construction and Prehearing Statement. Our current availability is listed below.

Additionally, during the P.R. 4-1 meet and confer on February 24, 2023, Charter represented that it was not contending that any of its proposed terms should be governed by 35 U.S.C. § 112(6). Please confirm that is still your position.

1. Monday, March 27: 2:00-4:00 pm CT
2. Tuesday, March 28: 1:00 - 2:00 pm CT, 3:00-5:00 pm CT
3. Wednesday, March 29: 10:00 am - 12:00 pm CT, 3:00 - 4:00 pm CT

Best,

Nick

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TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 PacketCable Overview 1

1.2 PacketCable Motivation 1

1.3 PacketCable Project Phasing 2

2 PACKETCABLE 1.0 3

2.1 PacketCable Architecture Framework 4

2.2 PacketCable Zones and Domains 5

2.3 PacketCable 1.0 Specifications 5

2.4 PacketCable 1.0 Design Considerations 6

2.4.1 General Architectural Goals 7
2.4.2 Call Signaling 7
2.4.3 Quality of Service 8
2.4.4 CODEC and Media Stream 9
2.4.5 Device Provisioning and OSS 9
2.4.6 Security 9

3 PACKETCABLE FUNCTIONAL COMPONENTS 10

3.1 Multimedia Terminal Adapter (MTA) 10

3.1.1 MTA Functional Requirements 11
3.1.2 MTA identifiers 11

3.2 Cable Modem (CM) 12

3.3 HFC Access Network 12

3.4 Cable Modem Termination System (CMTS) 12

3.4.1 CMTS Gate 13

3.5 Call Management Server (CMS) 13

3.6 PSTN Gateway 14

3.6.1 Media Gateway Controller (MGC) 15
3.6.2 Media Gateway (MG) 15
3.6.3 Signaling Gateway (SG) 16

3.7 OSS Back Office Components 17

3.7.1 TGS 17
3.7.2 Dynamic Host Configuration Protocol Server (DHCP) 18
3.7.3 Domain Name System Server (DNS) 18
3.7.4 Trivial File Transfer Protocol Server or HyperText Transfer Protocol Server (TFTP or HTTP) 18
3.7.5 SYSLOG Server (SYSLOG) 18
3.7.6 Record Keeping Server (RKS) 18

3.8 Announcement Server (ANS) 18

3.8.1 Announcement Controller (ANC) 19

3.8.2 Announcement Player (ANP) 19
4 PROTOCOL INTERFACES 20
4.1 Call Signaling Interfaces 20
4.1.1 Network-based Call Signaling (NCS) Framework 21
4.1.2 PSTN Signaling Framework 22
4.2 Media Streams 23
4.3 MTA Device Provisioning 25
4.4 SNMP Element Management Layer Interfaces 26
4.5 Event Messages Interfaces 26
4.5.1 Event Message Framework 26
4.6 Quality-of-Service (QoS) 28
4.6.1 QoS Framework 28
4.6.2 Layer Two vs. Layer Four MTA QoS Signaling 30
4.6.3 Dynamic Quality-of-Service 31
4.7 Announcement Services 33
4.7.1 ANS Physical vs. Logical configuration 34
4.8 Security 34
4.8.1 Overview 34
4.8.2 Device Provisioning Security 38
5 NETWORK DESIGN CONSIDERATIONS 41
5.1 Time Keeping and Reporting Issues 41
5.2 Timing for Playout Buffer Alignment with Coding Rate 41
5.3 IP Addressing 41
5.4 Dynamic IP Addressing Assignment 42
5.5 FQDN Assignment 43
5.6 Priority Marking of Signaling and Media Stream Packets 43
5.7 Fax Support 44
5.8 Analog Modem Support 45
6 FUTURE CONSIDERATIONS 46
APPENDIX A. ACKNOWLEDGEMENTS 47
APPENDIX B. REFERENCES 48
APPENDIX C. GLOSSARY 51
APPENDIX D. EXAMPLE DELAY BUDGETS 61

Figures

- Figure 1. PacketCable Reference Architecture 4
- Figure 2. Zones and Administrative Domains..... 5
- Figure 3. PacketCable Component Reference Model 10
- Figure 4. E-MTA Conceptual Functional Architecture 12
- Figure 5. Call Signaling Interfaces 20
- Figure 6. RTP Media Stream Flows in a PacketCable Network 23
- Figure 7. RTP Packet Format 24
- Figure 8. PacketCable Provisioning Interfaces.....25
- Figure 9. Representative Event Messages Architecture.....27
- Figure 10. Event Message Interfaces 27
- Figure 11. PacketCable QoS Signaling Interfaces 28
- Figure 12. Annoucement Services Components and Interfaces.....33
- Figure 13. PacketCable Security Interfaces 36

Tables

- Table 1 PacketCable 1.0 Specifications and Reports 6
- Table 2. Call Signaling Interfaces 21
- Table 3. Device Provisioning Interfaces 25
- Table 4. Event Message Interfaces 27
- Table 5. QoS Interfaces for Standalone and Embedded MTAs 29
- Table 6. QoS Interfaces 29
- Table 7. Announcement Interfaces 34
- Table 8. Security Interfaces 37

1 INTRODUCTION

1.1 PacketCable Overview

PacketCable™ is a project conducted by Cable Television Laboratories, Inc. (CableLabs®) and its member companies. The PacketCable project is aimed at defining interface specifications that can be used to develop interoperable equipment capable of providing packet-based voice, video and other high-speed multimedia services over hybrid fiber coax (HFC) cable systems utilizing the DOCSIS protocol. PacketCable utilizes a network superstructure that overlays the two-way data-ready broadband cable access network. While the initial PacketCable offering will be packet-based voice communications for existing and new cable subscribers, the long-term project vision encompasses a large suite of packet-based capabilities.

The objective of the PacketCable Architecture Technical Report is to provide a high level reference framework that identifies the functional components and defines the interfaces necessary to implement the capabilities detailed in the individual PacketCable specifications as listed in section 2.3.

1.2 PacketCable Motivation

The emergence of the Internet Protocol (IP) as the standard transport for packet data networks has enabled a revolution in communications service and applications. This online revolution is evidenced by the widespread use of email, chat groups, music, video, and the exponential growth of the World Wide Web, for entertainment, information exchange, online commerce, and a wide range of the new and innovative services. New classes of IP based information appliances are also emerging, including multimedia personal computers, IP based set top boxes, and IP based voice and video phones.

In recent years the growth of a worldwide IP based data network, coupled with the exponential growth in the number of households that have online access, have resulted in an enabling environment for offering integrated voice and data services over a common broadband cable access network and IP transport backbone. While the initial application of IP voice technology was for toll bypass services, particularly high-cost international toll service, the technology has now matured to the point where it is feasible to offer IP-based voice communications services comparable to those offered by telecommunications carriers on the PSTN.

With the success of the DOCSIS standardization effort, the QoS enhancements of DOCSIS 1.1, and the acceleration of major cable system upgrades for two way capacity, the infrastructure is in place for development and deployment of packetized voice and video applications. These applications can be deployed with minimal incremental cost, providing a technically distinctive and cost-effective alternative for subscribers' voice communications needs, as well as a platform for introducing the next generation of voice and other real time multimedia services.

1.3 PacketCable Project Phasing

The PacketCable architecture is designed to be a robust, complete, end-end broadband architecture that supports voice, video, and other multimedia services. The architecture is capable of supporting millions of subscribers over multiple cable operator networks.

It is understood that the initial focus of the PacketCable architecture must support the time-to-market business considerations of CableLabs Member Companies for deploying packet-based services. Going forward, the PacketCable architecture must continue to evolve to meet Member business requirements and to accommodate advances resulting from the maturing of IP-based technology. The PacketCable project will release specifications that define this architecture in a phased approach according to technical feasibility and business priority. As new PacketCable specifications are released, they will complement the previously released specifications.

From time to time this document refers to the voice communications capabilities of a PacketCable network in terms of "IP Telephony." The legal/regulatory classification of IP-based voice communications provided over cable networks and otherwise, and the legal/regulatory obligations, if any, borne by providers of such voice communications, are not yet fully defined by appropriate legal and regulatory authorities. Nothing in this document is addressed to, or intended to affect, those issues. In particular, while this document uses standard terms such as "call," "call flow," "telephony," etc., it should be recalled that while a PacketCable network performs activities analogous to these PSTN functions, the manner by which it does so differs considerably from the manner in which they are performed in the PSTN by telecommunications carriers, and that these differences may be significant for legal/regulatory purposes. Moreover, while reference is made here to "IP Telephony," it should be recognized that this term embraces a number of different technologies and network architecture, each with different potential associated legal/regulatory obligations. No particular legal/regulatory consequences are assumed or implied by the use of this term.

2 PACKETCABLE 1.0

'PacketCable 1.0' is a CableLabs definition for the first release of specifications that define the PacketCable reference architecture.

In this version of the architecture framework, the emphasis is on specification of the subscriber environment and its interface requirements to the PacketCable network including the DOCSIS HFC access network, Call Management Server, media servers, PSTN gateway, and MTA device provisioning components. The requirements for these functional components and the standardized interfaces between components are defined in detail in the PacketCable 1.0 specifications. In later versions, additional component interfaces will be defined.

PacketCable 1.0 consists of a variety of functional components, each of which must work in harmony to create a consistent and cost-effective delivery mechanism for packet-based services. This distributed architecture allows incremental development and deployment of new features and services, leaving room for implementation flexibility and product innovation. A key focus of the initial PacketCable release is the definition of low-cost subscriber equipment and a network architecture that supports low cost packet-based services. Follow-on phases of this project will continue to add support for advanced subscriber-side functionality. This may require evolution in the PacketCable call signaling, QoS security, provisioning, and billing protocols.

PacketCable allows the use of proprietary vendor-specific solutions for interfaces not defined in specifications. Over time, as additional PacketCable interface protocols are defined, these proprietary interfaces will need to be updated in order to be compliant with PacketCable specifications.

2.1 PacketCable Architecture Framework

At a very high level, the PacketCable 1.0 architecture contains three networks: the "DOCSIS HFC Access Network", the "Managed IP Network" and the PSTN. The Cable Modem Termination System (CMTS) provides connectivity between the "DOCSIS HFC Access Network" and the "Managed IP Network". Both the Signaling Gateway (SG) and the Media Gateway (MG) provide connectivity between the "Managed IP Network" and the PSTN. The reference architecture for PacketCable 1.0 is shown in Figure 1.

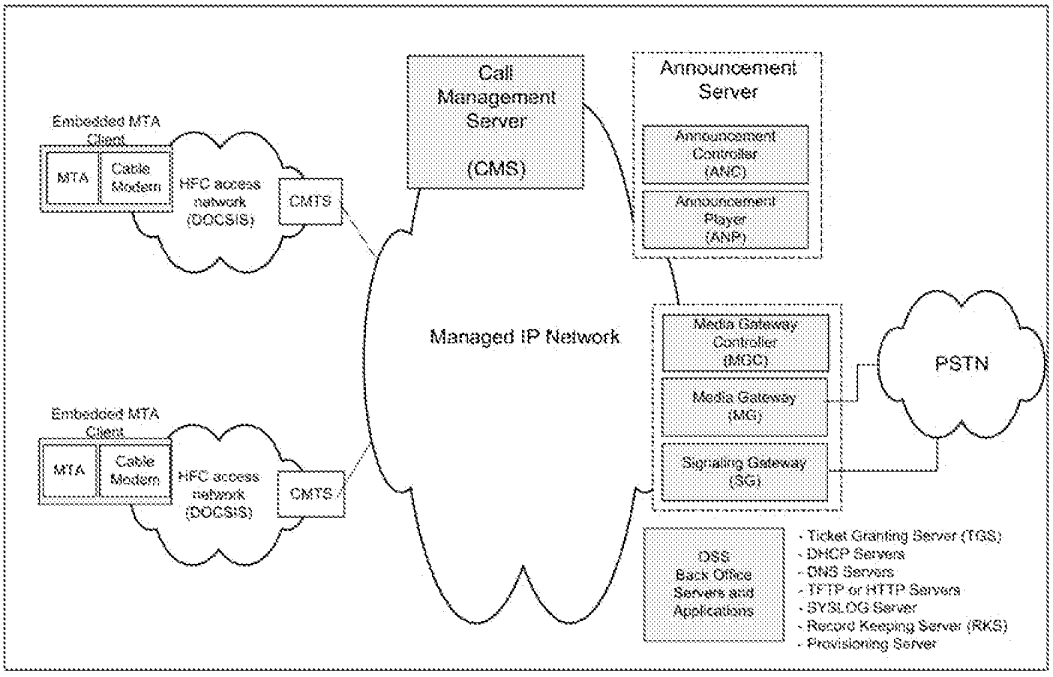


Figure 1. PacketCable Reference Architecture

The DOCSIS HFC access network provides high-speed, reliable, and secure transport between the customer premise and the cable headend. This access network may provide all DOCSIS 1.1 capabilities including Quality of Service. The DOCSIS HFC access network includes the following functional components: the Cable Modem (CM), Multi-media Terminal Adapter (MTA), and the Cable Modem Termination System (CMTS).

The Managed IP network serves several functions. First, it provides interconnection between the basic PacketCable functional components responsible for signaling, media, provisioning, and quality of service establishment. In addition, the managed IP network provides long-haul IP connectivity between other Managed IP and DOCSIS HFC networks. The Managed IP network includes the following functional components: Call Management Server (CMS), Announcement Server (ANS), several Operational Support System (OSS) back-office servers, Signaling Gateway (SG), Media Gateway (MG), and Media Gateway Controller (MGC).

The individual network components that are shown in Figure 1 are described in detail in Section 3.

2.2 PacketCable Zones and Domains

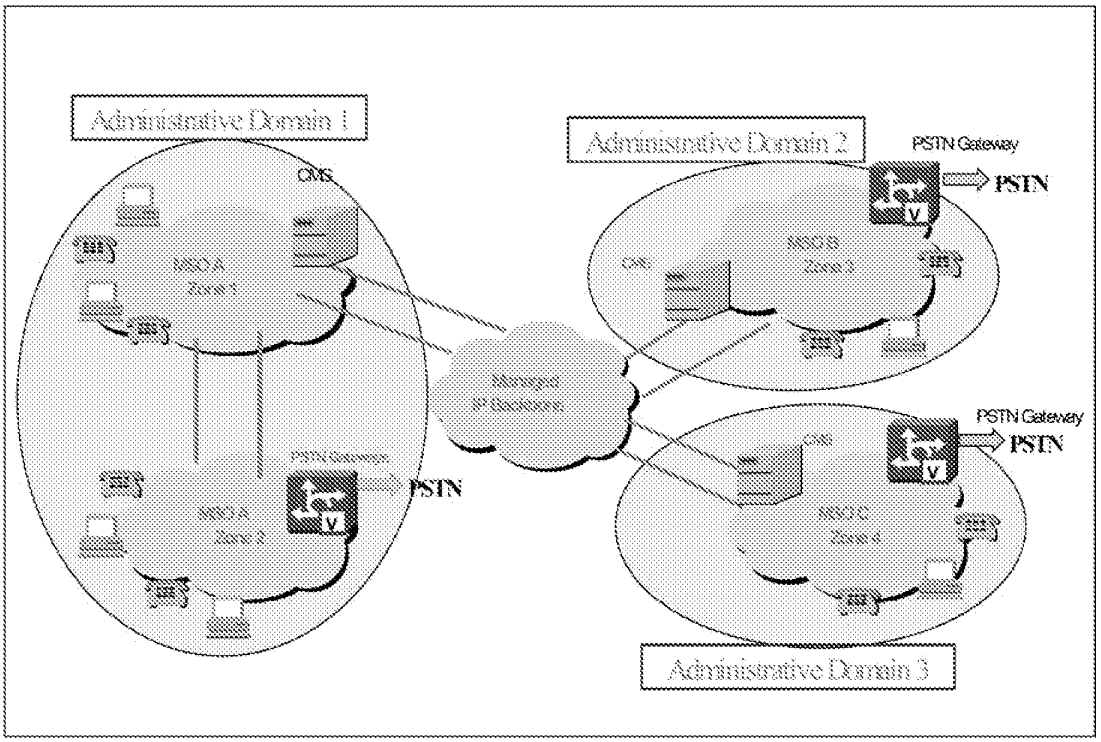


Figure 2. Zones and Administrative Domains

A PacketCable zone consists of the set of MTAs in one or more DOCSIS HFC access networks that are managed by a single functional CMS as shown in Figure 2. Interfaces between functional components within a single zone are defined in the PacketCable 1.0 specifications. Interfaces between zones (e.g., CMS-CMS) have not been defined and will be addressed in future phases of the PacketCable architecture.

A PacketCable domain is made up of one or more PacketCable zones that are operated and managed by a single administrative entity. A PacketCable domain may also be referred to as an administrative domain. Interfaces between domains have not defined in PacketCable 1.0 and will be addressed in future phases of the PacketCable architecture.

2.3 PacketCable 1.0 Specifications

PacketCable 1.0 consists of the eleven Specifications and three Technical Reports shown in Table 1.

Table 1 PacketCable 1.0 Specifications and Reports

PacketCable Specification Reference Number	Specification Name
PKT-SP-CODEC	Audio/Video Codecs
PKT-SP-DQOS	Dynamic Quality-of-Service
PKT-SP-EC-MGCP	Network-Based Call Signaling (NCS)
PKT-SP-EM	Event Messages
PKT-SP-ISTP	Internet Signaling Transport Protocol (ISTP)
PKT-SP-MIBS	MIB Framework
PKT-SP-MIBS-MTA	MTA MIB
PKT-SP-MIBS-NCS	NCS MTA MIB
PKT-SP-PROV	MTA Device Provisioning
PKT-SP-SEC	Security
PKT-SP-TGCP	PSTN Gateway Call Signaling Protocol
PacketCable Technical Report Reference Number	**Technical Report Name**
PKT-TR-CF	Call Flows
PKT-TR-ARCH	Architecture Framework
PKT-TR-OSS	OSS Overview

2.4 PacketCable 1.0 Design Considerations

In order to enable real-time multimedia communications across the cable network infrastructure, PacketCable specifications define protocols in the following areas:

- Call Signaling
- Quality of Service
- Media Stream Transport and Encoding
- Device Provisioning
- Event Messaging
- Security and Privacy
- Operational Support Systems

This section provides an overview of the high-level design goals and concepts used in developing the specifications that define the PacketCable 1.0 reference architecture. Individual PacketCable specifications should be consulted to obtain detailed protocol requirements for each of these areas.

2.4.1 General Architectural Goals

- Enable voice quality capabilities comparable to or better than the PSTN as perceived by the end-user.
- Provide a network architecture that is scalable and capable of supporting millions of subscribers.
- Ensure the one-way delay for local IP access and IP egress (i.e. excluding the IP backbone network) is less than 45ms.
- Support primary and secondary line residential voice communications capabilities.
- Leverage existing protocol standards. PacketCable strives to specify open, approved industry standards that have been widely adopted in other commercial communication networks. This includes protocols approved by the ITU, IETF, IEEE, Telcordia and other communications standards organizations.
- Leverage and build upon the data transport and Quality of Service capabilities provided by DOCSIS.
- Define an architecture that allows multiple vendors to rapidly develop low-cost interoperable solutions to meet Member time-to-market requirements.
- Ensure that the probability of blocking a call can be engineered to be less than 1% during the High Day Busy Hour (HDBH)
- Ensure that call cutoffs and call defects can be engineered to be less than 1 per 10,000 completed calls.
- Support modems (up to V.90 56 kb/s) and fax (up to 14.4 kbps)
- Ensure that frame slips due to unsynchronized sampling clocks or due to lost packets occur less than 0.25 per minute.

2.4.2 Call Signaling

- Define a network-based signaling paradigm.
- Provide end-to-end call signaling for the following call models:
    - calls that originate from the PSTN and terminate on the cable network
    - calls that originate on the cable network and terminate on the cable network within a single PacketCable zone
    - calls that originate from the cable network and terminate on the PSTN
- Provide signaling to support custom calling features such as:
    - Call Waiting
    - Cancel Call Waiting
    - Call Forwarding (no-answer, busy, variable)
    - Three-way Calling

- Voice mail Message Waiting Indicator

- Provide signaling to support Custom Local Area Signaling Services (CLASS) features such as:
  - Calling Number Delivery
  - Calling Name Delivery
  - Calling Identity Delivery On Call Waiting
  - Calling Identity Delivery Blocking
  - Anonymous Call Rejection
  - Automatic Callback
  - Automatic Recall
  - Distinctive Ringing/Call Waiting
  - Customer Originated Trace
- Support a signaling paradigm consistent with existing IP telephony standards for use within a cable operator's PacketCable network and when connecting to the PSTN.
- Ability to direct dial any domestic or international telephone number (E.164 address)
- Ability to receive a call from any domestic or international telephone number supported by the PSTN.
- Ensure that a new subscriber retains current phone number via Local Number Portability (LNP)
- Ability to use the IXC of choice for intra-LATA toll (local toll) and inter-LATA (long distance) calls. This includes pre-subscription and "dial-around" (10-1X-XXX).
- Support Call Blocking/Call Blocking Toll restrictions, (e.g. blocking calls to 900-, 976-, etc.)

2.4.3 Quality of Service

- Provide a rich set of policy mechanisms to provide and manage QoS for PacketCable services over the access network.
- Provide admission control mechanisms for both upstream and downstream directions.
- Allow dynamic changes in QoS in the middle of PacketCable calls.
- Enable transparent access to all of the QoS mechanisms defined in DOCSIS 1.1. PacketCable clients need not be aware of specific DOCSIS QoS primitives and parameters.

- Minimize and prevent abusive QoS usage including theft-of and denial-of service attacks. Ensure QoS policy is set and enforced by trusted PacketCable network elements.
- Provide a priority mechanism for 911 and other priority based signaling services.

2.4.4 CODEC and Media Stream

- Minimize the effects that latency, packet-loss, and jitter have on voice-quality in the IP telephony environment.
- Define a minimum set of audio codecs that must be supported on all PacketCable endpoint devices (MTAs). Evaluation criteria for mandatory codecs are selected as those most efficient with respect to voice quality, bandwidth utilization, and implementation complexity.
- Accommodate evolving narrow-band and wide-band codec technologies.
- Specify echo cancellation and voice activity detection mechanisms.
- Support for transparent, error-free DTMF transmission and detection.
- Support terminal devices for the deaf and hearing impaired.
- Provide mechanisms for codec switching when fax and modem services are required.

2.4.5 Device Provisioning and OSS

- Support dynamic and static provisioning of customer premise equipment (MTA and Cable Modem).
- Provisioning changes should not require reboot of MTA.
- Allow dynamic assignment and management of IP addresses for subscriber devices
- Ensure that real-time provisioning and configuration of MTA software does not adversely affect subscriber service.
- Define SNMP MIBs for managing customer premise equipment (MTA).

2.4.6 Security

- Enable residential voice capabilities with the same or higher level of perceived privacy as in the PSTN.
- Provide protection against attacks on the MTA.
- Protect the MSO from various denial of service, network disruption and theft of service attacks.
- Design considerations include confidentiality, authentication, integrity, non-repudiation and access control.

3 PACKETCABLE FUNCTIONAL COMPONENTS

This section describes the functional components present in a PacketCable network. Component descriptions are not intended to define or imply product implementation requirements but instead to describe the functional role of each of these components in the reference architecture. Note that specific product implementations may combine functional components as needed. Not all components are required to be present in a PacketCable Network.

The PacketCable architecture contains trusted and untrusted network elements. Trusted network elements are typically located within a Cable Operator's managed backbone network. Untrusted network elements, such as the CM and MTA, are typically located within the subscriber's home and outside of the MSO's facility.

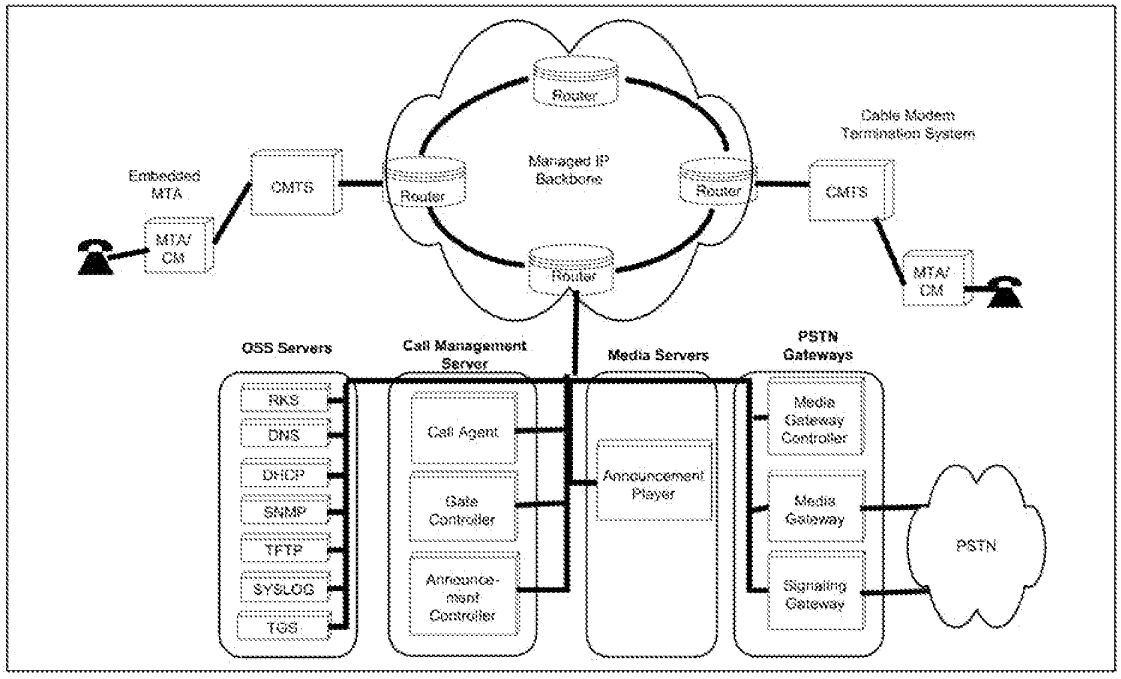


Figure 3. PacketCable Component Reference Model

3.1 Multimedia Terminal Adapter (MTA)

An MTA is a PacketCable client device that contains a subscriber-side interface to the subscriber's CPE (e.g., telephone) and a network-side signaling interface to call control elements in the network. An MTA provides codecs and all signaling and encapsulation functions required for media transport and call signaling.

MTAs reside at the customer site and are connected to other PacketCable network elements via the HFC access network (DOCSIS). PacketCable 1.0 MTAs are required to support the Network Call Signaling (NCS) protocol.

An embedded MTA (E-MTA) is a single hardware device that incorporates a DOCSIS 1.1 cable modem as well as a PacketCable MTA component. Figure 4 shows a representative functional diagram of an E-MTA.

PacketCable 1.0 specifications only require support for embedded MTAs. Throughout this report, unless otherwise noted, the term MTA refers to an embedded MTA.

3.1.1 MTA Functional Requirements

An MTA is responsible for the following functionality:

- NCS call signaling with the CMS
- QoS signaling with the CMS and the CMTS
- Authentication, confidentiality and integrity of some messages between the MTA and other PacketCable network elements
- Mapping media streams to the MAC services of the DOCSIS access network
- Encoding/decoding of media streams
- Providing multiple audio indicators to phones, such as ringing tones, call-waiting tones, stutter dial tone, dial tone, etc.
- Standard PSTN analog line signaling for audio tones, voice transport, caller-id signaling, DTMF, and message waiting indicators
- The G.711 audio codec
- One or more RJ11 analog interface(s) as defined by Bellcore TR-909

Additional MTA functionality is defined in other PacketCable specifications such as NCS Signaling [5], Dynamic Quality-of-Service [4], Audio-Video Codecs [3], MIBS [8][9], and MTA Device Provisioning [12].

3.1.2 MTA identifiers

The following identifiers characterize the E-MTA:

- An embedded MTA has two MAC addresses, one for the cable modem and one for the MTA.
- An embedded MTA has two IP addresses, one for the cable modem and one for the MTA.
- An embedded MTA has two Fully Qualified Domain Names (FQDN), one for the cable modem and one for the MTA
- At least one telephone number per configured physical port
- Device capabilities
- The MTA's associated CMS

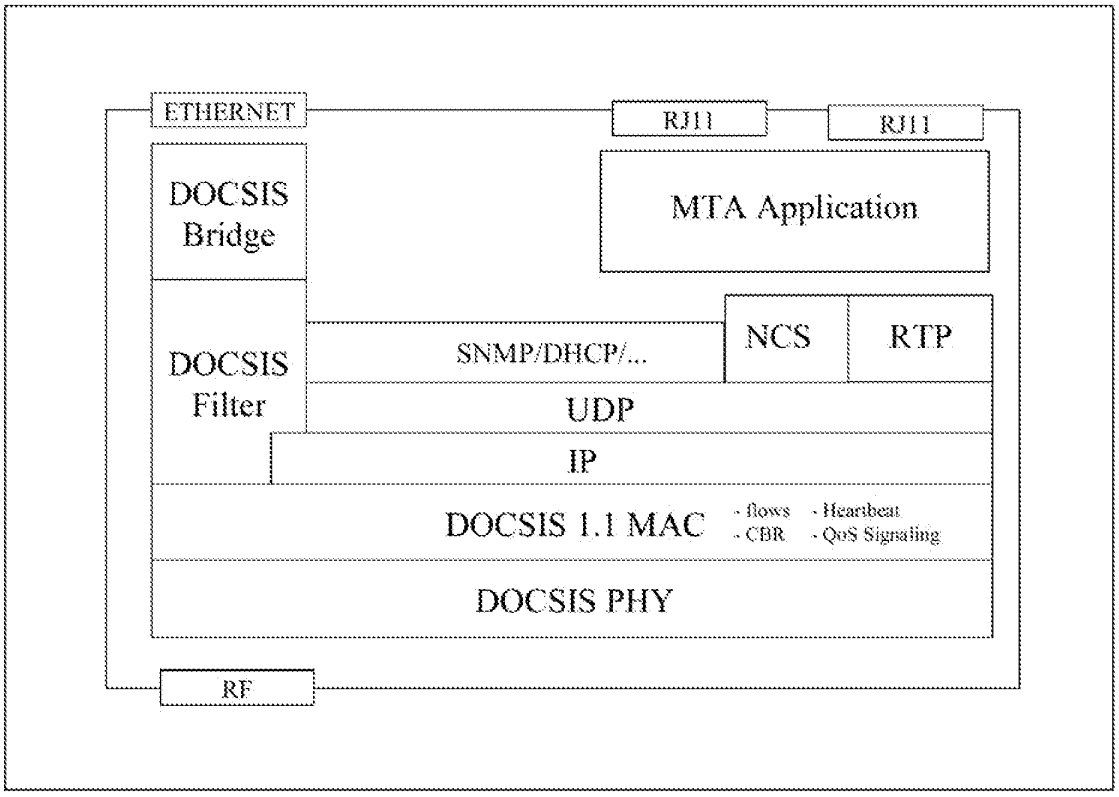


Figure 4. E-MTA Conceptual Functional Architecture

3.2 Cable Modem (CM)

The cable modem (CM) is a network element that is defined in the DOCSIS [19]. The CM is a modulator/demodulator residing on the customer premise that provides data transmission over the cable network using the DOCSIS protocol. In PacketCable, the CM plays a key role in handling the media stream and provides services such as classification of traffic into service flows, rate shaping, and prioritized queuing.

3.3 HFC Access Network

PacketCable-based services are carried over the Hybrid Fiber/Coax (HFC) access network. The access network is a bi-directional, shared-media system that consists of the Cable Modem (CM), the Cable Modem Termination System (CMTS), and the DOCSIS MAC and PHY access layers.

3.4 Cable Modem Termination System (CMTS)

The CMTS provides data connectivity and complimentary functionality to cable modems over the HFC access network (DOCSIS). It also provides connectivity to wide area networks. The CMTS is located at the cable television system head-end or distribution hub.

The CMTS is responsible for the following functions:

- Providing the required QoS to the CM based upon policy configuration.
- Allocating upstream bandwidth in accordance to CM requests and network QoS policies.
- Classifying each arriving packet from the network side interface and assigning it to a QoS level based on defined filter specifications.
- Policing the TOS field in received packets from the cable network to enforce TOS field settings per network operator policy.
- Altering the TOS field in the downstream IP headers based on the network operator's policy.
- Performing traffic shaping and policing as required by the flow specification.
- Forwarding downstream packets to the DOCSIS network using the assigned QoS.
- Forwarding upstream packets to the backbone network devices using the assigned QoS.
- Converting and classifying QoS Gate parameters into DOCSIS QoS parameters.
- Signaling and reserving any backbone QoS necessary to complete the service reservation.
- Recording usage of resources per call using PacketCable Event Messages.

3.4.1 CMTS Gate

The CMTS Gate is a functional component of the CMTS that performs traffic classification and enforces QoS policy on media streams as directed by the Gate Controller (GC).

3.5 Call Management Server (CMS)

The Call Management Server provides call control and signaling related services for the MTA, CMTS, and PSTN gateways in the PacketCable network. The CMS is a trusted network element that resides on the managed IP portion of the PacketCable network.

A PacketCable 1.0 CMS consists of the following logical PacketCable components.

Call Agent (CMS/CA) – Call Agent is a term that is often used interchangeably with CMS, especially in the MGCP. In PacketCable, the Call Agent (CA) refers to the control component of the CMS that is responsible for providing signaling services using the NCS protocol to the MTA. In this context, Call Agent responsibilities include but are not limited to:

- Implementing call features
- Maintaining call progress state
- The use of codecs within the subscriber MTA device

- Collecting and pre-processing dialed digits
- Collecting and classifying user actions

Gate Controller (CMS/GC) – The Gate Controller (GC) is a logical QoS management component within the CMS that coordinates all quality of service authorization and control. Gate Controller functionality is defined in the Dynamic Quality of Service specification.

The CMS may also contain the following logical components:

Media Gateway Controller - The MGC is logical signaling management component used to control PSTN Media Gateways. The MGC function is defined in detail later in this section.

Announcement Controller - The ANC is a logical signaling management component used to control network announcement servers. The ANC function is defined in detail in Section 3.8.

The CMS may also provide the following functions:

- Call management and CLASS features
- Directory Services and Address translation
- Call routing
- Record usage of local number portability services
- Zone-to-Zone call signaling and QoS admission control

For the purposes of this specification, protocols that implement the functionality of the CMS are specified as terminating at the CMS – actual implementations may distribute the functionality in one or more servers that sit "behind" the Call Management Server.

3.6 PSTN Gateway

PacketCable allows MTA's to inter-operate with the current PSTN through the use of PSTN Gateways.

In order to enable operators to minimize cost and optimize their PSTN interconnection arrangements, the PSTN Gateway is decomposed into three functional components:

- **Media Gateway Controller (MGC)** – The MGC maintains the call state and controls the overall behavior of the PSTN gateway.
- **Signaling Gateway (SG)** – The SG provides a signaling interconnection function between the PSTN SS7 signaling network and the IP network.
- **Media Gateway (MG)** – The MG terminates the bearer paths and transcodes media between the PSTN and IP network.

3.6.1 Media Gateway Controller (MGC)

The Media Gateway Controller (MGC) receives and mediates call-signaling information between the PacketCable network and the PSTN. It maintains and controls the overall call state for calls requiring PSTN interconnection.

The MGC controls the MG by instructing it to create, modify, and delete connections that support the media stream over the IP network. The MGC also instructs the MG to detect and generate events and signals such as continuity test tones for ISUP trunks, or MF signaling for MF trunks. Each trunk is represented as an endpoint.

The following is a list of functions performed by the Media Gateway Controller:

- **Call Control Function** – maintains and controls the overall PSTN Gateway call state for the portion of a call that traverses the PSTN Gateway. The function interfaces with external PSTN elements as needed for PSTN Gateway call control, e.g., by generating TCAP queries.
- **PacketCable Signaling** – terminates and generates the call signaling from and to the PacketCable side of the network.
- **MG Control** – The MG Control function exercises overall control of endpoints in the Media Gateway:
  - Event Detection instructs the MG to detect events, e.g., in-band tones and seizure state, on the endpoint and possibly connections.
  - Signal Generation instructs the MG to generate in-band tones and signals on the endpoint and possibly connections.
  - Connection Control instructs the MG on the basic handling of connections from and to endpoints in the MG.
  - Attribute Control instructs the MG regarding the attributes to apply to an endpoint and/or connection, e.g., encoding method, use of echo cancellation, security parameters, etc.
- **External Resource Monitoring** – maintains the MGC's view of externally visible MG resources and packet network resources, e.g. endpoint availability.
- **Call Routing** – makes call routing decisions.
- **Security** – ensures that any entity communicating with the MGC adheres to the security requirements.
- **Usage Recording via Event Messages** – records usage of resources per call.

3.6.2 Media Gateway (MG)

The Media Gateway provides bearer connectivity between the PSTN and the PacketCable IP network. Each bearer is represented as an endpoint and the MGC instructs the MG to set-up and control media connections to other endpoints on the PacketCable network. The MGC also instructs the MG to detect and generate events and signals relevant to the call state known to the MGC.

3.6.2.1 Media Gateway Functions

The following is a list of functions performed by the Media Gateway:

- Terminates and controls physical circuits in the form of bearer channels from the PSTN.
- Discriminates between media and Channel Associated In-band signaling information from the PSTN circuit.
- Detects events on endpoints and connections as requested by the MGC. This includes events needed to support in-band signaling, e.g., MF.
- Generates signals on endpoints and connections, e.g., continuity tests, alerting, etc. as instructed by the MGC. This includes signals needed to support in-band signaling.
- Creates, modifies, and deletes connections to and from other endpoints as instructed by the MGC.
- Controls and assigns internal media processing resources to specific connections upon receipt of a general request from the Media Gateway Controller.
- Performs media transcoding between the PSTN and the PacketCable network. This includes all aspect of the transcoding such as codecs, echo cancellation, etc.
- Ensures that any entity communicating with the MG adheres to the security requirements.
- Determines usage of relevant resources and attributes associated with those resources, e.g., number of media bytes sent and received.
- Reports usage of resources to the MGC.

3.6.3 Signaling Gateway (SG)

The Signaling Gateway function sends and receives circuit-switched network signaling at the edge of the PacketCable network. For PacketCable 1.0, the signaling gateway function only supports non-facility associated signaling in the form of SS7. Facility associated signaling in the form of MF is supported by the MG function directly.

3.6.3.1 SS7 Signaling Gateway Functions

The following is a list of functions performed by the Signaling Gateway function:

- Terminates physical SS7 signaling links from the PSTN (A, F links).
- Implements security features, to ensure that the Gateway security is consistent with PacketCable and SS7 network security requirements.
- Terminates Message Transfer Part (MTP) level 1, 2 and 3.
- Implements MTP network management functions as required for any SS7 signaling point.

- Performs ISUP Address Mapping to support flexible mapping of Point Codes (both Destination Point Code and Origination Point Code) and/or Point Code/CIC code combination contained within SS7 ISUP messages to the appropriate Media Gateway Controller (MGC) (either a domain name or an IP address). The addressed MGC will be responsible for controlling the Media Gateway, which terminates the corresponding trunks.
- Performs TCAP Address Mapping to map Point Code/Global Title/SCCP Subsystem Number combinations within SS7 TCAP messages to the appropriate Media Gateway Controller or Call Management Server.
- Provides mechanism for certain trusted entities ("TCAP Users") within the PacketCable network, such as Call Agents, to query external PSTN databases via TCAP messages sent over the SS7 network.
- Implements the transport protocol required to transport the signaling information between the Signaling Gateway and the Media Gateway Controller.

3.7 OSS Back Office Components

The OSS back office contains business, service, and network management components supporting the core business processes. As defined by the ITU TMN framework, the main functional areas for OSS are fault management, performance management, security management, accounting management, and configuration management. These topics are covered in detail in the PacketCable OSS Framework Technical Report [15].

PacketCable 1.0 defines a limited set of OSS functional components and interfaces to support MTA device provisioning and Event Messaging to carry billing information.

3.7.1 TGS

For PacketCable, the term TGS (Ticket Granting Server) is utilized for a Kerberos server. The Kerberos protocol with the public key PKINIT extension is used for key management on the MTA-CMS interface [37].

The TGS grants Kerberos tickets to the MTA. A ticket contains information used to set up authentication, privacy, integrity and access control for the call signaling between the MTA and the CMS. This ticket is issued in three different scenarios.

- During device provisioning, the MTA requests a ticket from the TGS. It is strongly recommended that the MTA save Kerberos tickets in persistent storage. In the case when the MTA reboots, if the saved ticket is still valid, then the MTA will not need to execute the PKINIT to request a new ticket from the TGS.
- In normal operation, each time a ticket expires, the MTA will request a new ticket during the grace period from the TGS. Note: In the case of power failure in the CMS, the MTA will no longer be associated with this CMS. When this CMS restarts it will request "wake up" information from the MTA. If the ticket the MTA currently holds is beyond the expiration time, often referred to as a stale ticket, the MTA will request a new ticket from the TGS. If the MTA is still

holding a valid ticket then it should send this ticket to the CMS without requesting a new one from the TGS.

- When the TGS is not available on the network and the MTA can not get a new ticket during the grace period, the MTA must hold on to the current, but stale ticket until a TGS is available to grant a new ticket. The request from the MTA during this condition is specified in the PacketCable Security specification [13].

3.7.2 Dynamic Host Configuration Protocol Server (DHCP)

The DHCP server is a back office network element used during the MTA device provisioning process to dynamically allocate IP addresses and other client configuration information.

3.7.3 Domain Name System Server (DNS)

The DNS server is a back office network element used to map between ASCII domain names and IP addresses.

3.7.4 Trivial File Transfer Protocol Server or HyperText Transfer Protocol Server (TFTP or HTTP)

The TFTP Server is a back office network element used during the MTA device provisioning process to download configuration files to the MTA. An HTTP Server may be used instead of a TFTP server to download configuration files to the MTA.

3.7.5 SYSLOG Server (SYSLOG)

The SYSLOG server is a back office network element used to collect events such as traps and errors from an MTA.

3.7.6 Record Keeping Server (RKS)

The RKS is a trusted network element component that receives PacketCable Event Messages from other trusted PacketCable network elements such as the CMS, CMTS, and MGC. The RKS also, at a minimum, is a short-term repository for PacketCable Event Messages. The RKS may assemble the Event Messages into coherent sets or Call Detail Records (CDRs), which are then made available to other back office systems such as billing, fraud detection, and other systems.

3.8 Announcement Server (ANS)

An Announcement Server is a network component that manages and plays informational tones and messages in response to events that occur in the network. An Announcement Server (ANS) is a logical entity composed of an Announcement Controller (ANC) and an Announcement player (ANP).

3.8.1 Announcement Controller (ANC)

The ANC initiates and manages all announcement services provided by the Announcement Player. The ANC requests the ANP to play announcements based on call state as determined by the CMS. When information is collected from the end-user by the ANP, the ANC is responsible for interpreting this information and manage the session accordingly. Hence, the ANC may also manage call state.

3.8.2 Announcement Player (ANP)

The Announcement Player is a media resource server. It is responsible for receiving and interpreting commands from the ANC and for delivering the appropriate announcement(s) to the MTA. The ANP also is responsible for accepting and reporting user inputs (e.g., DTMF tones). The ANP functions under the control of the ANC.

4 PROTOCOL INTERFACES

Protocol specifications have been defined for most of the component interfaces in the PacketCable architecture. An overview of each protocol interface is provided within this section. The individual PacketCable specifications should be consulted for the complete protocol requirements.

It is possible that some of these interfaces may not exist in a given vendor's product implementation. For example, if several functional PacketCable components are combined then it is possible that some of these interfaces are internal to that component.

4.1 Call Signaling Interfaces

Call signaling requires multiple interfaces within the PacketCable architecture. These interfaces are identified in Figure 5. Each interface in the diagram is labeled, and further described in the subsequent Table 2.

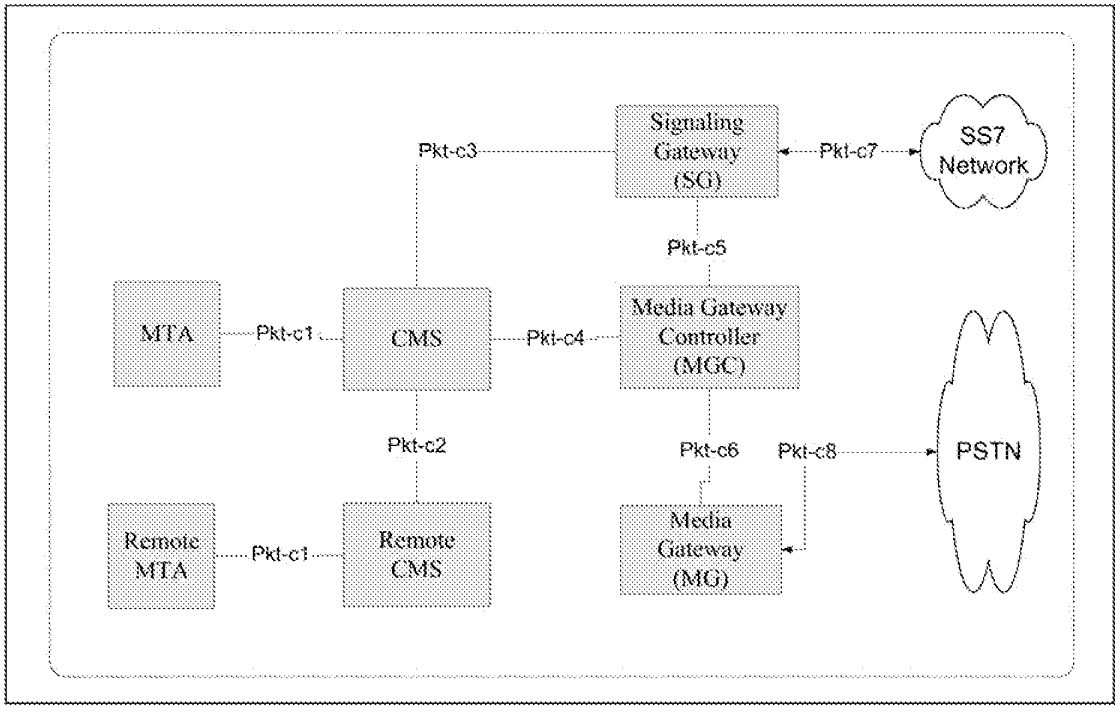


Figure 5. Call Signaling Interfaces

Case 2:22-cv-00125-JRG Document 97-8 Filed 05/09/23 Page 134 of 290 PageID #: 2291

Table 2. Call Signaling Interfaces

Interface	PacketCable Functional Components	Description
Pkt-c1	MTA – CMS	Call signaling messages exchanged between the MTA and CMS using the NCS protocol, which is a profile of MGCP.
Pkt-c2	CMS-CMS	Call signaling messages exchanged between CMS's. The protocol for this interface is undefined in PacketCable 1.0.
Pkt-c3	CMS – SG	Call signaling messages exchanged between CMS and SG using the ISTP/TCAP protocol.
Pkt-c4	CMS – MGC	Call signaling messages exchanged between the CMS and MGC. The protocol for this interface is undefined in PacketCable 1.0
Pkt-c5	SG – MGC	Call signaling messages exchanged between the MGC and SG using the ISTP/ISUP and ISTP/TCAP protocol
Pkt-c6	MGC – MG	Interface for media control of the media gateway and possibly in-band signaling using the TGCP protocol, which is a profile of MGCP, similar to NCS.
Pkt-c7	SG – SS7	The SG terminates physical SS7 signaling links from the PSTN (A, F links). The following protocols are supported: • ISUP User Interface. Provides an SS7 ISUP signaling interface to external PSTN carriers. • TCAP User Interface. Provides mechanism for certain trusted entities ("TCAP Users") within the PacketCable network, such as Call Agents, to query external PSTN databases via TCAP messages sent over the SS7 network.
Pkt-c8	MG – PSTN	This interface defines bearer channel connectivity from the Media Gateway to the PSTN and supports the following call signaling protocols: • In-Band MF Signaling A future version of PacketCable may support ISDN PRI[i].

4.1.1 Network-based Call Signaling (NCS) Framework

The PacketCable Network-Based Call Signaling (NCS) protocol (Pkt-c1) is an extended variant of the IETF's MGCP call signaling protocol. The NCS architecture places call state and feature implementation in a centralized component, the Call Management Server (CMS), and places device control intelligence in the MTA. The MTA passes device events to the CMS, and responds to commands issued from the CMS. The CMS, which may consist of multiple geographically or administratively distributed systems, is responsible for setting up and tearing down calls, providing advanced services [CLASS and custom calling features], performing call authorization, and generating billing event records, etc.

Examples of the partition of function would be for the CMS to instruct the MTA to inform the CMS when the phone goes off hook, and seven DTMF digits have been entered. When this sequence of events occur, the MTA notifies the CMS. The CMS

[i] This function may be viewed as belonging in the Signaling Gateway function.

may then instruct the MTA to create a connection, reserve QoS resources through the access network for the pending voice connection, and also to play a locally generated ringback tone. The CMS in turn communicates with a remote CMS (or MGC) to setup the call. When the CMS detects answer from the far end, it instructs the MTA to stop the ringback tone, activate the media connection between the MTA and the far-end MTA, and begin sending and receiving media stream packets.

By centralizing call state and service processing in the CMS, the service provider is in a position to centrally manage the reliability of the service provided. In addition the service provider gains full access to all software and hardware in the event that a defect that impacts subscriber services occurs. Software can be centrally controlled, and updated in quick debugging and resolution cycles that do not require deployment of field personnel to the customer premise. Additionally, the service provider has direct control over the services introduced and the associated revenue streams associated with such services.

4.1.2 PSTN Signaling Framework

PSTN signaling interfaces are summarized in Table 2 (Pkt-c3 through Pkt-c8). These interfaces provide access to PSTN-based services and to PSTN subscribers from the PacketCable network.

The PacketCable PSTN signaling framework consists of a PSTN gateway that is subdivided into three functional components:

- Media Gateway Controller (MGC)
- Media Gateway (MG)
- Signaling Gateway (SG)

The Media Gateway Controller and Media Gateway are analogous to, respectively, the CMS and MTA in the NCS framework. The Media Gateway provides bearer and in-band signaling connectivity to the PSTN. The Media Gateway Controller implements all the call state and intelligence and controls the operation of the Media Gateway through the TGCP protocol (pkt-c6). This includes creation, modification and deletion of connections as well as in-band signaling information to and from the MG. TGCP is an extended variant of the IETF's MGCP call signaling protocol. The TGCP variant is closely aligned with NCS.

The CMS and the MGC may each send routing queries (e.g., 800 number lookup, LNP lookup) to an SS7 Service Control Point (SCP) via the SG (pkt-c3 and pkt-c5). The MGC, via the SG, also exchanges ISUP signaling with the PSTN's SS7 entities for trunk management and control. The ISTP protocol provides the signaling interconnection service between the PacketCable network call control elements (Call Management Server and Media Gateway Controller) and the PSTN SS7 Signaling network through the SS7 Signaling Gateway. ISTP contains features for initialization; address mapping from the SS7 domain to the IP domain; message delivery for SS7 ISUP and TCAP; congestion management, fault management, maintenance operations; and redundant configuration support. ISTP bridges the gap between basic IP transport mechanisms and application level signaling. Although not a translation of

the SS7 MTP3 and SCCP protocols, ISTP implements analogues to some of the MTP3 and SCCP functions in a fashion appropriate to distributed systems communicating over an IP network. These capabilities allow the IP network to interact with and receive all the services of the PSTN. As service capabilities evolve over time, these same signaling capabilities may be used to support PSTN access to the PacketCable network's own routing and service databases.

4.2 Media Streams

The IETF standard RTP (RFC 1899 - Real-Time Transport Protocol) is used to transport all media streams in the PacketCable network[32]. PacketCable utilizes the RTP profile for audio and video streams as defined in RFC 1990[35].

The primary media flow paths in the PacketCable network architecture are shown in Figure 6 and are further described below.

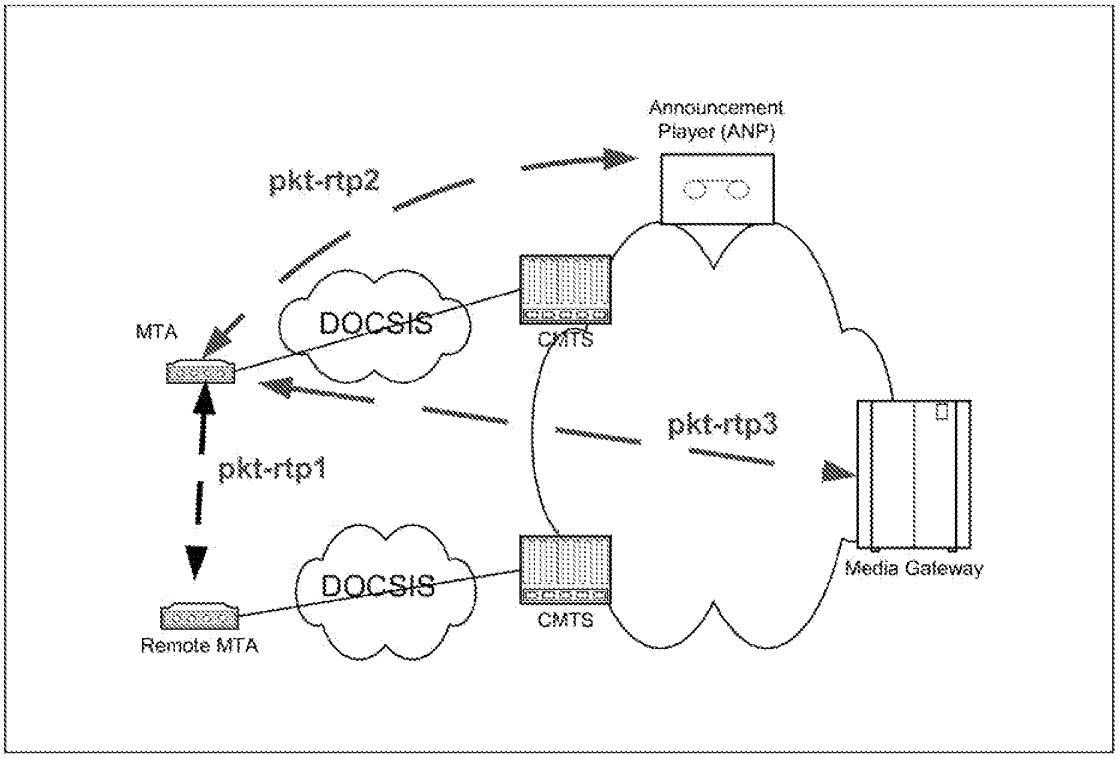


Figure 6. RTP Media Stream Flows in a PacketCable Network

pkt-rtp1: Media flow between MTAs. Includes, for example, encoded voice, video, and fax.

pkt-rtp2: Media flow between the ANP and the MTA. Includes, for example, tones and announcements sent to the MTA by the Announcement Player.

pkt-rtp3: Media flow between the MG and the MTA. Includes, for example, tones, announcements, and PSTN media flow sent to the MTA from the Media Gateway.

RTP encodes a single channel of multimedia information in a single direction. The standard calls for an 8-byte header with each packet. An 8-bit RTP "Payload Type" is defined to indicated which encoding algorithm is used. Most of the standard audio and video algorithms are assigned to particular PT values in the range 0 through 95. The range 96 through 127 is reserved for "dynamic" RTP payload types. The range 128 through 255 is reserved for private administration.

The packet format for RTP data transmitted over IP over Ethernet is depicted in Figure 7 below.

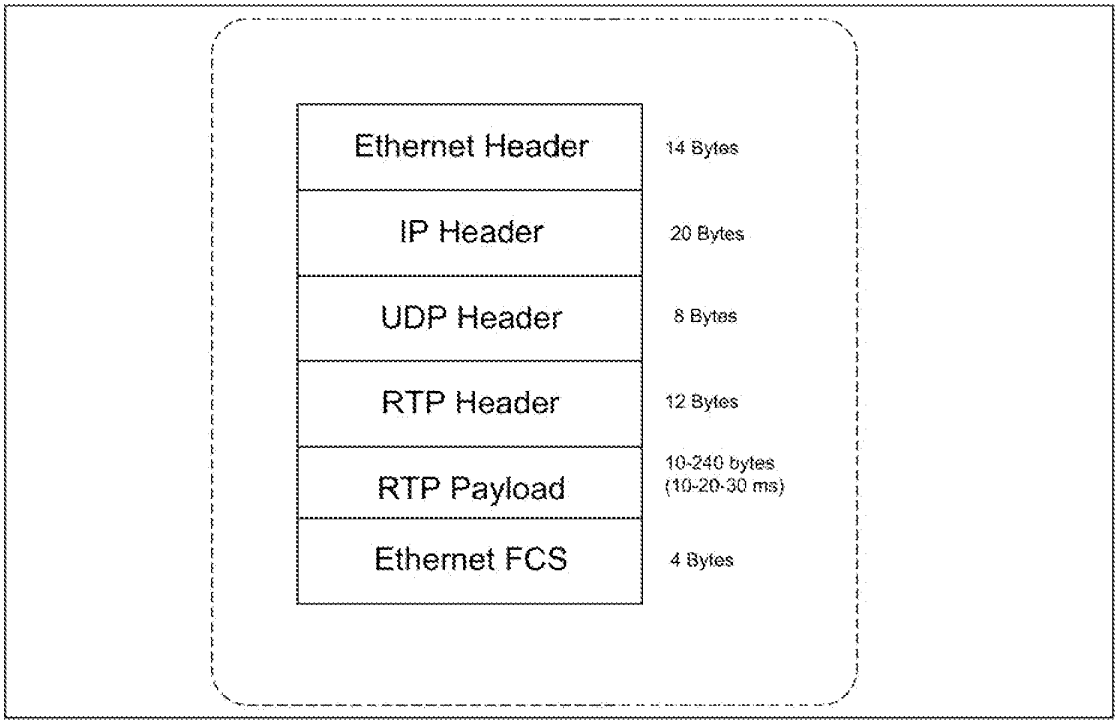


Figure 7. RTP Packet Format

The length of the RTP Payload as well as the frequency with which packets are transmitted depends on the algorithm as defined by the Payload Type field.

RTP sessions are established dynamically by the endpoints involved, so there is no "well-known" UDP port number. The Session Description Protocol (SDP) was developed by the IETF to communicate the particular IP address and UDP port an RTP session is using.

The packet header overhead of Ethernet, IP, UDP, and RTP is significant when compared to a typical RTP Payload size, which can be as small as 10 bytes for packetized voice. The DOCSIS 1.1 specification addresses this issue with a Payload Header Suppression feature for abbreviating common headers.

4.3 MTA Device Provisioning

The scope of MTA Device Provisioning is to enable a MTA to register and provide subscriber services over the HFC network. Provisioning covers initialization, authentication, and registration functions required for MTA device provisioning. The Provisioning Specification [12] also includes attribute definitions required in the MTA configuration file.

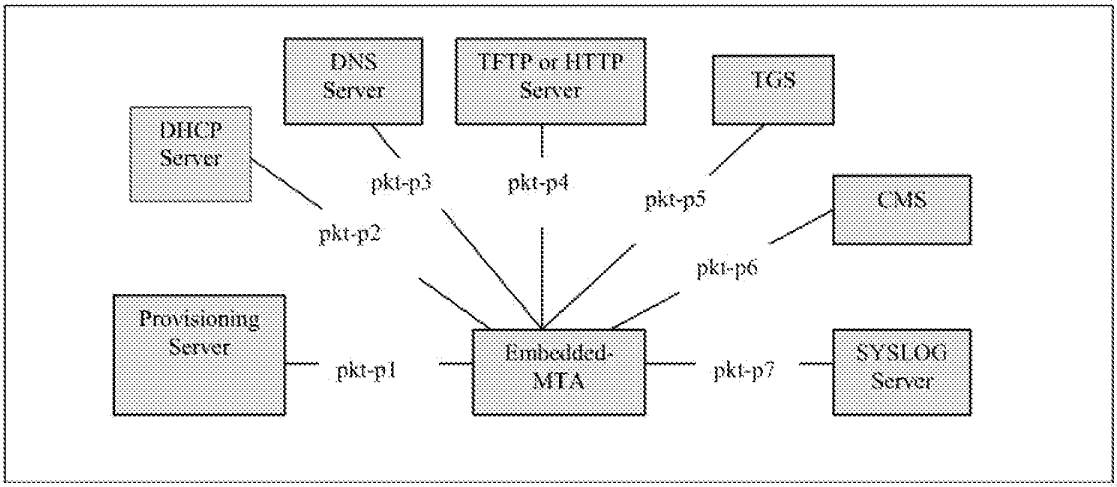


Figure 8. PacketCable Provisioning Interfaces

Table 3 describes the provisioning interfaces shown in the above diagram.

Table 3. Device Provisioning Interfaces

Interface	PacketCable Functional Components	Description
Pkt-p1	MTA-PROV Server	Interface to exchange device capability as well as MTA device and endpoint information between the MTA and Provisioning Server using the SNMP protocol. The MTA also sends notification that provisioning has completed along with a pass/fail status using the SNMP protocol.
Pkt-p2	MTA- DHCP Server	DHCP interface between the MTA and DHCP Server used to assign an IP address to the MTA. If a DNS server is required during provisioning, then the address of this server is also included.
Pkt-p3	MTA – DNS Server	DNS interface between the MTA and DNS Server used to obtain the IP address of a PacketCable server given its fully qualified domain name.
Pkt-p4	MTA – HTTP or TFTP Server	MTA configuration file is downloaded to the MTA from the TFTP Server or HTTP Server.
Pkt-p5	MTA – TGS	MTA obtains a Kerberos ticket from the Ticket Granting Server using the Kerberos protocol.
Pkt-p6	MTA – CMS	MTA establishes an IPSec Security Association with the CMS using the Kerberos protocol.
Pkt-p7	MTA – SYSLOG	MTA sends notification that provisioning has completed along with a pass/fail status to the SYSLOG server via UDP.

Case 2:22-cv-00125-JRG Document 97-8 Filed 05/09/23 Page 139 of 290 PageID #: 2296

4.4 SNMP Element Management Layer Interfaces

PacketCable requires SNMPv3 to interface the MTA to element management systems for MTA device provisioning. SNMPv3 "traps" and "informs" are supported for event handling, as well as "sets" and "gets" for provisioning. PacketCable MIBs are defined in the MTA MIB specification [8] and the NCS MIB specification [9].

The PacketCable NCS MIB contains Network Call Signaling information for provisioning on both a device and a per endpoint basis. The MTA MIB contains data for device provisioning and for supporting provisioned functions such as event logging. More detailed information on the MIBs framework can be found in the PacketCable MIBs framework specification [10].

4.5 Event Messages Interfaces

4.5.1 Event Message Framework

An Event Message is a data record containing information about network usage and activities. A single Event Message may contain a complete set of data regarding usage or it may only contain part of the total usage information. When correlated by the Record Keeping System (RKS), information contained in multiple Event Messages provides a complete record of the service. This complete record of the service is often referred to as a Call Detail Record (CDR). Event Messages or CDRs may be sent to one or more back office applications such as a billing system, fraud detection system, or pre-paid services processor.

This PacketCable Event Messages specification defines the structure of the Event Message data record and defines RADIUS as the transport protocol. Event Message data record is designed to be flexible and extensible in order to carry information about network usage for a wide variety of services. Additional transport protocols may be recommended in future releases of this specification. Although the scope of the specification is limited to defining Event Messages for basic residential voice capabilities, it is expected that this specification will be expanded to support additional PacketCable-based services. Figure 9 shows a representative Event Message architecture.

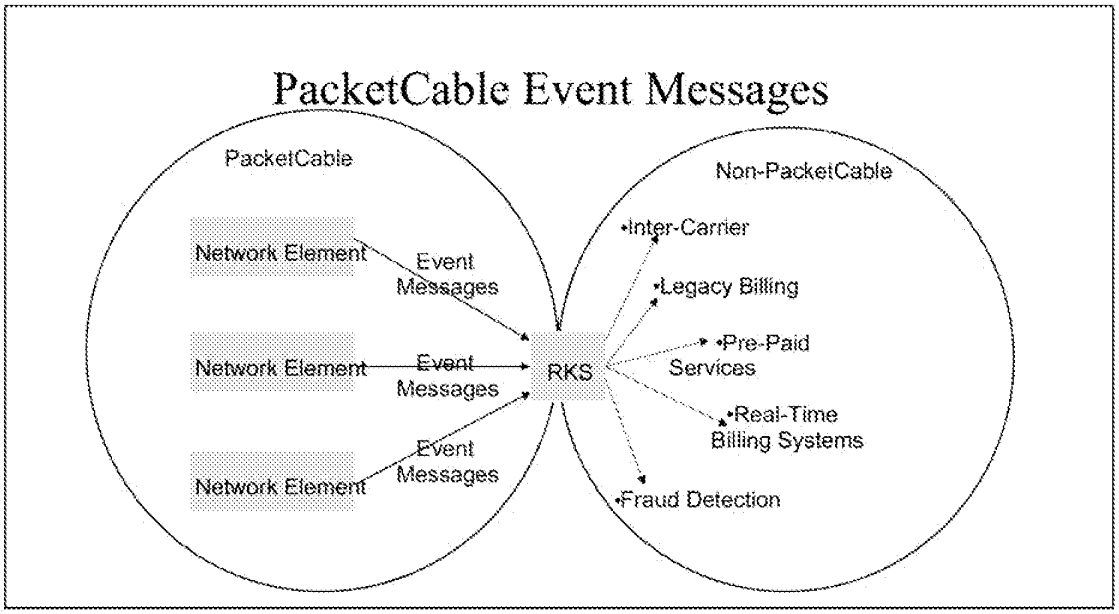


Figure 9. Representative Event Messages Architecture

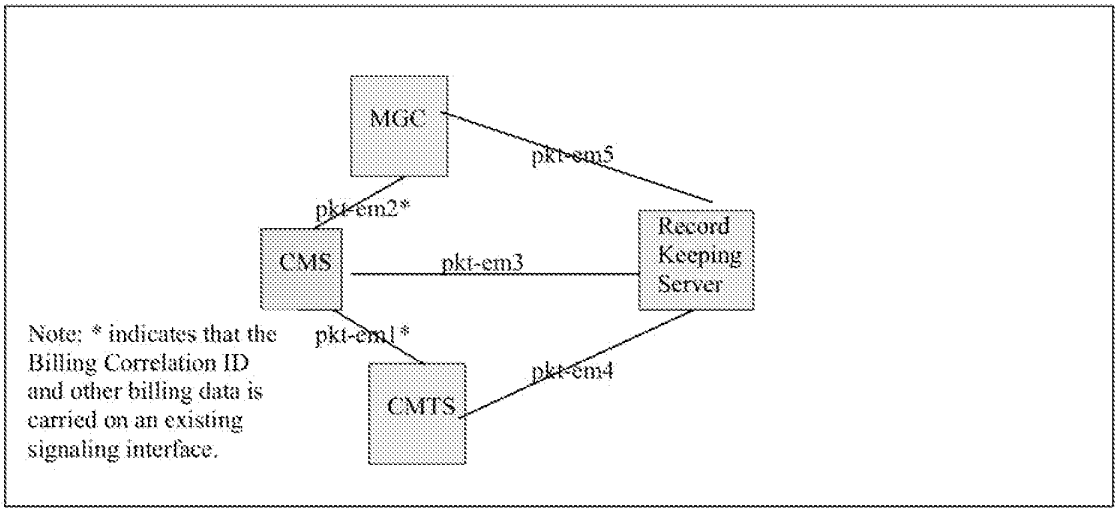


Figure 10. Event Message Interfaces

The following table describes the Event Message interfaces shown in Figure 9.

Table 4. Event Message Interfaces

Interface	PacketCable Functional Component	Description
pkt-em1	CMS-CMTS	DQoS Gate-Set message carrying Billing Correlation ID and other data required for CMTS to send Event Messages to an RKS.
Pkt-em2	CMS-MGC	Vendor-proprietary interface carrying Billing Correlation ID and other data required billing data. Either the CMS or MGC

Interface	PacketCable Functional Component	Description
		may originate a call and therefore need to create the Billing Correlation ID and send this data to the other.
Pkt-em3	CMS-RKS	RADIUS protocol carrying PacketCable Event Messages.
Pkt-em4	CMTS-RKS	RADIUS protocol carrying PacketCable Event Messages.
Pkt-em5	MGC-RKS	RADIUS protocol carrying PacketCable Event Messages.

4.6 Quality-of-Service (QoS)

4.6.1 QoS Framework

Quality of Service signaling interfaces are defined between many of the components of the PacketCable network. Signaling may be handled at the application layer (e.g. SDP parameters), network layer (e.g. RSVP), or the data-link layer (e.g. DOCSIS 1.1 QoS).

From the perspective of the MTA and its access network the PacketCable QoS Framework is represented in Figure 11:

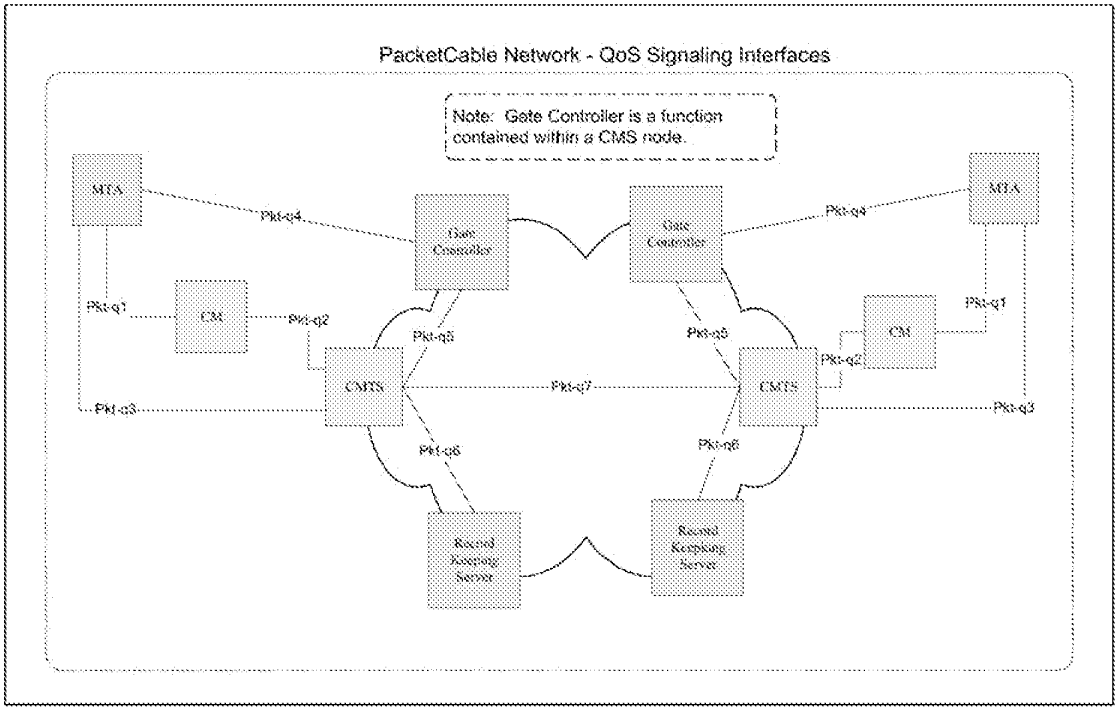


Figure 11. PacketCable QoS Signaling Interfaces

Table 5 briefly identifies each interface and how each interface is used in the Dynamic QoS Specification (DQoS). Two alternatives are shown for this specification: first a general interface that is applicable to either embedded or

standalone MTAs; and second, an optional interface that is available only to embedded MTAs.

Table 5. QoS Interfaces for Standalone and Embedded MTAs

Interface	PacketCable Functional Components	DQoS Embedded/ Standalone MTA	D-QoS Embedded MTA
Pkt-q1	MTA – CM	N/A	E-MTA, MAC Control Service Interface
Pkt-q2	CM – CMTS (DOCSIS)	DOCSIS, CMTS-initiated	DOCSIS, CM-initiated
Pkt-q3	MTA – CMTS	RSVP+[2]	N/A
Pkt-q4	MTA – GC/CMS	NCS/DCS	NCS
Pkt-q5	GC – CMTS	Gate Management	Gate Management
Pkt-q6	CMTS – RKS	Billing	Billing
Pkt-q7	CMTS – CMTS	Gate Management	Gate Management

The function of each QoS interface is further described is defined in Table 6 below.

Table 6. QoS Interfaces

Interface	PacketCable Functional Components	Description
Pkt-q1	MTA – CM	This interface is only defined for the embedded MTA. The interface decomposes into three sub-interfaces: *Control*: used to manage DOCSIS service-flows and their associated QoS traffic parameters and classification rules. *Synchronization*: used to synchronize packet and scheduling for minimization of latency and jitter. *Transport*: used to process packets in the media stream and perform appropriate per-packet QoS processing. The MTA/CM interface is conceptually defined in Appendix E of the DOCSIS RFI specification.
Pkt-q2	CM – CMTS	This is the DOCSIS QoS interface (control, scheduling, and transport). It should be noted that, architecturally, control functions can be initiated from either the CM or the CMTS. However the CMTS is the final policy arbiter and granter of admission into the DOCSIS access network. The following capabilities of the DOCSIS MAC are used within PacketCable: ▪ Multiple service flows, each with its own class of upstream traffic, both single and multiple voice connections per DOCSIS service flow ▪ Prioritized classification of traffic streams to service flows. ▪ Guaranteed minimum/constant bitrate scheduling service ▪ Constant bit rate scheduling with traffic activity detection service

[2] For PacketCable 1.0, only the embedded MTA interfaces as defined in Section 4 of the Dynamic Quality of Service specification are required. The CMTS is not required to support RSVP across the MTA-CMTS interface as defined in DQoS Section 3 [4].

Interface	PacketCable Functional Components	Description
		(slow down, speed up, stop, and restart scheduling) • DOCSIS packet header suppression for increased call density • DOCSIS classification of voice flows to service flow • DOCSIS synchronization of CODEC to CMTS clock and Grant Interval • Two-phase activation of QoS resources • TOS packet marking at network layer • Guarantees on latency and jitter. • Internal sub-layer signaling between PacketCable MTA and DOCSIS (embedded MTA) • This interface is further defined in the DOCSIS RFI specification.
Pkt-q3	MTA – CMTS	The interface is used for request of bandwidth and QoS resources related to the bandwidth. The interface runs on top of layer 4 protocols that bypass the CM. As a result of message exchanges between the MTA and CMTS, service flows are activated using CMTS-originated signaling on interface PKT-Q2. An enhanced version of RSVP is utilized for this signaling.
Pkt-q4	MTA – CMS/GC	Signaling interface between the MTA and CMS/GC. Many parameters are signaled across this interface such as media stream, IP addresses, and Codec selection, but it is possible for certain protocols to either derive QoS semantics from the signaling, or to extend the application layer signaling protocol to contain explicit QoS signaling parameters.
Pkt-q5	CMS/GC – CMTS	This interface is used to manage the dynamic Gates for media stream bearer channels. This interface enables the PacketCable network to request and authorize QoS changes without requiring any layer two DOCSIS access network QoS control functions in MTA. When supporting standalone MTAs no new client-side QoS signaling protocol needs to be designed. The GC/CMS takes responsibility for requesting policy, and the CMTS takes responsibility for access control and quickly setting up QoS on the DOCSIS access link.
Pkt-q6	CMTS – RKS	This interface is used by the CMTS to signal to the RKS all changes in call authorization and usage. This interface is defined in the Event Messages specification.
Pkt-q7	CMTS – CMTS	This interface is used for coordination of resources between the CMTS of the local MTA and the CMTS of the remote MTA. The CMTS is responsible for the allocation and policing of local QoS resources.

4.6.2 Layer Two vs. Layer Four MTA QoS Signaling

QoS signaling from the MTA can be performed either at layer two (DOCSIS) or layer four (RSVP). Layer two signaling is accessible to CM and CMTS devices that exist at the RF boundary of the DOCSIS access network. Layer four signaling is required for devices that are one or more hops removed from the RF boundary of the DOCSIS access network.

If layer two QoS signaling is initiated by the MTA, the MTA must be an embedded MTA. The MTA utilizes the implicit interface for controlling the DOCSIS MAC service flows as suggested by Appendix E of the DOCSIS 1.1 RFI specification.

Layer four QoS signaling is initiated by the MTA; the MTA may be either an embedded MTA or standalone MTA. Enhanced RSVP is used for this signaling and is intercepted by the CMTS. The CMTS utilizes layer two QoS signaling to communicate QoS signaling changes to the CM.

4.6.3 Dynamic Quality-of-Service

PacketCable Dynamic QoS (D-QoS) utilizes the call signaling information at the time that the call is made to dynamically authorize resources for the call. Dynamic QoS prevents various theft of service attack types by integrating the QoS messaging with other protocols and network elements. The network elements that are necessary for a Dynamic QoS control are shown in Figure 11.

The function within the CMTS that performs traffic classification and enforces QoS policy on media streams is called a Gate. The Gate Controller element manages Gates for PacketCable media streams. The following key information is included in signaling between the GC and the CMTS:

- **Maximum Allowed QoS Envelope** – The maximum allowed QoS envelope enumerates the maximum QoS resource (e.g., "2 grants of 160 bytes per 10ms") the MTA is allowed to admit for a given media stream bearer flow. If the MTA requests a value greater than the parameters contained within the envelope the request will be denied.
- **Identity of the media stream endpoints** – The GC/CMS authorizes the parties that are involved in a media stream bearer flow. Using this information the CMTS can police the data stream to ensure that the data stream is destined and originated from the parties that are authorized.
- **Billing Information** – The GC/CMS creates opaque billing information that the CMTS does not have to decode. The information might be as simple as billing identity or the nature of the call. The CMTS forwards this billing information to the RKS as the call is activated or terminated.

The role of each of the PacketCable components in implementing D-QoS is as follows:

Call Management Server/Gate Controller – The CMS/GC is responsible for QoS authorization. The QoS authorization might depend on the type of call, type of user or other parameters defined by policy.

CMTS – Using information supplied by the GC/CMS the CMTS performs admission control on the QoS requests and at the same time polices the data stream to make sure that the data stream is originated and sent to authorized-media stream parties. The CMTS interacts with CM, RKS, MTA, and Terminating CMTS. The responsibilities of CMTS with respect to each of these elements is:

- CMTS to CM – The CMTS is responsible of setting up and tearing down service flows in such a way that the service level agreement it made with the MTA is met. Inasmuch as the CMTS does not trust the CM it polices the traffic from the CM such that the CM works in the way CMTS requested.
- CMTS to Record Keeping Server – The CMTS updates the Record Keeping Server (RKS) each time there is a change in the QoS Service Level Agreement between CMTS and MTA. It uses the Billing Information that is given by GC/CMS to identify each authorized QoS link. The CMTS puts timing information in the message it sends and also buffers the messages if the connection to RKS is severed.
- CMTS to MTA – The MTA makes dynamic requests for modification of QoS traffic parameters. When the CMTS receives the request it makes an authorization check to find out whether the requested characteristics are within the authorized QoS envelope and also whether the media stream endpoints are authorized. Then it provisions the QoS attributes for the RFI link on the CMTS and activates the appropriate QoS traffic parameters via signaling with the CM. When all the provisioning and authorization checks succeed the CMTS sends a success message to the GC/CMS indicating that MTA and CMTS are engaged in a Service Level Agreement.
- CMTS to Terminating CMTS – The CMTS sends messages to the terminating end CMTS (or other terminating access networking device) to ensure that the committed bandwidth on both sides is the same. If the committed bandwidth is not the same then both sides close the connection.

Cable Modem (CM) – Even though the CM is an untrusted entity the CM is responsible for the correct operation of the QoS link between itself and the CMTS. The CMTS makes sure that the CM cannot abuse the RFI link, but it is the responsibility of the CM to utilize the RFI link to provide services that are defined by the DOCSIS 1.1 specification.

Record Keeping Server (RKS) – The RKS acts as a database and stores each event as sent by the CMTS. The RKS stores the messages by attaching received time and network element information. The RKS has to have sufficient interface and/or processing power to allow additional processing to be done.

MTA – The MTA is the entity to which the Service Level Agreement is provided by the access network. The MTA is responsible for the proper use of the QoS link. If it exceeds the traffic authorized by the SLA than it the MTA will not receive the QoS characteristics that it requested. The MTA uses two stage QoS bandwidth allocation – while the call origination is proceeding the QoS resources are admitted, then when the call is answered the resources are activated.

4.7 Announcement Services

Announcements are typically needed for calls that do not complete. Additionally, they may be used to provide enhanced information services to the caller (e.g., calling card, n11 services, etc.). The signaling interfaces to support PacketCable Announcement Services are shown in Figure 12 and are summarized in Table 7 below.

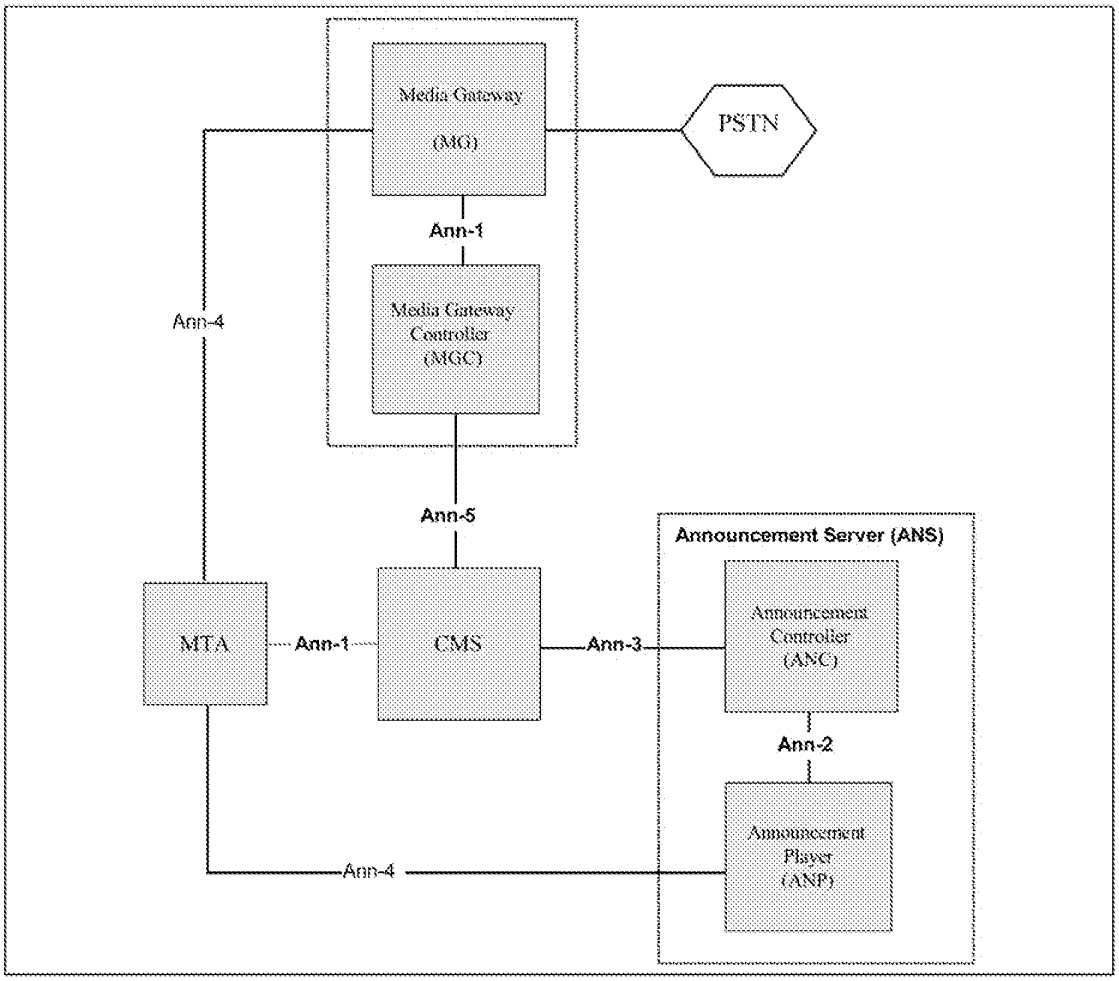


Figure 12. Annoucement Services Components and Interfaces

Table 7. Announcement Interfaces

Interface	PacketCable Functional Components	Protocol
Pkt-ann1	MTA – CMS MGC – MG	The CMS to MTA interface provides a mechanism for the CMS to signal the MTA to play locally stored announcements. Storing announcements in the MTA allows for providing informative progress tones to the end user independently of the network state (e.g., congestion). An NCS-based announcement package has been defined that can be used for both the CMS-MTA and MGC-MG interfaces. Simple, fixed-content announcements (e.g., all-lines-busy) may also be stored at the Media Gateway to provide announcements to PSTN users. The MGC to MG interface provides a mechanism for the MG to play fixed-content announcements to PSTN end-users involved in off-net to on-net calls.
Pkt-ann2	ANC – ANP	The signaling protocol for the ANC to ANP interface is NCS with an announcement package. When the CMS identifies a need for an ANS-based announcement, it sends a request to the ANC over interface Ann-3. Upon receiving a request from the CMS, the ANC opens a session with the Announcement Player using the NCS package.
Pkt-ann3	CMS – ANC	The protocol for the Ann-3 interface is undefined for PacketCable 1.0
Pkt-ann4	ANP-MTA	Defines the media stream format (RTP) for delivery of the announcement from the Announcement Player to the MTA using the RTP protocol.
Pkt-ann5	CMS-MGC	The Ann-5 protocol interface is undefined for PacketCable 1.0.

4.7.1 ANS Physical vs. Logical configuration

The ANC and ANP are logical components that may reside in the same physical entities. When logical components reside in the same physical entity, interfaces between these components become optional. In addition, standalone components using the Ann-2 and Ann-3 interfaces MAY be shared by many network entities.

4.8 Security

4.8.1 Overview

Each of PacketCable's protocol interfaces is subject to threats that could pose security risks to both the subscriber and service provider. The PacketCable architecture addresses these threats by specifying, for each defined protocol interface, the underlying security mechanisms (such as IPSec) that provide the protocol interface with the security services it requires, e.g., authentication, integrity, confidentiality.

For example, the media stream path may traverse a large number of potentially unknown Internet service and backbone service providers' wires. As a result, the media stream may be vulnerable to malicious eavesdropping, resulting in a loss of communications privacy. PacketCable core security services include a mechanism for

providing end-to-end encryption of RTP media streams, thus substantially reducing the threat to privacy.

The security services available through PacketCable's core service layer are authentication, access control, integrity, confidentiality and non-repudiation. A PacketCable protocol interface may employ zero, one or more of these services to address its particular security requirements.

PacketCable security addresses the security requirements of each constituent protocol interface by:

- identifying the threat model specific to each constituent protocol interface
- identifying the security services (authentication, authorization, confidentiality, integrity, and non-repudiation) required to address the identified threats.
- specifying the particular security mechanism providing the required security services.

The security mechanisms include both the security protocol (e.g., IPSec, RTP-layer security, and SNMPv3 security) and the supporting key management protocol (e.g., IKE, PKINIT/Kerberos).

Figure 13 provides a summary of all the PacketCable security interfaces.

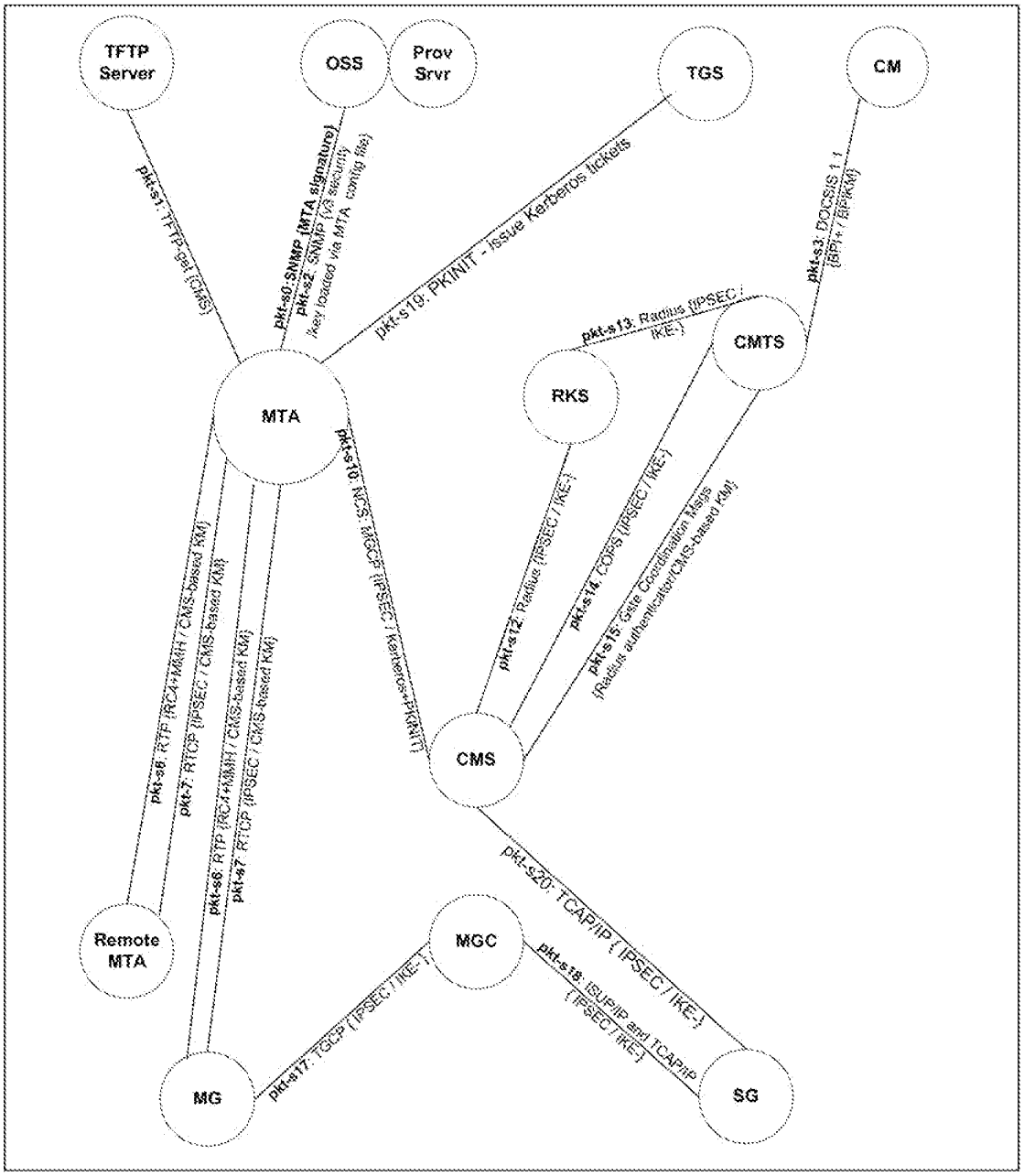


Figure 13. PacketCable Security Interfaces

In Figure 13, each interface is labeled as:

<label>: <protocol> { <security protocol> / <key management protocol> }

If the key management protocol is missing, it means that it is not needed for that interface. PacketCable interfaces that do not require security are not shown on this diagram.

The following abbreviations are used in the above diagram:

- **IKE-:** IKE with pre-shared keys
- **IKE+:** IKE requires public key certificates
- **CMS-based KM:** Keys randomly generated and distributed by CMS

The following table describes each of the interfaces shown in the above diagram.

Table 8. Security Interfaces

Interface	PacketCable Functional Components	Description
pkt-s0	MTA – Provisioning App	SNMPv3 INFORM from the MTA to the SNMP Manager, followed by optional SNMP GET(s) by the SNMP Manager are used to query MTA device capabilities. This occurs at the time where SNMPv3 keys may not be available, and security is provided with an RSA signature, formatted according to CMS (Cryptographic Message Syntax).
Pkt-s1	MTA – TFTP or HTTP Server	MTA Configuration file download. The MTA downloads a configuration file (with TFTP-get) that is signed by the TFTP server and sealed with the MTA public key, with a CMS (Cryptographic Message Syntax) wrapper. This flow occurs right after an SNMPv3 INFORM followed by an optional SNMP GET(s) – see flow pkt-s0
pkt-s2	MTA – Provisioning App	Standard SNMPv3 security. The SNMPv3 keys are downloaded with the MTA configuration file, using interface pkt-s1.
Pkt-s3	CM – CMTS	BPI+ privacy layer on the HFC link. Both security and key management are defined by DOCSIS 1.1.
pkt-s6	MTA – MTA	End-to-end media packets between two MTAs, or between MTA and MG. RTP packets are encrypted directly with RC4, without any additional security layers. An MMH-based MAC (Message Authentication Code) optionally provides message integrity. Keys are distributed by the CMS to the two endpoints.
Pkt-s7	MTA – MTA	RTCP control protocol for RTP, defined above. Message integrity and encryption provided with IPSEC. Key management is same as for RTP – keys are distributed by CMS.
Pkt-s10	MTA-CMS	MTA-CMS signaling for NCS. Message integrity and privacy via IPSEC. Key management is with Kerberos with PKINIT (public key initial authentication) extension.
Pkt-s12	CMS – RKS	Radius billing events sent by the CMS to the RKS. Radius authentication keys are hardcoded to 0. Instead, IPSEC is used for message integrity as well as privacy. Key management is IKE-.

Interface	PacketCable Functional Components	Description
Pkt-s13	CMTS – RKS	Radius events sent by the CMTS to the RKS. Radius authentication keys are hardcoded to 0. Instead, IPSEC is used for message integrity, as well as privacy. Key management is IKE-.
Pkt-s14	CMS – CMTS	COPS protocol between the GC and the CMTS, used to download QoS authorization to the CMTS. Message integrity and privacy provided with IPSEC. Key management is IKE-.
Pkt-s15	CMS – CMTS	Gate Coordination messages for DQoS. Message integrity is provided with an application-layer (Radius) authenticator. Keys are distributed by local CMS over COPS.
Pkt-s16	N/A	N/A
pkt-s17	MGC – MG	PacketCable interface to the PSTN Media Gateway. IPSEC is used for both message integrity and privacy. Key management is IKE-.
Pkt-s18	MGC – SG	PacketCable interface to the PSTN Signaling Gateway. IPSEC is used for both message integrity and privacy. Key management is IKE-.
Pkt-s19	MTA – TGS	Kerberos/PKINIT key management protocol, where the TGS issues CMS tickets to the MTAs.
Pkt-s20	CMS – SG	CMS queries the PSTN Gateway for LNP (Local Number Portability) and other telephony services. IPSEC is used for both message integrity and privacy. Key management is IKE-.

4.8.2 Device Provisioning Security

The PacketCable security architecture divides device provisioning into three distinct activities: subscriber enrollment, device provisioning and device authorization.

4.8.2.1 Subscriber Enrollment

The subscriber enrollment process establishes a permanent subscriber billing account that uniquely identifies the MTA to the CMS via the MTA's serial number or MAC address. The billing account is also used to identify the services subscribed to by the subscriber for the MTA.

Subscriber enrollment may occur in-band or out-of-band. The actual specification of the subscriber enrollment process is out of scope for PacketCable and may be different for each Service Provider.

4.8.2.2 Device Provisioning

The MTA device verifies the authenticity of the configuration file it downloads from the boot server. Privacy of the configuration data is also provided. The configuration data will be "signed and sealed" by packaging it into a PKCS #7 sealed object.

4.8.2.3 Dynamic Provisioning

SNMPv3 security will be used for dynamically provisioning voice communications capabilities on an embedded-MTA.

4.8.2.4 Device Authorization

Device authorization is when a provisioned MTA Device authenticates itself to the Call Management Server, and establishes a security association with that server prior to becoming fully operational. Device authorization allows subsequent call signaling to be protected under the established security association.

4.8.2.5 Signaling Security

All signaling traffic, which includes QoS signaling, call signaling, and signaling with the PSTN Gateway Interface, will be secured via IPSec. IPSec security association management will be done through the use of two key management protocols: Kerberos/PKINIT and IKE. Kerberos/PKINIT will be used to exchange keys between MTA clients and their CMS server; IKE will be used to manage all other signaling IPSec SAs.

4.8.2.6 Media Stream Security

Each media RTP packet is encrypted for privacy. The MTAs have an ability to negotiate a particular encryption algorithm, although the only one that is currently specified is RC4. Encryption is applied to the packet's payload but not to its header.

Each RTP packet may include an optional message authentication code (MAC). The MAC algorithm can also be negotiated, although the only one that is currently specified is MMH. The MAC computation spans the packet's unencrypted header and encrypted payload.

Keys for the encryption and MAC calculation are derived from the End-End secret, which is exchanged between sending and receiving MTA as part of the call signaling. Thus, the key exchanges for media stream security are secured themselves by the call signaling security.

4.8.2.7 OSS and Billing System Security

The SNMP agents in PacketCable devices implement SNMPv3. The SNMPv3 User Security Model [RFC 2274] provides authentication and privacy services for SNMP traffic. SNMPv3 view-based access control [RFC 2275] may be used for access control to MIB objects.

The IKE key management protocol is used to establish encryption and authentication keys between the Record Keeping Server (RKS) and each PacketCable network element that generates Event Messages. When the network IPSec Security Associations are established, these keys must be created between each RKS (primary, secondary, etc) and every CMS and CMTS. The key exchange between the MGC and RKS may exist and is left to vendor implementation in PacketCable 1.0. The Event

Messages are sent from the CMS and CMTS to the RKS using the RADIUS transport protocol, which is in turn secured by IPSec.

5 NETWORK DESIGN CONSIDERATIONS

5.1 Time Keeping and Reporting Issues

In order to maintain service quality, it is highly recommended that all network equipment clocks be maintained to within 200 milliseconds of Universal Time Coordinated (UTC).

It is recommended that PacketCable networks maintain a timeserver that is accurate to within a specified interval of Universal Time Coordinated (UTC). It is recommended that the server be able to exchange time information with other network equipment such that the receiving equipment is able to be synchronized to the time server clock at the completion of the synchronization protocol exchange.

NTP [38] is the recommended protocol for PacketCable time synchronization.

All systems that generate billing event messages must synchronize their clocks to a network clock source. Synchronization should be done to ensure that the reporting device's own clock remains within ±100 milliseconds of the last synchronization value.

5.2 Timing for Playout Buffer Alignment with Coding Rate

Packet generating and packet handing equipment generally operate with free-running clocks. Problems may arise in the offering of isochronous services due to the plesiochronous nature of these clocks. The difference in clock speed between these plesiochronous entities are generally exhibited as overrun or underrun of the playout buffers.

In order to minimize the occurrence of these conditions, all CMTS' should lock their downstream transmission rate to a clock derived from a source that reflects a Stratum-3 clock. Embedded MTAs should use the downstream transmission rate to derive the clock used to determine packetization period. MTAs should also use this clock to determine the rate of playout from the receive buffer. Non-embedded MTAs should use the average packet arrival interval[3] as the basis for determining their packetization and playout clock.

5.3 IP Addressing

An embedded MTA is a multi-function entity with one function required for CM administration and the second function being the MTA function itself. All IP addresses in a PacketCable network are IPV4.

All PacketCable 1.0 embedded MTAs are required to have 2 IP addresses - one for the CM and one for the MTA. All PacketCable 1.0 embedded MTAs are required to have 2 MAC addresses - one for the CM and one for the MTA.

The following requirements can be met using the dual IP address configuration:

[3] I.e., the interval from arrival of the first bit of packet N to the arrival of the first bit of packet N+1, ignoring intervals where a packet does not arrive within 5 ms of the expected periodicity.

- An embedded MTA containing a dual IP address can assign a private IP address for the CM host function, in the case where NAT translation is not provided elsewhere in the PacketCable network.
- With two IP addresses per MTA, the PacketCable operator can route the voice service packets over a voice backbone and all other packets (data) over a data backbone. Essentially the routing backbone must be configured such that different routing paths are followed for each of the two destination IP addresses.
- The PacketCable operator can simplify network side administration and management functions using separate IP addresses. For example, policy filters can be instantiated that block or permit traffic from the MTA component of the node. In addition, network service providers can provide source address screening services, and network traffic statistics and diagnostics can be collected based upon the IP address of the MTA.

Dual IP addresses result in special considerations that affect the following:

- IP protocol stack implementation of the MTA,
- Implementation of PacketCable OSS and device provisioning protocols,
- Network routing implementations.

5.4 Dynamic IP Addressing Assignment

An operational issue exists regarding the dynamic IP addresses assignment for MTAs. The NCS model specified in PacketCable 1.0 is based on a Call Management Server mapping a subscriber's service to an endpoint identifier and an IP address. Therefore, call processing operations would be affected if the MTA's IP address changed during an active call. However, there are some recommendations that network operators and MTA vendors can employ to eliminate this situation.

1. When configuring DHCP options for an MTA, the network operator should configure the IP Address Lease Time (Option Code 51) to specify a very long lease time. This option is detailed in "Dynamic Host Configuration Protocol" [RFC2131] and "DHCP Options and BOOTP Vendor Extensions" [RFC2132]. Per paragraph 3.3 of RFC2131, a lease time setting of "0xffffffff" represents an infinite lease. Use of long lease times will minimize the possibility that an active MTA would be unable to renew its assigned IP address lease.
2. Network operators should also configure an MTA's DHCP Timer T1 and T2 values (Option Codes 58 and 59, respectively) to be no more than the default values specified in paragraph 4.4.5 of RFC2131. Configuring an MTA to begin it's IP address lease time renewal process at no more than 50% of the assigned lease time, combined with the use of very long lease time values, will further ensure that an MTA will be able to renew its IP address lease.
3. MTA vendors should implement mechanisms to prevent an MTA from entering the RENEWING state (as specified in RFC2131) while call

processing is active. It is left to vendor implementation to determine exactly how this capability might best be implemented in their product.

5.5 FQDN Assignment

The following are potential operational issues that are expected to be resolved through vendor-specific implementations:

It is assumed that the OSS back office will generate the appropriate FQDNs for all PacketCable devices, and pass this data to the appropriate PacketCable devices and other network elements. These interfaces are not defined in PacketCable 1.0.

An operational issue exists regarding synchronization of databases within the provisioning domain. Specifically the DHCP database, and the DNS table's require concurrent updates when a subscriber record changes (this includes creation). RFC2131 provides a mechanism by which a host (a DHCP client) could acquire certain configuration information, specifically its IP address(es). However, DHCP does not provide any mechanisms to update the DNS Resource Records that contain the information about mapping between the host's FQDN and its IP address(es) (i.e., the Address and Pointer Resource Records). Thus the information maintained by DNS for a DHCP client may be incorrect – a host (the client) could acquire its address by using DHCP, but the Address Resource Record for the host's FQDN wouldn't reflect the address that the host acquired, and the Pointer Resource Record for the acquired address wouldn't reflect the host's FQDN.

The problem has two main issues. One, how do you update the DNS system when a new IP address is dispensed, and two, how long do you make time out values for RR's. Both of these issues are vendor implementation issues and therefore lie outside of the scope of PacketCable specifications. However, some recommendations on 'best practices' are outlined in RFC 2131.

5.6 Priority Marking of Signaling and Media Stream Packets

Both the media stream and the signaling stream for PacketCable-based services require methods for properly marking and transporting packets at a sufficiently high level of quality of service, both in the DOCSIS access network and in the managed IP backbone.

The primary mechanism for providing low-latency quality of service for media streams in the access network is the DOCSIS 1.1 flow classification service. This service classifies packets into specific flows based upon packet fields such as IP source and destination addresses and UDP port number parameters. In the upstream such classified packets are transported via an appropriate constant bit rate service (for current codecs) as dynamically scheduled by the CMTS. In the downstream the packets are transported via an appropriate high priority queuing and scheduling mechanism. DQoS (between CMS and CMTS) and DOCSIS (between CMTS and CM) signaling mechanisms are used to dynamically setup the media stream flow classification rules and service flow QoS traffic parameters.

In addition to flow classification, it is useful to mark media stream packets with appropriate priority markings. Such priority markings can be utilized within CMTS/CM queuing systems and also within Diff-serv managed QoS backbones (which may not contain flow classification mechanisms) in order to provide high priority QoS treatment of such packets. It should be noted that while no definition is provided as to how QoS is managed in the Managed IP backbone in the current architecture, it is expected that the mechanisms defined for PacketCable QoS will be usable within such a managed backbone.

Signaling packets may also benefit from prioritized QoS services. In particular as an access network becomes loaded to capacity, it may be important to forward signaling packets at a higher priority than data packets in order to avoid excessive signaling latency. It should be noted that from a network traffic-engineering point of view it has not yet been determined whether high priority treatment of signaling packets is required. If signaling prioritization is desired, then the method for providing prioritized QoS is based upon two mechanisms. First mark all signaling packets with a high priority marking, and second provide a DOCSIS Classifier that classifies such packets to be transported on a higher priority service flow. The Classifier can be as simple as mapping all upstream packets with this priority to the high priority SID, or can be more complex and also identify the IP address of the MTA(s) which originate the signaling. The higher priority service flow may be either statically provisioned or dynamically created by the administrator of the CMTS. It should be noted that if the administrator is concerned about theft of service of the high priority service flow, then he may configure the service flow for high priority (low latency) but low bandwidth.

Marking of packets for both the media stream and the signaling stream (NCS) is performed by the MTA and the CMS. The marking is performed at the IP layer using a field that has alternately been called the TOS byte or the Diff-serv Code Point (DSCP). The TOS byte was the original definition of the byte while DSCP is the new definition of the byte as used by the IETF Diff-serv architecture. Because two formats for this byte exist, the configuration of the values should be done in a format and type independent way (in the MIBs for the MTA and Call Agent).

Management Information Bases (MIBS) are defined in PacketCable for assigning the provisioned and default values for media stream priority marking and signaling stream priority marking (e.g. a value of '3' for signaling and a value of '5' for media). It should be noted that in NCS the signaled SDP parameters may contain overrides for the configured media stream priority marking value on a connection by connection basis. No mechanism currently exists for dynamically overriding the provisioned priority marking value of the signaling stream on a call by call basis.

5.7 Fax Support

PacketCable supports real-time fax transmission. Fax is 'best' accomplished using the G.711 standard for audio encoding/decoding. If a call is established using a compressed codec, the embedded MTA will have to be instructed to look for fax tones. If fax tones are detected, the CMS will have to be notified and the MTA will be

instructed to switch to using G.711. Note that this places a requirement on the embedded device to monitor the media stream and detect fax tones.

Support for switching over to fax from a voice call is required; however, switching back to voice from fax is not required (*i.e.*, monitoring the fax media stream for an ending signal and then switching back to a low bandwidth codec).

Local termination of fax and translating the fax stream to an IP fax relay data stream is not required in this version of the architecture.

5.8 Analog Modem Support

Analog modems are supported in a similar fashion to fax—a MTA will be asked to detect modem tones and, when such tones are detected, the CMS will instruct the MTA to switch over to the G.711 codec if it is not already in use. Note that this places a requirement on the embedded device to monitor the voice stream and to detect analog modem tones.

Switching over to G.711 to support analog modem signaling from a voice call will be supported; however, switching back to voice from modem signaling will not be required to be supported (*i.e.*, monitoring the modem media stream for an ending signal and then switching back to a low-bandwidth codec).

Local termination of modems and translating the modem stream to an IP modem relay data stream is not required in this version of the architecture.

6 FUTURE CONSIDERATIONS

The goal of PacketCable is to enable full-featured, robust, wide-scale deployment for global cable IP networks. To meet this goal, the PacketCable project will continue to evolve to support ground-breaking services, features, and functionality. The project evolution is accompanied by an architecture evolution as new features are added and old ones are re-designed. Continuing the design evolution allows cutting-edge techniques to be added to optimize access, maximize bandwidth utilization and provide for advanced multimedia features.

Future PacketCable network capabilities will likely include but are not limited to, inter-zone and inter-domain signaling, tools for client power management, primary line support, fault management and performance management. Additional equipment types such as standalone MTAs (S-MTAs) and new media servers are also planned for specification.

Potential changes in other areas could address enhanced QoS, provisioning and security capabilities. For example, QoS could add layer four QoS signaling (for providing service to standalone MTAs via RSVP with enhancements) and a specific protocol for backbone networks. Provisioning for subscriber installed and dynamically provisioned MTAs (out-of-box registration and activation of service) may be possible in the near future on PacketCable networks. Security could include support for new network devices, and interfaces to those devices. Additionally, security would be added for the MTA-CMTS interface (RSVP) for QoS signaling, and for any newly defined provisioning and signaling protocols. Also, an increased choice in the number of cryptographic algorithms may be made available.

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Appendix C. Glossary

AAA	Authentication, Authorization and Accounting
Access Control	Limiting the flow of information from the resources of a system only to authorized persons, programs, processes or other system resources on a network.
Active	A service flow is said to be "active" when it is permitted to forward data packets. A service flow must first be admitted before it is active.
Admitted	A service flow is said to be "admitted" when the CMTS has reserved resources (e.g. bandwidth) for it on the DOCSIS network.
AF	Assured Forwarding. A Diffserv Per Hop Behavior.
AH	Authentication header is an IPSec security protocol that provides message integrity for complete IP packets, including the IP header.
A-link	A-Links are SS7 links that interconnect STPs and either SSPs or SCPs. 'A' stands for "Access".
Announcement Server	An announcement server plays informational announcements in PacketCable network. Announcements are needed for communications that do not complete and to provide enhanced information services to the user.
AMA	Automated Message Accounting., a standard form of call detail records (CDRs) developed and administered by Bellcore (now Telcordia Technologies)
Asymmetric Key	An encryption key or a decryption key used in a public key cryptography, where encryption and decryption keys are always distinct.
AT	Access Tandem. A switching point in PSTN networks that allows access to an entire calling area.
ATM	Asynchronous Transfer Mode. A protocol for the transmission of a variety of digital signals using uniform 53-byte cells.
Authentication	The process of verifying the claimed identity of an entity to another entity.
Authenticity	The ability to ensure that the given information is without modification or forgery and was in fact produced by the entity who claims to have given the information.
Authorization	The act of giving access to a service or device if one has the permission to have the access.
BAF	Bellcore AMA Format, another way of saying AMA
BPI+	Baseline Privacy Interface Plus is the security portion of the DOCSIS 1.1 standard which runs on the MAC layer.
CBC	Cipher block chaining mode is an option in block ciphers that combine (XOR) the previous block of ciphertext with the current block of plaintext before encrypting that block of the message.
CBR	Constant Bit Rate.
CA	Certification Authority - a trusted organization that accepts certificate applications from entities, authenticates applications, issues certificates and maintains status information about certificates.
CA	Call Agent. In this specification "Call Agent" is part of the CMS that maintains call state, and controls the line side of calls.
CDR	Call Detail Record. A single CDR is generated at the end of each billable activity. A single billable activity may also generate multiple CDRs

CIC	Circuit Identification Code. In ANSI SS7, a two octet number that uniquely identifies a DSO circuit within the scope of a single SS7 Point Code.
CID	Circuit ID (Pronounced "Kid"). This uniquely identifies an ISUP DS0 circuit on a Media Gateway. It is a combination of the circuit's SS7 gateway point code and Circuit Identification Code (CIC). The SS7 DPC is associated with the Signaling Gateway that has domain over the circuit in question.
CIF	Common Intermediate Format. A coding format for digital signals.
Cipher	An algorithm that transforms data between plaintext and ciphertext.
Ciphersuite	A set which must contain both an encryption algorithm and a message authentication algorithm (e.g. a MAC or an HMAC). In general, it may also contain a key management algorithm, which does not apply in the context of PacketCable.
Ciphertext	The (encrypted) message output from a cryptographic algorithm that is in a format that is unintelligible.
CIR	Committed Information Rate.
Cleartext	The original (unencrypted) state of a message or data.
CM	DOCSIS Cable Modem.
CMS	Cryptographic Message Syntax
CMS	Call Management Server. Controls the audio call connections. Also called a Call Agent in MGCP/SGCP terminology.
CMTS	Cable Modem Termination System, the device at a cable head-end which implements the DOCSIS RFI MAC protocol and connects to CMs over an HFC network.
Codec	COder-DECoder
Confidentiality	A way to ensure that information is not disclosed to any one other then the intended parties. Information is encrypted to provide confidentiality. Also known as privacy.
COPS	Common Open Policy Service Protocol is currently an internet draft which describes a client/server model for supporting policy control over QoS Signaling Protocols and provisioned QoS resource management.
CoS	Class of Service. The type 4 tuple of a DOCSIS 1.0 configuration file.
CSR	Customer Service Representative
Cryptoanalysis	The process of recovering the plaintext of a message or the encryption key without access to the key.
Cryptographic algorithm	An algorithm used to transfer text between plaintext and ciphertext.
DA	Directory Assistance
DE	Default. A Diffserv Per Hop Behavior.
Decipherment	A procedure applied to ciphertext to translate it into plaintext.
Decryption	A procedure applied to ciphertext to translate it into plaintext.
Decryption key	The key in the cryptographic algorithm to translate the ciphertext to plaintext
DHCP	Dynamic Host Configuration Protocol.
DHCP-D	DHCP Default - Network Provider DHCP Server
Digital certificate	A binding between an entity's public key and one or more attributes relating to its identity, also known as a public key certificate

Digital signature	A data value generated by a public key algorithm based on the contents of a block of data and a private key, yielding an individualized cryptographic checksum
DNS	Domain Name Server
Downstream	The direction from the head-end toward the subscriber location.
DSCP	Diffserv Code Point. A field in every IP packet which identifies the Diffserv Per Hop Behavior. In IP version 4, the TOS byte is redefined to be the DSCP. In IP version 6, the Traffic Class octet is used as the DSCP. See Appendix A.
DOCSIS	Data Over Cable System Interface Specification.
DPC	Destination Point Code. In ANSI SS7, a 3 octet number which uniquely identifies an SS7 Signaling Point, either an SSP, STP, or SCP.
DQoS	Dynamic Quality of Service, i.e. assigned on the fly for each call depending on the QoS requested
DTMF	Dual-tone Multi Frequency (tones)
EF	Expedited Forwarding. A Diffserv Per Hop Behavior.
E-MTA	Embedded MTA – a single node which contains both an MTA and a cable modem.
Encipherment	A method used to translate information in plaintext into ciphertext.
Encryption	A method used to translate information in plaintext into ciphertext.
Encryption Key	The key used in a cryptographic algorithm to translate the plaintext to ciphertext.
Endpoint	A Terminal, Gateway or MCU
EO	End Office. A switching point in the PSTN Local Exchange Carrier network that directly connects to subscriber access lines.
Errored Second	Any 1-sec interval containing at least one bit error.
ESP	IPSec Encapsulation Security Payload protocol that provides both IP packet encryption and optional message integrity, not covering the IP packet header.
ETSI	European Telecommunications Standards Institute
Event Message	Message capturing a single portion of a call connection
FGD	Feature Group D signaling. A type of circuit used for exchanging traffic with a PSTN LEC network.
F-link	F-Links are SS7 links that directly connect two SS7 end points, such as two SSPs. 'F' stands for "Fully Associated"
Flow [IP Flow]	A unidirectional sequence of packets identified by ISO Layer 3 and Layer 4 header information. This information includes source/destination IP addresses, source/destination port numbers, protocol ID. Multiple multimedia streams may be carried in a single IP Flow.
Flow [DOCSIS Flow]	(a.k.a. DOCSIS-QoS "service flow"). A unidirectional sequence of packets associated with a SID and a QoS. Multiple multimedia streams may be carried in a single DOCSIS Flow.
FQDN	Fully Qualified Domain Name. Refer to IETF RFC 821 for details.
Gateway	Devices bridging between the PacketCable IP Telephony world and the PSTN. Examples are the Media Gateway which provides the bearer circuit interfaces to the PSTN and transcodes the media stream, and the Signaling Gateway which sends and receives circuit switched network signaling tot he edge of the PacketCable network.

H.323	An ISO standard for transmitting and controlling audio and video information. The H.323 standard calls for the use of the H.225/H.245 protocol for call control between a "gateway" audio/video endpoint and a "gatekeeper" function.
Header	Protocol control information located at the beginning of a protocol data unit.
HFC	Hybrid Fiber/Coax(ial [cable]). HFC system is a broadband bi-directional shared media transmission system using fiber trunks between the head-end and the fiber nodes, and coaxial distribution from the fiber nodes to the customer locations.
H.GCP	A protocol for media gateway control being developed by ITU.
HMAC	Hashed Message Authentication Code – a message authentication algorithm, based on either SHA-1 or MD5 hash and defined in RFC 2104.
HTTP	Hyper Text Transfer Protocol. Refer to IETF RFC 1945 and RFC 2068.
IANA	Internet Assigned Numbered Authority. See www.ietf.org for details.
IC or IXC	Inter-exchange Carrier. A long distance carrier.
IETF	Internet Engineering Task Force. A body responsible, among other things, for developing standards used in the Internet.
IKE	Internet Key Exchange is a key management mechanism used to negotiate and derive keys for SAs in IPSec.
IKE–	A notation defined to refer to the use of IKE with pre-shared keys for authentication.
IKE+	A notation defined to refer to the use of IKE, which requires digital certificates for authentication.
Integrity	A way to ensure that information is not modified except by those who are authorized to do so.
IntraLATA	Within a Local Access Transport Area
IP	Internet Protocol. An Internet network-layer protocol.
IPSec	Internet Protocol Security, a collection of Internet standards for protecting IP packets with encryption and authentication.
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part is a protocol within the SS7 suite of protocols that is used for call signaling within an SS7 network.
ISTP	Internet Signaling Transport Protocol
ISTP – User	Any element, node, or software process that uses the ISTP stack for signaling communications.
ITU	International Telecommunication Union
IVR	Interactive Voice Response System
Jitter	Variability in the delay of a stream of incoming packets making up a flow such as a voice call
Kerberos	A secret-key network authentication protocol that uses a choice of cryptographic algorithms for encryption and a centralized key database for authentication.
Key	A mathematical value input into the selected cryptographic algorithm.
Key Exchange	The swapping of public keys between entities to be used to encrypt communication between the entities.

Key Management	The process of distributing shared symmetric keys needed to run a security protocol.
Keying Material	A set of cryptographic keys and their associated parameters, normally associated with a particular run of a security protocol.
Key Pair	An associated public and private key where the correspondence between the two are mathematically related, but it is computationally infeasible to derive the private key from the public key.
Keyspace	The range of all possible values of the key for a particular cryptographic algorithm.
LATA	Local Access and Transport Area
Latency	The time, expressed in quantity of symbols, taken for a signal element to pass through a device.
LD	Long Distance
LIDB	Line Information Data Base, containing information on telephone customers required for real-time access such as calling card personal identification numbers (PINs) for real-time validation
Link Encryption	Cryptography applied to data as it travels on data links between the network devices.
LLC	Logical Link Control, used here to mean the Ethernet Packet header and optional 802.1P tag which may encapsulate an IP packet. A sublayer of the Data Link Layer.
LNP	Local Number Portability. Allows a customer to retain the same phone number when switching from one local service provider to another.
LSSGR	LATA Switching Systems Generic Requirements
MAC	Message Authentication Code - a fixed length data item that is sent together with a message to ensure integrity, also known as a MIC.
MAC	Media Access Control. It is a sublayer of the Data Link Layer. It normally runs directly over the physical layer.
MC	Multipoint Controller
MD5	Message Digest 5 - a one-way hash algorithm which maps variable length plaintext into fixed length (16 byte) ciphertext.
MDCP	A media gateway control specification submitted to IETF by Lucent. Now called SCTP.
MDU	Multi-Dwelling Unit. Multiple units within the same physical building. The term is usually associated with high rise buildings
MEGACO	Media Gateway Control IETF working group. See www.ietf.org for details.
MG	The media gateway provides the bearer circuit interfaces to the PSTN and transcodes the media stream.
MGC	An Media Gateway Controller is the overall controller function of the PSTN gateway. It receives, controls and mediates call signaling information between the PacketCable and PSTN.
MGCP	Media Gateway Control Protocol. Protocol follow on to SGCP.
MIB	Management Information Base
MIC	Message integrity code, a fixed length data item that is sent together with a message to ensure integrity, also known as a MAC.
MMC	Multi-Point Mixing Controller. A conferencing device for mixing media

	streams of multiple connections.
MSO	Multi-System Operator, a cable company that operates many head-end locations in several cities.
MSU	Message Signal Unit
MTA	Media Terminal Adapter – contains the interface to a subscribers' CPE, a network interface, CODECs, and all signaling and encapsulation functions required for VoIP transport, class features signaling, and QoS signaling.
MTP	The Message Transfer Part is a set of two protocols (MTP 2, 3) within the SS7 suite of protocols that are used to implement physical, data link and network level transport facilities within an SS7 network.
MWD	Maximum Waiting Delay
NANP	North American Numbering Plan. The set of rules for assigning phone numbers in North America.
NAT	Network Address Translation
NAT Network Layer	Network Address Translation Layer 3 in the Open System Interconnection (OSI) architecture; the layer that provides services to establish a path between open systems.
Network Management	The functions related to the management of data across the network.
NCS	Network Call Signaling
Nonce	A random value used only once which is sent in a communications protocol exchange to prevent replay attacks.
Non-Repudiation	The ability to prevent a sender from denying later that he or she sent a message or performed an action.
NPA-NXX	Numbering Plan Area (more commonly known as area code) NXX (sometimes called exchange) represents the next three numbers of a phone number. The N can be any number from 2-9 and the Xs can be any number. The combination of a phone number's NPA-NXX will usually indicate the physical location of the call device. The exceptions include toll-free numbers and ported number (see LNP)
NTP	Network Time Protocol, an internet standard used for synchronizing clocks of elements distributed on an IP network
NTSC	National Television Standards Committee which defines the analog color television, broadcast standard used today in North America.
Off-Net Call	Call connecting a PacketCable subscriber out to a user on the PSTN
On-Net Call	Call placed by one customer to another customer entirely on the PacketCable Network
One-way Hash	A hash function that has an insignificant number of collisions upon output.
OSP	Operator Service Provider
OSS	Operations Systems Support. The back office software used for configuration, performance, fault, accounting and security management.
PAL	Phase Alternate Line – the European color television format which evolved from the American NTSC standard.
PDU	Protocol Data Unit
PKCS	Public Key Cryptography Standards, published by RSA Data Security Inc. Describes how to use public key cryptography in a reliable, secure and interoperable way.

PKI	Public Key Infrastructure - a process for issuing public key certificates, which includes standards, Certification Authorities, communication between authorities and protocols for managing certification processes.
PKINIT	The extension to the Kerberos protocol that provides a method for using public key cryptography during initial authentication.
PHS	Payload Header Suppression, a DOCSIS technique for compressing the Ethernet, IP and UDP headers of RTP packets.
Plaintext	The original (unencrypted) state of a message or data.
Pre-shared Key	A shared secret key passed to both parties in a communication flow, using an unspecified manual or out-of-band mechanism.
Privacy	A way to ensure that information is not disclosed to any one other then the intended parties. Information is usually encrypted to provide confidentiality. Also known as confidentiality.
Private Key	The key used in public key cryptography that belongs to an individual entity and must be kept secret.
Proxy	A facility that indirectly provides some service or acts as a representative in delivering information there by eliminating a host from having to support the services themselves.
PSC	Payload Service Class Table, a MIB table that maps RTP payload Type to a Service Class Name.
PSFR	Provisioned Service Flow Reference. An SFR that appears in the DOCSIS configuration file.
PSTN	Public Switched Telephone Network.
Public Key	The key used in public key cryptography that belongs to an individual entity and is distributed publicly. Other entities use this key to encrypt data to be sent to the owner of the key.
Public Key Certificate	A binding between an entity's public key and one or more attributes relating to its identity, also known as a digital certificate.
Public Key Cryptography	A procedure that uses a pair of keys, a public key and a private key for encryption and decryption, also known as asymmetric algorithm. A user's public key is publicly available for others to use to send a message to the owner of the key. A users private key is kept secret and is the only key which can decrypt messages sent encrypted by the users public key.
PCM	Pulse Code Modulation – A commonly employed algorithm to digitize an analog signal (such as a human voice) into a digital bit stream using simple analog to digital conversion techniques.
QCIF	Quarter Common Intermediate Format
QoS	Quality of Service, guarantees network bandwidth and availability for applications.
RADIUS	Remote Access Dial-In User Service, an internet protocol (RFC 2138 and RFC 2139) originally designed for allowing users dial-in access to the internet through remote servers. Its flexible design has allowed it to be extended well beyond its original intended use
RAS	Registration, Admissions and Status. RAS Channel is an unreliable channel used to convey the RAS messages and bandwidth changes between two H.323 entities.
RC4	A variable key length stream cipher offered in the ciphersuite, used to encrypt the media traffic in PacketCable.

RFC	Request for Comments. Technical policy documents approved by the IETF which are available on the World Wide Web at http://www.ietf.cnri.reston.va.us/rfc.html
RFI	The DOCSIS Radio Frequency Interface specification.
RJ-11	Standard 4-pin modular connector commonly used in the United States for connecting a phone unit into the wall jack
RKS	Record Keeping Server, the device which collects and correlates the various Event Messages
Root Private Key	The private signing key of the highest level Certification Authority. It is normally used to sign public key certificates for lower-level Certification Authorities or other entities.
Root Public Key	The public key of the highest level Certification Authority, normally used to verify digital signatures that it generated with the corresponding root private key.
RSA Key Pair	A public/private key pair created for use with the RSA cryptographic algorithm.
RSVP	Resource reSerVation Protocol
RTCP	Real Time Control Protocol
RTO	Retransmission Timeout
RTP	Real Time Protocol, a protocol defined in RFC 1889 for encapsulating encoded voice and video streams.
S-MTA	Standalone MTA -- a single node which contains an MTA and a non DOCSIS MAC (e.g. ethernet).
SA	Security Association - a one-way relationship between sender and receiver offering security services on the communication flow .
SAID	Security Association Identifier - uniquely identifies SAs in the BPI+ security protocol, part of the DOCSIS 1.1 specification.
SCCP	The Signaling Connection Control Part is a protocol within the SS7 suite of protocols that provides two functions in addition to those that are provided within MTP. The first is the ability to address applications within a signaling point. The second function is Global Title Translation.
SCP	A Service Control Point is a Signaling Point within the SS7 network, identifiable by a Destination Point Code, that provides database services to the network.
SCTP	Simple Control Transmission Protocol.
SDP	Session Description Protocol.
SDU	Service Data Unit. Information that is delivered as a unit between peer service access points.
Secret Key	The cryptographic key used in a symmetric key algorithm, which results in the secrecy of the encrypted data depending solely upon keeping the key a secret, also known as a symmetric key.
Session Key	A cryptographic key intended to encrypt data for a limited period of time, typically between a pair of entities.
SF	Service Flow. A unidirectional flow of packets on the RF interface of a DOCSIS system.
SFID	Service Flow ID, a 32-bit integer assigned by the CMTS to each DOCSIS Service Flow defined within a DOCSIS RF MAC domain. Any 32-bit SFID

	must not conflict with a zero-extended 14-bit SID. SFIDs are considered to be in either the upstream direction (USFID) or downstream direction (DSFID). USFIDs and DSFIDs are allocated from the same SFID number space.
SFR	Service Flow Reference, a 16-bit message element used within the DOCSIS TLV parameters of Configuration Files and Dynamic Service messages to temporarily identify a defined Service Flow. The CMTS assigns a permanent SFID to each SFR of a message.
SG	Signaling Gateway. A SG is a signaling agent that receives/sends SCN native signaling at the edge of the IP network.
SGCP	Simple Gateway Control Protocol. Earlier draft of MGCP.
SHA – 1	Secure Hash Algorithm 1 - a one-way hash algorithm.
SID	Service ID. A 14-bit number assigned by a CMTS to identify an upstream virtual circuit. Each SID separately requests and is granted the right to use upstream bandwidth.
Signed and Sealed	An "envelope" of information which has been signed with a digital signature and sealed by using encryption.
SIP	Session Initiation Protocol is an application layer control (signaling) protocol for creating, modifying and terminating sessions with one or more participants.
SNMP	Simple Network Management Protocol
SOHO	Small Office/Home Office
SPI	Security Parameters Index - a field in the IPSEC header that along with the destination IP address provides a unique number for each SA.
SS7	Signaling System Number 7. SS7 is an architecture and set of protocols for performing out-of-band call signaling with a telephone network.
SSP	Service Switching Point. SSPs are points within the SS7 network that terminate SS7 signaling links and also originate, terminate, or tandem switch calls.
STP	Signal Transfer Point. An STP is a node within an SS7 network that routes signaling messages based on their destination address. It is essentially a packet switch for SS7. It may also perform additional routing services such as Global Title Translation.
Subflow	A unidirectional flow of IP packets characterized by a single source and destination IP address and source and destination UDP/TCP port.
Symmetric Key	The cryptographic key used in a symmetric key algorithm, which results in the secrecy of the encrypted data depending solely upon keeping the key a secret, also known as a secret key.
Systems Management	Functions in the application layer related to the management of various open systems Interconnection (OSI) resources and their status across all layers of the OSI architecture.
TCAP	Transaction Capabilities Application Protocol. A protocol within the SS7 stack that is used for performing remote database transactions with a Signaling Control Point.
TCP	Transmission Control Protocol
TD	Timeout for Disconnect
TFTP	Trivial File Transfer Protocol
TFTP-D	Default – Trivial File Transfer Protocol

TGS	Ticket Granting Server used to grant Kerberos tickets.
TGW	Telephony Gateway
TIPHON	Telecommunications & Internet Protocol Harmonization Over Network.
TLV	Type-Length-Value tuple within a DOCSIS configuration file.
TN	Telephone Number
ToD	Time of Day Server
TOS	Type of Service. An 8-bit field of every IP version 4 packet. In a Diffserv domain, the TOS byte is treated as the Diffserv Code Point, or DSCP.
Transit Delays	The time difference between the instant at which the first bit of a PDU crosses one designated boundary, and the instant at which the last bit of the same PDU crosses a second designated boundary.
Trunk	An analog or digital connection from a circuit switch which carries user media content and may carry telephony signaling (MF, R2, etc.).
TSG	Trunk Subgroup
Tunnel Mode	An IPSEC (ESP or AH) mode that is applied to an IP tunnel, where an outer IP packet header (of an intermediate destination) is added on top of the original, inner IP header. In this case, the ESP or AH transform treats the inner IP header as if it were part of the packet payload. When the packet reaches the intermediate destination, the tunnel terminates and both the outer IP packet header and the IPSEC ESP or AH transform are taken out.
UDP	User Datagram Protocol, a connectionless protocol built upon Internet Protocol (IP).
Upstream	The direction from the subscriber location toward the head-end.
VAD	Voice Activity Detection
VBR	Variable bit-rate
VoIP	Voice over IP
WBEM	Web-Based Enterprise Management (WBEM) is the umbrella under which the DMTF (Desktop Management Task Force) will fit its current and future specifications. The goal of the WBEM initiative is to further management standards using Internet technology in a manner that provides for interoperable management of the Enterprise. There is one DMTF standard today within WBEM and that is CIM (Common Information Model). WBEM compliance means adhering to the CIM. See www.dmtf.org
X.509 certificate	a public key certificate specification developed as part of the ITU-T X.500 standards directory

Appendix D. Example Delay Budgets

A model that estimates delay and jitter for PacketCable networks is shown in the following charts. This information is for informative purpose only.

VoIP over DOCSIS Delay & Jitter Model

John T. Chapman, jchapman@cisco.com V2.1, 9/8/99 (v1.0 5/3/98)

Scenario	A	B	C	D	E	F	G	H	I	J	K	L	
Voice Coding	G.711T	G.728T	G.729T	G.711T	G.728T	G.729T	G.711	G.728	G.729	G.711	G.728	G.729	
Voice per Packet (ms)	10	10	10	20	20	20	10	10	10	20	20	20	
Delay Round Trip													
Codec:													
No Grant Sync:	25	30	39	35	40	49	32	45	50	42	55	60	ms
Grant Sync:	25	30	39	35	40	49	32	45	50	42	55	60	ms
Cable Plant:													
No Grant Sync:	15	15	15	25	25	25	15	15	15	25	25	25	ms
Grant Sync:	9	9	9	9	9	9	9	9	9	9	9	9	ms
Backbone:	210	210	210	210	210	210	210	210	210	210	210	210	ms
BTI <-> BTI													
No Grant Sync:	290	300	318	331	340	358	304	330	340	345	370	380	ms
Grant Sync:	278	288	306	299	308	326	292	318	328	313	338	348	ms
PSTN <-> BTI													
No Grant Sync:	275	285	303	305	315	333	289	315	325	319	345	355	ms
Grant Sync:	269	279	297	289	299	317	283	309	319	303	329	339	ms
Jitter One Way													
Coder:	0	0	0	0	0	0	0	0	0	0	0	0	ms
Cable Plant Upstream:													
No Grant Sync:	3	3	3	3	3	3	3	3	3	3	3	3	ms
Grant Sync:	3	3	3	3	3	3	3	3	3	3	3	3	ms
Backbone:	10	10	10	10	10	10	10	10	10	10	10	10	ms
Cable Plant Downstream:	1	1	1	1	1	1	1	1	1	1	1	1	ms
Decoder:	0	0	0	0	0	0	0	0	0	0	0	0	ms
BTI -> BTI													
No Grant Sync:	14	14	14	14	14	14	14	14	14	14	14	14	ms
Grant Sync:	14	14	14	14	14	14	14	14	14	14	14	14	ms
BTI -> PSTN													
No Grant Sync:	13	13	13	13	13	13	13	13	13	13	13	13	ms
Grant Sync:	13	13	13	13	13	13	13	13	13	13	13	13	ms
PSTN -> BTI	11	11	11	11	11	11	11	11	11	11	11	11	ms

Jitter Model Used: Case 1: Correlated

Delay Analysis:

Scenario:	A	B	C	D	E	F	G	H	I	J	K	L		Variable?
Voice Coding:	G.711T	G.728T	G.729T	G.711T	G.728T	G.729T	G.711	G.728	G.729	G.711	G.728	G.729		
Voice per Packet (ms):	10	10	10	20	20	20	10	10	10	20	20	20		cv
Coder														
Codec Tx Look Ahead:	0.0	0.0	5.0	0.0	0.0	5.0	5.0	0.0	5.0	0.0	0.0	5.0	ms	
Tx Processing Delay:	0.0	2.5	4.0	0.0	2.5	4.0	1.0	10.0	10.0	1.0	10.0	10.0	ms	
Packetization:	10.0	10.0	10.0	20.0	20.0	20.0	10.0	10.0	10.0	20.0	20.0	20.0	ms	
Sub-Total:	**10.0**	**12.5**	**19.0**	**20.0**	**22.5**	**29.0**	**16.0**	**20.0**	**25.0**	**26.0**	**30.0**	**35.0**	**ms**	
CM -> CMTS														
Bytes per Frame:	106.0	49.0	39.0	189.0	86.0	49.0	106.0	46.0	39.0	186.0	59.0	49.0	bytes	
Upstream Rate:	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	Mbps	
CM prop Time:	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	ms	v
Upstream Playout Time:	0.3	0.2	0.1	0.6	0.2	0.2	0.3	0.2	0.1	0.6	0.2	0.2	ms	
Grant Arrival Uncertainty:														
-> no Grant Sync:	8.0	8.0	8.0	16.0	16.0	16.0	8.0	8.0	8.0	16.0	16.0	16.0	ms	
-> with Grant Sync:	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	ms	
Grant Window:	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	ms	v
uBR prop time:	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	ms	v
Cable Plant prop time:	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	ms	
Sub-Total no GS:	**12.3**	**12.1**	**12.0**	**22.5**	**22.1**	**22.1**	**12.3**	**12.3**	**12.0**	**22.5**	**22.1**	**22.1**	**ms**	
Sub-Total with GS:	**6.3**	**6.1**	**6.0**	**6.5**	**6.1**	**6.1**	**6.3**	**6.1**	**6.0**	**6.5**	**6.1**	**6.1**	**ms**	
Backbone														
# Switching Nodes:	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	nodes	
Delay per Node:	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	ms	
Node Prop Time:	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	ms	v
Specified Plant Delay:	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	ms	
Sub-Total:	**105.0**	**105.0**	**105.0**	**105.0**	**105.0**	**105.0**	**105.0**	**105.0**	**105.0**	**105.0**	**105.0**	**105.0**	**ms**	
CMTS -> CM														
Bytes per Frame:	149.0	89.0	79.0	229.0	109.0	89.0	149.0	89.0	79.0	229.0	109.0	89.0	bytes	
Downstream Rate:	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	Mbps	
uBR propagation time:	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	ms	v

Codec Parameters

	Row	G.711T	G.711	G.729T	G.729	G.728T	G.728	SC-10	G.723.1	G.722T	
Bit Rate	2	64	64	8	8	16	16	10	5.6	64	kbps
Frame Size	3	5	0	10	10	2.5	2.5	20	30	0	ms
Tx Look Ahead	4	0	5	5	5	0	0	19.5	7.5	0	ms
Tx Processing Delay	5	0	1	4	10	2.5	10	10	10	0	ms
Rx Processing Delay	6	0	1	5	10	2.5	10	10	10	0	ms

Global Variables

OH Bytes in u/s Frame:	29	bytes	Header Suppression On
OH Bytes in d/s Frame:	69	bytes	Header Suppression Off
Cable Plant Radius:	100	miles	
Minimum Jitter Buffer:	10	ms	
Jitter Model for Calculation	1	1,2,3	1 = correlated, 2 = only backbone correlated, 3 = uncorrelated

Notes:

=> Delay design goal is <= 300 ms
=> data input fields are marked in yellow with a black border
=> The CODEC "T" suffix refers to an optimized implemention with minimized processing delay
  => Non-T versions are a conservative implementation. "T" versions are an aggressive implementation and require development effort
  => G.711 uses 5 ms look ahead for VAD
  => G.711T moves VAD look ahead into the packetization time, and optimizes DSP processing
  => G.729 assumes 5 ms of DSP power per channel for both rx and tx, a two channel implementation, and no process interleaving
  => G.729T assumes interleaving of packets
  => G.728 assumes 5 ms of DSP power per channel for both rx and tx, a two channel implementation, and no process interleaving
  => G.728T assumes optimized processing. Theoretical delay is 0.625. An extra 125 us was added for design margin
=> The processing delay of the DSP codec *must* be the worst case delay when handling multiple channels.
=> Over time as DSP horsepower increases, processing delay will decrease. Values are for DSP product of 1999.
=> The jitter buffer values are set equal to the max of measured jitter or minimum buffer size.
  => Jitter buffer is based upon CM to CM model, not PSTN to CM model.
=> Backbone budget may be 200 ms instead of 210 ms. This would free up 10 additional ms
=> Jitter has been calculated 3 different ways:
  1) correlated: All max jitter values are added together. This provides a worst case, but is not realistic
  2) uncorrelated except the backbone: This allows a fixed jitter buget in the backbone to be added to the rest of the uncorrelated delays
  3) uncorrelated: All jitter sources are considered uncorrelated.

Appendix F

US 20010039600A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2001/0039600 A1**

Brooks et al. (43) **Pub. Date: Nov. 8, 2001**

(54) **CABLE MODEM HAVING A PROGRAMMABLE MEDIA ACCESS CONTROLLER**

(76) Inventors: **John M. Brooks**, Niwot, CO (US); **Brett A. Bernath**, San Diego, CA (US)

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AUSTIN, TX 78701

(21) Appl. No.: **09/785,035**

(22) Filed: **Feb. 16, 2001**

Related U.S. Application Data

(63) Non-provisional of provisional application No. 60/183,130, filed on Feb. 17, 2000.

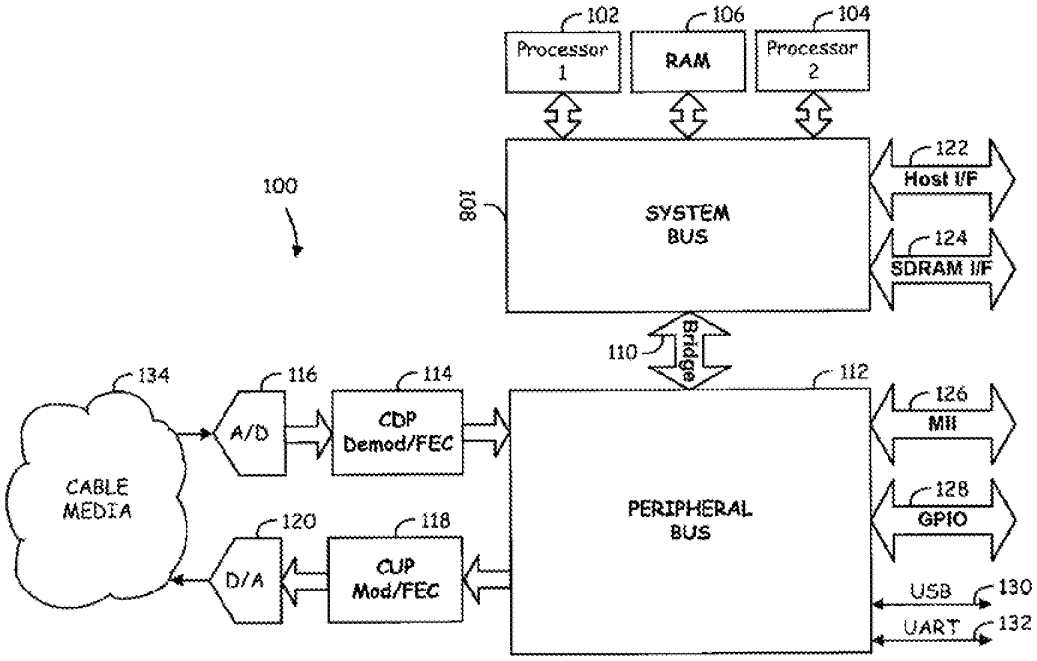
Publication Classification

(51) **Int. Cl.**[7] **G06F 13/38**; G06F 13/40

(52) **U.S. Cl.** **710/126**

(57) **ABSTRACT**

A cable modem having a programmable media access controller (MAC). A single cable modem device includes all necessary MAC functions. The invention allows programmable MAC functions to support evolving standards (e.g., DOCSIS) without requiring expensive hardware upgrades. Bifurcated microprocessor architecture, in which first processing circuitry is programmed to implement MAC functionality for processing information flowing to and from cable media interface circuitry, and second embedded processor core or host system processor provides operating system functionality are used. Alternatively, separate processor cores provide MAC functionality for downstream and upstream data paths, respectively. Cable media interface circuitry, and other peripheral circuitry, are coupled to a peripheral bus that is linked by a bridge circuit to a system bus. The processing circuitry MAC is communicatively coupled to the system bus. Centralized DMA control directs data transfer between the peripheral and system buses as determined, at least in part, by the programmable MAC.



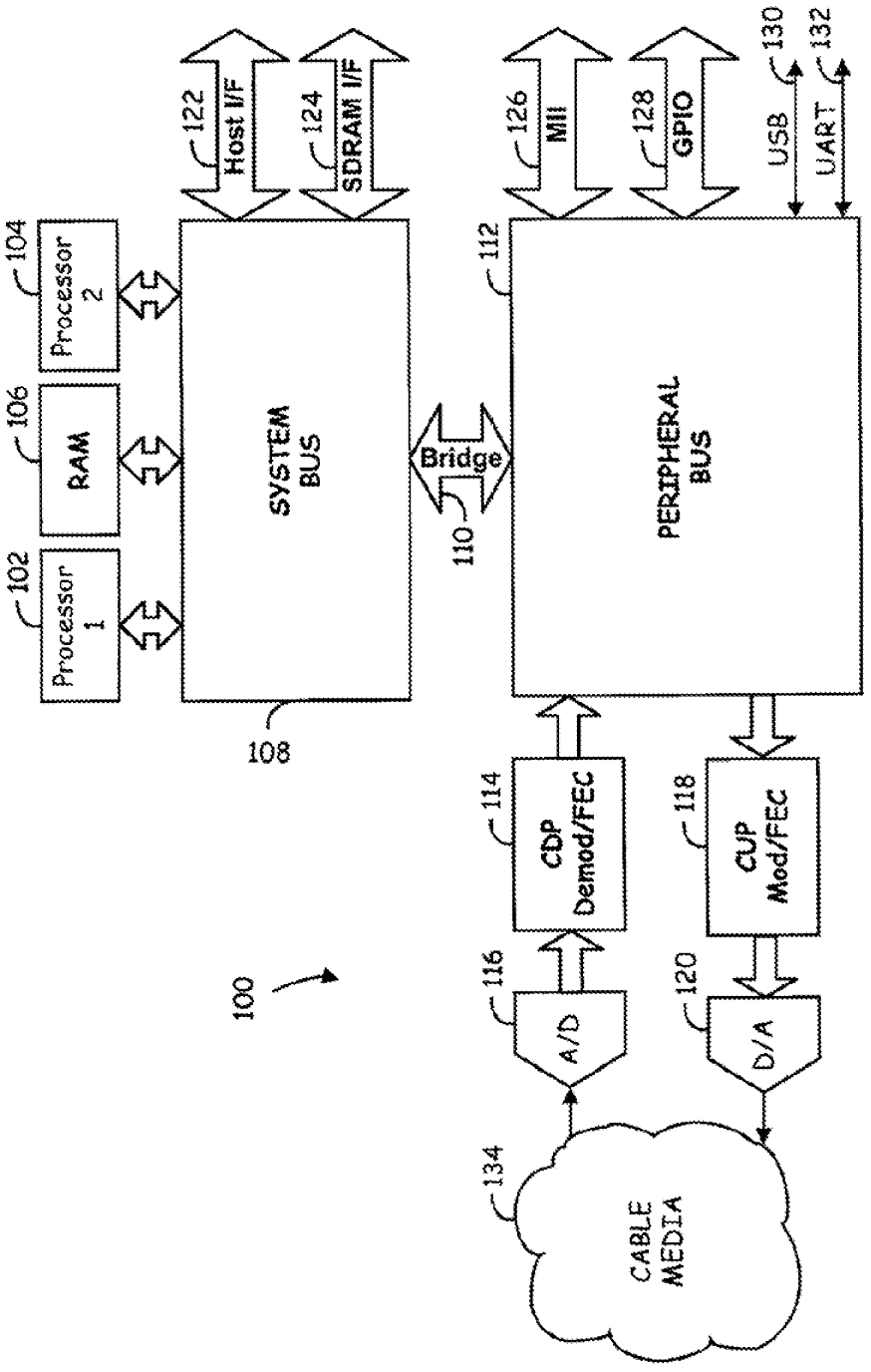

100
102
Processor 1
104
Processor 2
106
RAM
108
SYSTEM BUS
110
Bridge
112
PERIPHERAL BUS
114
CDP Demod/FEC
116
A/D
118
CUP Mod/FEC
120
D/A
122
Host I/F
124
SDRAM I/F
126
MII
128
GPIO
130
USB
132
UART
134
CABLE MEDIA

Fig. 1

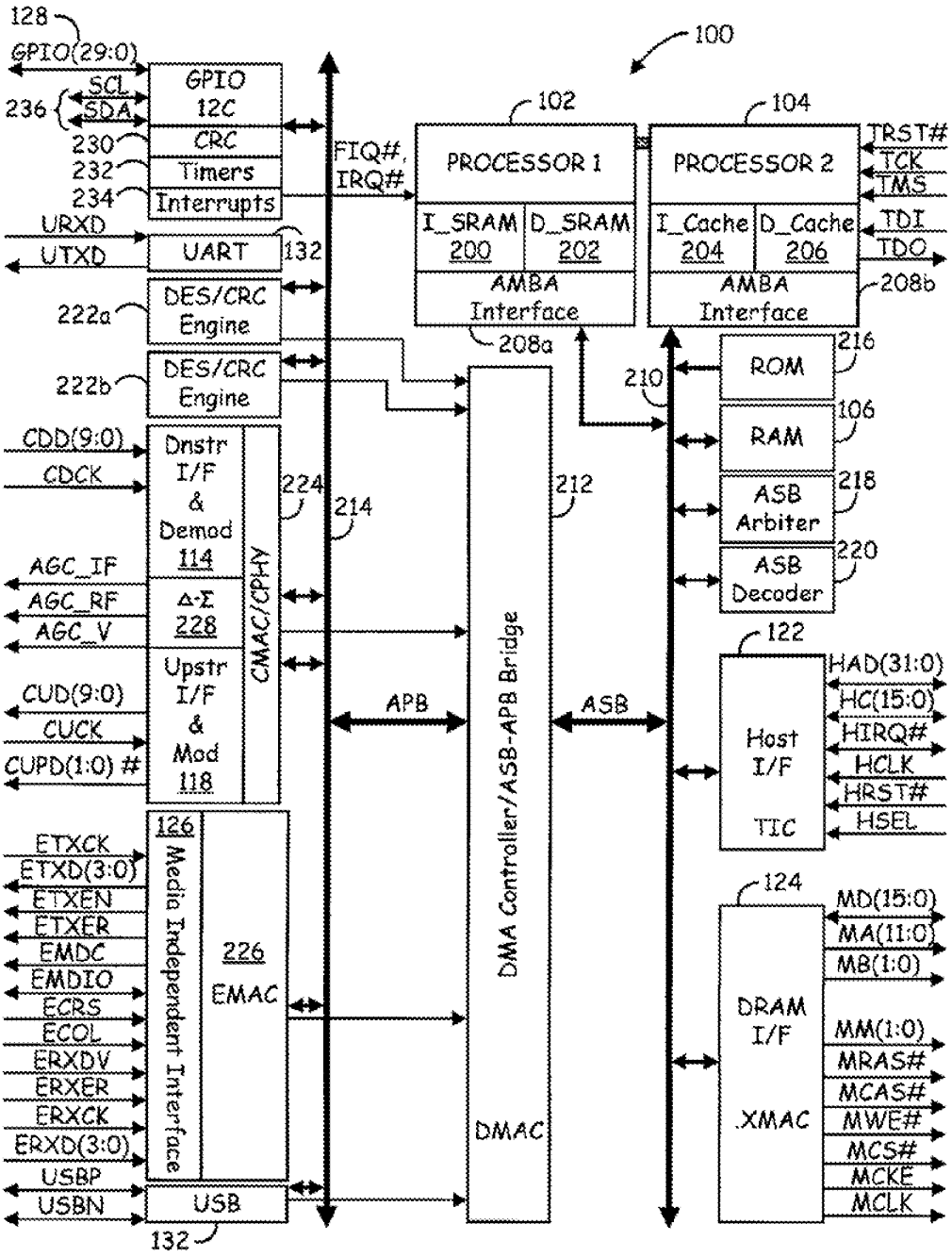

128
GPIO(29:0)
GPIO
I2C
236
SCL
SDA
230
CRC
232
Timers
234
Interrupts
URXD
UTXD
UART
132
222a
DES/CRC Engine
222b
DES/CRC Engine
CDD(9:0)
CDCK
Dnstr I/F & Demod 114
224
214
AGC_IF
AGC_RF
AGC_V
Δ-Σ 228
CMAC/CPHY
CUD(9:0)
CUCK
CUPD(1:0) #
Upstr I/F & Mod 118
126
Media Independent Interface
ETXCK
ETXD(3:0)
ETXEN
ETXER
EMDC
EMDIO
ECRS
ECOL
ERXDV
ERXER
ERXCK
ERXD(3:0)
226
EMAC
USBP
USBN
USB
132
FIQ#, IRQ#
APB
100
102
PROCESSOR 1
I_SRAM 200
D_SRAM 202
AMBA Interface
208a
104
PROCESSOR 2
I_Cache 204
D_Cache 206
AMBA Interface
208b
TRST#
TCK
TMS
TDI
TDO
212
DMA Controller/ASB-APB Bridge
DMAC
ASB
210
216
ROM
106
RAM
218
ASB Arbiter
220
ASB Decoder
122
Host I/F
TIC
HAD(31:0)
HC(15:0)
HIRQ#
HCLK
HRST#
HSEL
124
DRAM I/F
XMAC
MD(15:0)
MA(11:0)
MB(1:0)
MM(1:0)
MRAS#
MCAS#
MWE#
MCS#
MCKE
MCLK

Fig. 2

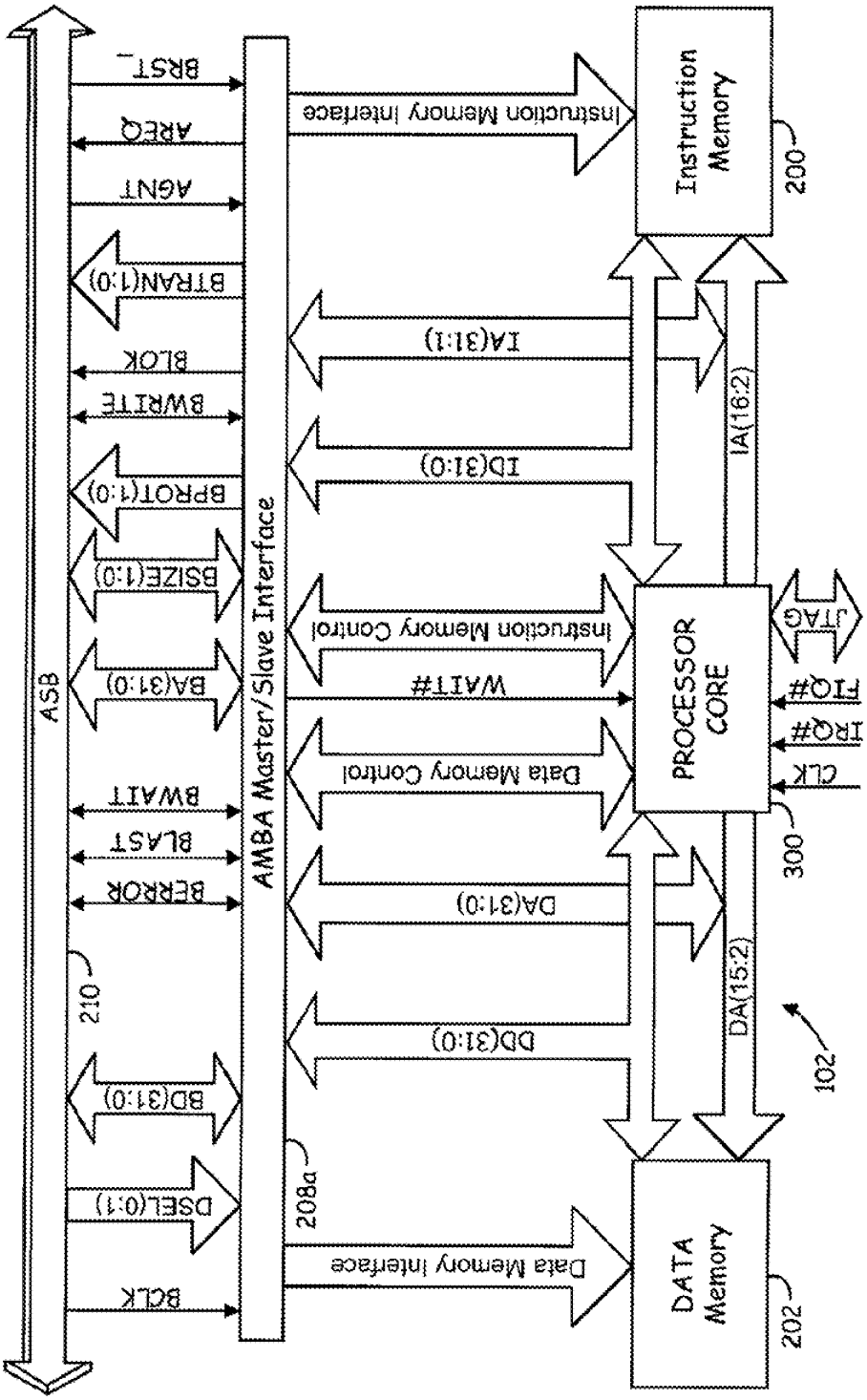

ASB
BRST_
AREQ
AGNT
BTRAN(1:0)
BLOK
BWRITE
BPROT(1:0)
BSIZE(1:0)
BA(31:0)
BWAIT
BLAST
BERROR
210
BD(31:0)
DSEL(0:1)
BCLK
AMBA Master/Slave Interface
208a
Instruction Memory Interface
IA(31:1)
ID(31:0)
Instruction Memory Control
WAIT#
Data Memory Control
DA(31:0)
DD(31:0)
Data Memory Interface
Instruction Memory
200
IA(16:2)
PROCESSOR CORE
300
JTAG
FIQ#
IRQ#
CLK
DA(15:2)
102
DATA Memory
202

Fig. 3

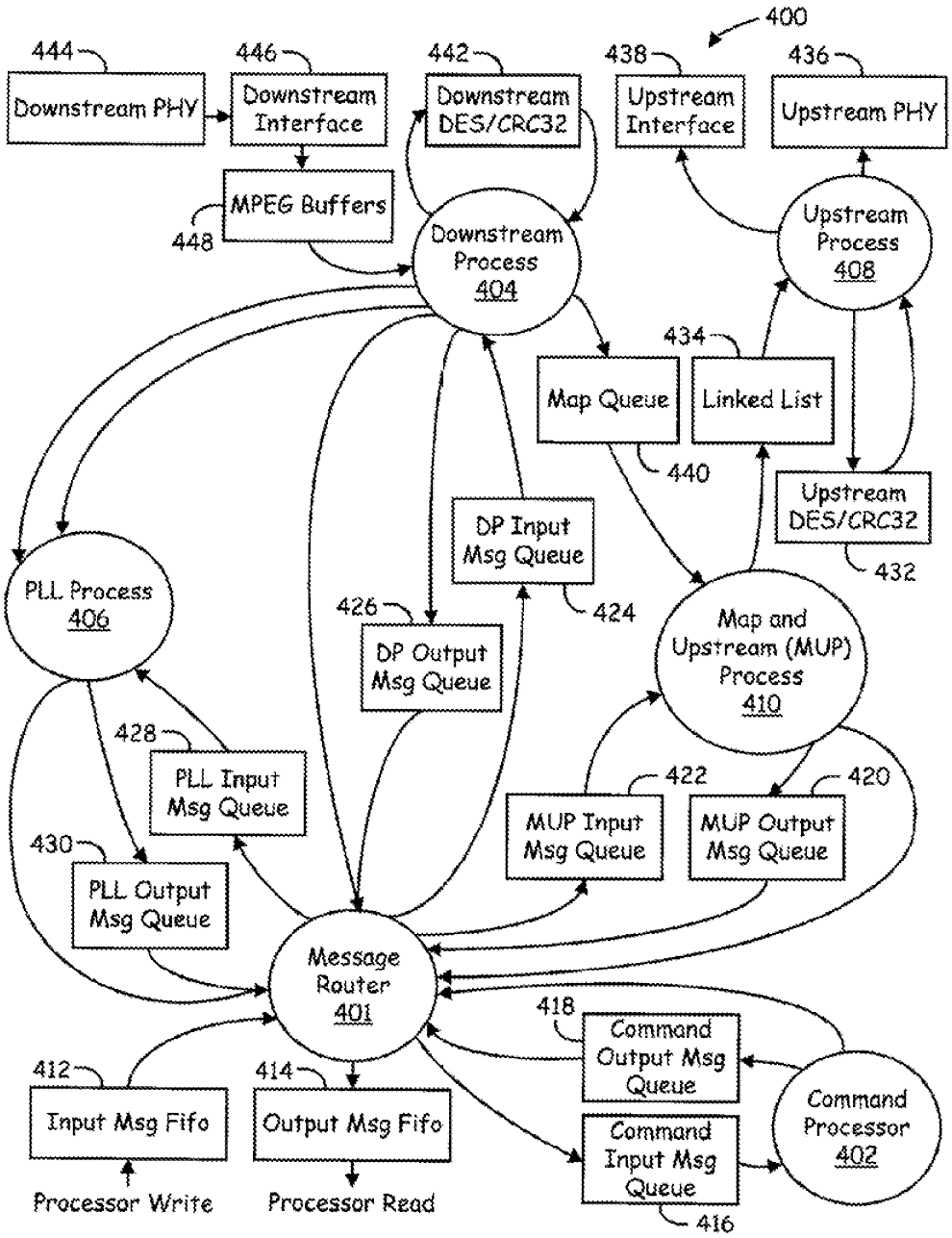

400
444
Downstream PHY
446
Downstream Interface
442
Downstream DES/CRC32
438
Upstream Interface
436
Upstream PHY
MPEG Buffers
448
Downstream Process 404
Upstream Process 408
434
Map Queue
Linked List
440
Upstream DES/CRC32
432
DP Input Msg Queue
424
PLL Process 406
426
DP Output Msg Queue
Map and Upstream (MUP) Process 410
428
PLL Input Msg Queue
422
420
MUP Input Msg Queue
MUP Output Msg Queue
430
PLL Output Msg Queue
Message Router 401
418
Command Output Msg Queue
Command Processor 402
412
Input Msg Fifo
414
Output Msg Fifo
Command Input Msg Queue
416
Processor Write
Processor Read

Fig. 4

PTO/SB/96 (07-09)
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STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Gordon Y. Li, Yoav Hebron

Application No./Patent No.: 8,223,775 Filed/Issue Date: 07/17/2012

Titled: ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

Entropic Communications, LLC , a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.

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The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Christopher C. Winslade/ 07/24/2015

Signature Date

Christopher C. Winslade, Reg. No. 36308 Attorney for Applicant

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To: TRIDENT MICROSYSTEMS (FAR EAST) LTD.
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5. From: TRIDENT MICROSYSTEMS, INC. and TRIDENT MICROSYSTEMS (FAR EAST) LTD. To: ENTROPIC COMMUNCIATIONS, INC.
The document was recorded in the United States Patent and Trademark Office at Reel, 028153 Frame, 0440 or for which a copy thereof is attached.

6. From: EXCALIBUR ACQUISITION CORPORATION and ENTROPIC COMMUNICATIONS, INC. To: ENTROPIC COMMUNICATIONS, INC.
The document was recorded in the United States Patent and Trademark Office at Reel, 035706 Frame, 0267 or for which a copy thereof is attached.

7. From: ENTROPIC COMMUNICATIONS, INC. and EXCALIBUR SUBSIDIARY, LLC To: ENTROPIC COMMUNICATIONS, LLC
The document was recorded in the United States Patent and Trademark Office at Reel, 035717 Frame, 0628 or for which a copy thereof is attached.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	E5982-00282

CONFIRMATION NO. 9980

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

POA ACCEPTANCE LETTER

OC000000076660716

Date Mailed: 08/05/2015

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 07/24/2015.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/mmasfaw/

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UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	E5982-00282

CONFIRMATION NO. 9980

77561
Duane Morris LLP (Entropic)
IP Department
30 South 17th Street
Philadelphia, PA 19103-4196

POWER OF ATTORNEY NOTICE

OC000000076660714

Date Mailed: 08/05/2015

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 07/24/2015.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/mmasfaw/

To: mhmpto@mcandrews-ip.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 23446

Aug 05, 2015 05:33:05 AM

Dear PAIR Customer:

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 23446 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:
The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
10675566	N570	08/05/2015	E5982-00282
	N570	08/05/2015	E5982-00282

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

PTO/AIA/80 (07-17)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no person is required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number: 23,446

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number: 23,446

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: ENTROPIC COMMUNICATIONS, LLC
1345 AVENUE OF THE AMERICAS, 46TH FLOOR
NEW YORK, NY 10105

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature /Andrea L. Gothing/	Date 2021-05-04
Name Andrea L. Gothing	Telephone 415-830-0613
Title Licensing Officer and Authorized Signatory, Entropic Communications, LLC	

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	43333150
Application Number:	10675566
International Application Number:	
Confirmation Number:	9980
Title of Invention:	ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM
First Named Inventor/Applicant Name:	Gordon Y. Li
Customer Number:	23446
Filer:	Ronald H. Spuhler/Deborah Wilson
Filer Authorized By:	Ronald H. Spuhler
Attorney Docket Number:	29566US01
Receipt Date:	23-JUL-2021
Filing Date:	30-SEP-2003
Time Stamp:	16:16:33
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Assignee showing of ownership per 37 CFR 3.73	29566US01_373c_Statement_AIA-96.pdf	126514 b28a0b4ad7460082b63a61d73ca6aa8b7fbf092f	no	3

Warnings:

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	29566US01_3-73-statement-supplemental-sheet.pdf	18951 5b2f8879153a6be06233cb3d778d074ab050f667	no	1
Warnings:					
Information:					
3	Power of Attorney	Entropic-POA_General_Assignee_EntropicCommunications_ALG.pdf	487892 51444e06ae84b241bfc127dc47c5d6c646944dd7	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	633357		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: ENTROPIC COMMUNICATIONS, LLC

Application No./Patent No.: 10/675,566 Filed/Issue Date: 2003-09-30

Titled: ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM

ENTROPIC COMMUNICATIONS, LLC, a limited liability company

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Gordon Y. Li, Yoav Hebron To: CONEXANT SYSTEMS, INC.

The document was recorded in the United States Patent and Trademark Office at
Reel 015024, Frame 0251, or for which a copy thereof is attached.

2. From: CONEXANT SYSTEMS, INC. To: NXP, B.V.

The document was recorded in the United States Patent and Trademark Office at
Reel 021531, Frame 0523, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: NXP, B.V. To: NXP HOLDING 1 B.V.

The document was recorded in the United States Patent and Trademark Office at
Reel 023928, Frame 0489, or for which a copy thereof is attached.

4. From: TRIDENT MICROSYSTEMS (EUROPE) B.V., NXP HOLDING 1 B.V. To: TRIDENT MICROSYSTEMS (FAR EAST) LTD.

The document was recorded in the United States Patent and Trademark Office at
Reel 023928, Frame 0552, or for which a copy thereof is attached.

5. From: TRIDENT MICROSYSTEMS, INC., TRIDENT MICROSYSTEMS (FAR EAST) LTD. To: ENTROPIC COMMUNICATIONS, INC.

The document was recorded in the United States Patent and Trademark Office at
Reel 028153, Frame 0440, or for which a copy thereof is attached.

6. From: EXCALIBUR ACQUISITION CORPORATION, ENTROPIC COMMUNICATIONS, INC. To: ENTROPIC COMMUNICATIONS, INC.

The document was recorded in the United States Patent and Trademark Office at
Reel 035706, Frame 0267, or for which a copy thereof is attached.

☑ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Ronald H. Spuhler/	2021-07-23
Signature	Date
Ronald H. Spuhler	52245
Printed or Typed Name	Title or Registration Number

[Page 2 of 2]

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

STATEMENT UNDER 37 CFR 3.73(c) -- Supplemental Sheet

Applicant/Patent Owner: ENTROPIC COMMUNICATIONS, LLC
Application No./Patent No.: 10/675,566 Filed/Issue Date: 2003-09-30
Titled: ARCHITECTURE FOR A FLEXIBLE AND HIGH-PERFORMANCE GATEWAY CABLE MODEM
Assignee: ENTROPIC COMMUNICATIONS, LLC, a limited liability company

7. From ENTROPIC COMMUNICATIONS, INC., EXCALIBUR SUBSIDIARY, LLC
To: ENTROPIC COMMUNICATIONS, LLC
The document was recorded in the United States Patent and Trademark Office at
Reel 035717, Frame 0628, or for which a copy thereof is attached.

8. From ENTROPIC COMMUNICATONS LLC To: MAXLINEAR COMMUNICATIONS LLC
The document was recorded in the United States Patent and Trademark Office at
Reel 055776, Frame 0482, or for which a copy thereof is attached.

9. From MAXLINEAR COMMUNICATIONS LLC To: ENTROPIC COMMUNICATIONS, LLC
The document was recorded in the United States Patent and Trademark Office at
Reel 055899, Frame 0291, or for which a copy thereof is attached.
.

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

[RONALD H. SPUHLER] /Ronald H. Spuhler/ Dated: 2021-07-23 Reg. No. 52245

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	

CONFIRMATION NO. 9980

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

POA ACCEPTANCE LETTER

OC000000127313262

Date Mailed: 07/29/2021

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 07/23/2021.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/sharris/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/675,566	09/30/2003	Gordon Y. Li	29566US01

CONFIRMATION NO. 9980

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

POWER OF ATTORNEY NOTICE

OC000000127313237

Date Mailed: 07/29/2021

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 07/23/2021.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/sharris/

To: mhmpto@mcandrews-ip.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 23446

Jul 29, 2021 03:59:59 AM

Dear PAIR Customer:

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 23446 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:
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Application	Document	Mailroom Date	Attorney Docket No.
10675566	N570	07/29/2021	
	N570	07/29/2021	

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-125	4/27/2022	Eastern District of Texas

PLAINTIFF	DEFENDANT
ENTROPIC COMMUNICATIONS, LLC	CHARTER COMMUNICATIONS, INC., ET AL

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,223,775	7/17/2012	Entropic Communications, LLC
2	8,284,690	10/9/2012	Entropic Communications, LLC
3	8,792,008	7/29/2014	Entropic Communications, LLC
4	9,210,362	12/8/2015	Entropic Communications, LLC
5	9,825,826	11/21/2017	Entropic Communications, LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

AO 120 (Rev. 08/10)

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ENTROPIC COMMUNICATIONS, LLC	CHARTER COMMUNICATIONS, INC., ET AL

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	10,135,682	11/20/2018	Entropic Communications, LLC
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EXHIBIT C

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Brooks et al. (43) **Pub. Date: Nov. 8, 2001**

(54) **CABLE MODEM HAVING A PROGRAMMABLE MEDIA ACCESS CONTROLLER**

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(22) Filed: **Feb. 16, 2001**

Related U.S. Application Data

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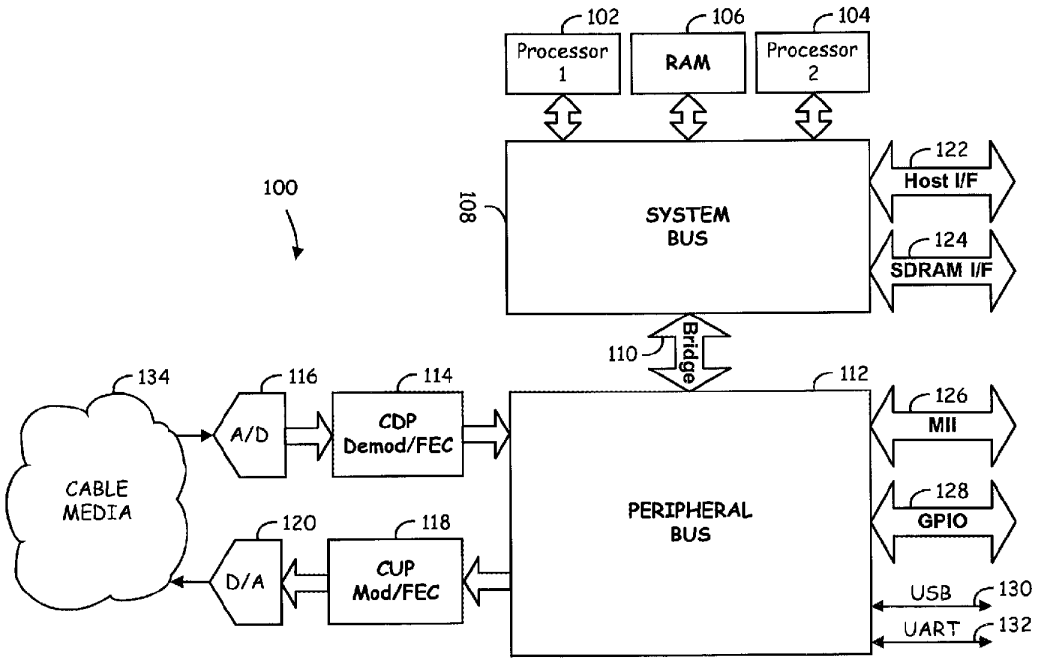
Publication Classification

(51) **Int. Cl.**[7] **G06F 13/38**; G06F 13/40

(52) **U.S. Cl.** **710/126**

(57) **ABSTRACT**

A cable modem having a programmable media access controller (MAC). A single cable modem device includes all necessary MAC functions. The invention allows programmable MAC functions to support evolving standards (e.g., DOCSIS) without requiring expensive hardware upgrades. Bifurcated microprocessor architecture, in which first processing circuitry is programmed to implement MAC functionality for processing information flowing to and from cable media interface circuitry, and second embedded processor core or host system processor provides operating system functionality are used. Alternatively, separate processor cores provide MAC functionality for downstream and upstream data paths, respectively. Cable media interface circuitry, and other peripheral circuitry, are coupled to a peripheral bus that is linked by a bridge circuit to a system bus. The processing circuitry MAC is communicatively coupled to the system bus. Centralized DMA control directs data transfer between the peripheral and system buses as determined, at least in part, by the programmable MAC.



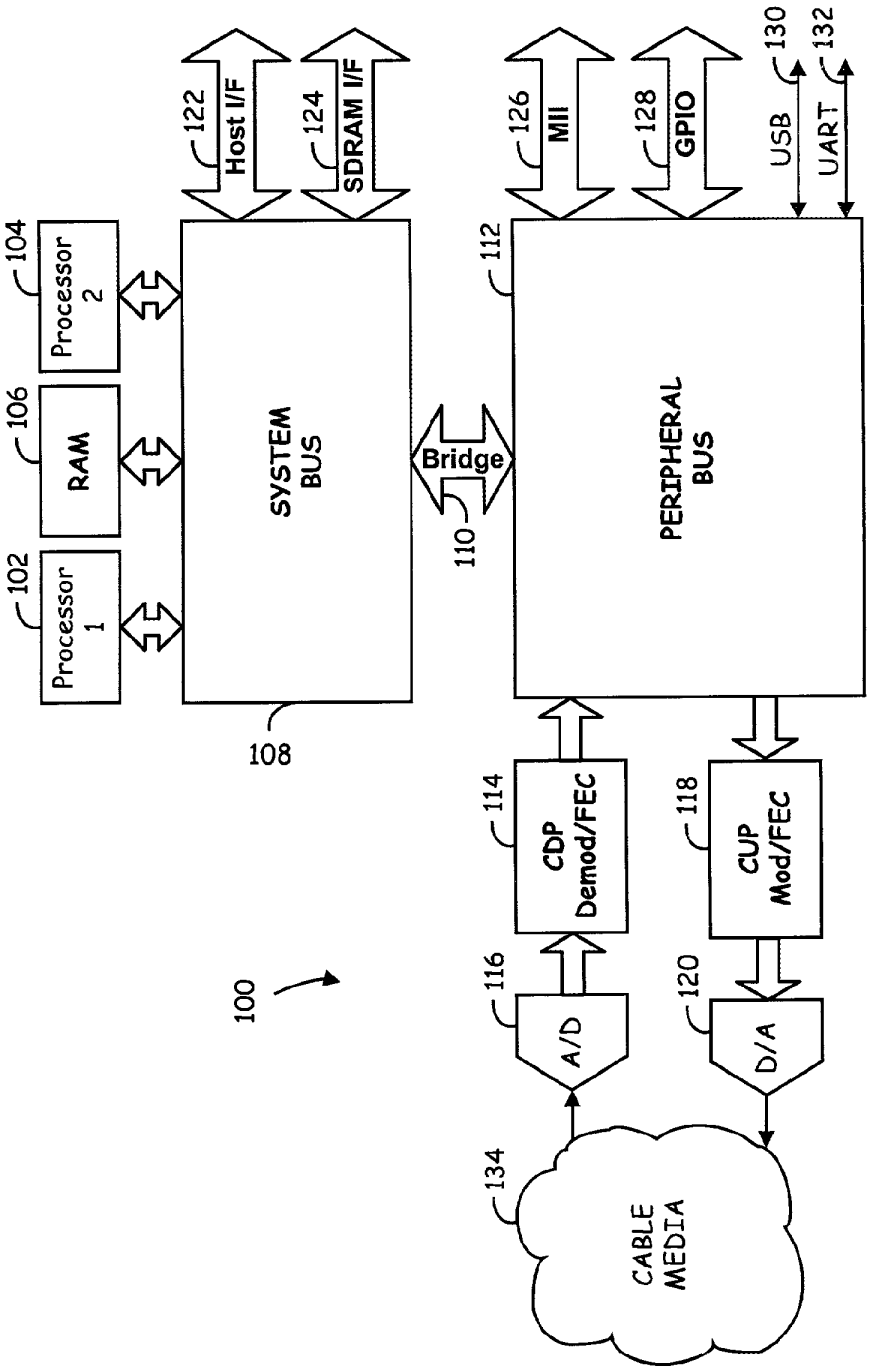

100
102
Processor 1
104
Processor 2
106
RAM
108
SYSTEM BUS
110
Bridge
112
PERIPHERAL BUS
114
CDP Demod/FEC
116
A/D
118
CUP Mod/FEC
120
D/A
122
Host I/F
124
SDRAM I/F
126
MII
128
GPIO
130
USB
132
UART
134
CABLE MEDIA

Fig. 1

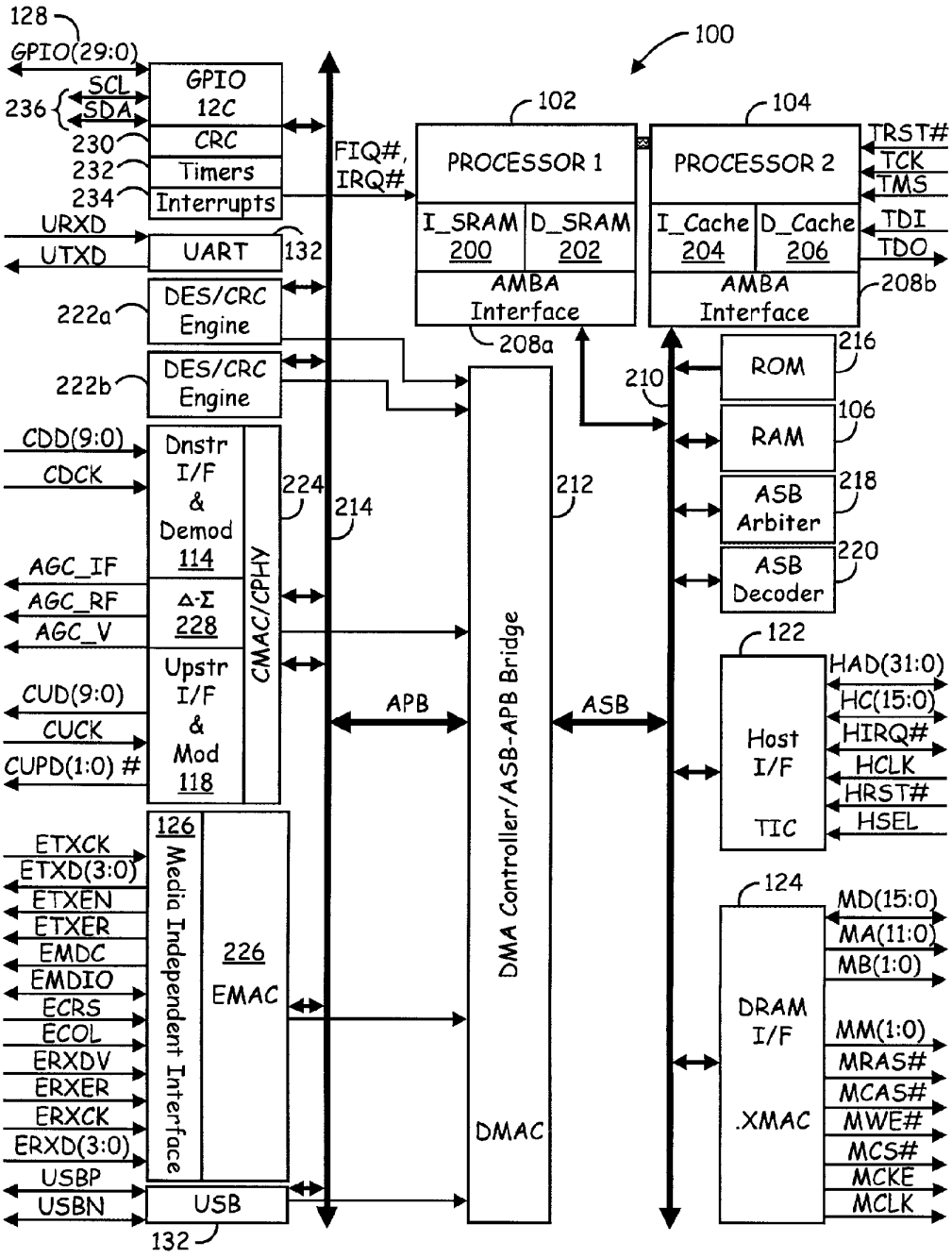

128
GPIO(29:0)
GPIO
I2C
SCL
SDA
236
CRC
230
Timers
232
Interrupts
234
URXD
UTXD
UART
132
222a
DES/CRC Engine
222b
DES/CRC Engine
CDD(9:0)
CDCK
Dnstr I/F & Demod 114
224
CMAC/CPHY
AGC_IF
AGC_RF
AGC_V
Δ-Σ 228
Upstr I/F & Mod 118
CUD(9:0)
CUCK
CUPD(1:0) #
126
Media Independent Interface
ETXCK
ETXD(3:0)
ETXEN
ETXER
EMDC
EMDIO
ECRS
ECOL
ERXDV
ERXER
ERXCK
ERXD(3:0)
226
EMAC
USBP
USBN
USB
132
214
FIQ#, IRQ#
APB
100
102
PROCESSOR 1
I_SRAM 200
D_SRAM 202
AMBA Interface
208a
104
PROCESSOR 2
I_Cache 204
D_Cache 206
AMBA Interface
208b
TRST#
TCK
TMS
TDI
TDO
210
212
DMA Controller/ASB-APB Bridge
DMAC
ASB
216
ROM
106
RAM
218
ASB Arbiter
220
ASB Decoder
122
Host I/F
TIC
HAD(31:0)
HC(15:0)
HIRQ#
HCLK
HRST#
HSEL
124
DRAM I/F
.XMAC
MD(15:0)
MA(11:0)
MB(1:0)
MM(1:0)
MRAS#
MCAS#
MWE#
MCS#
MCKE
MCLK

Fig. 2

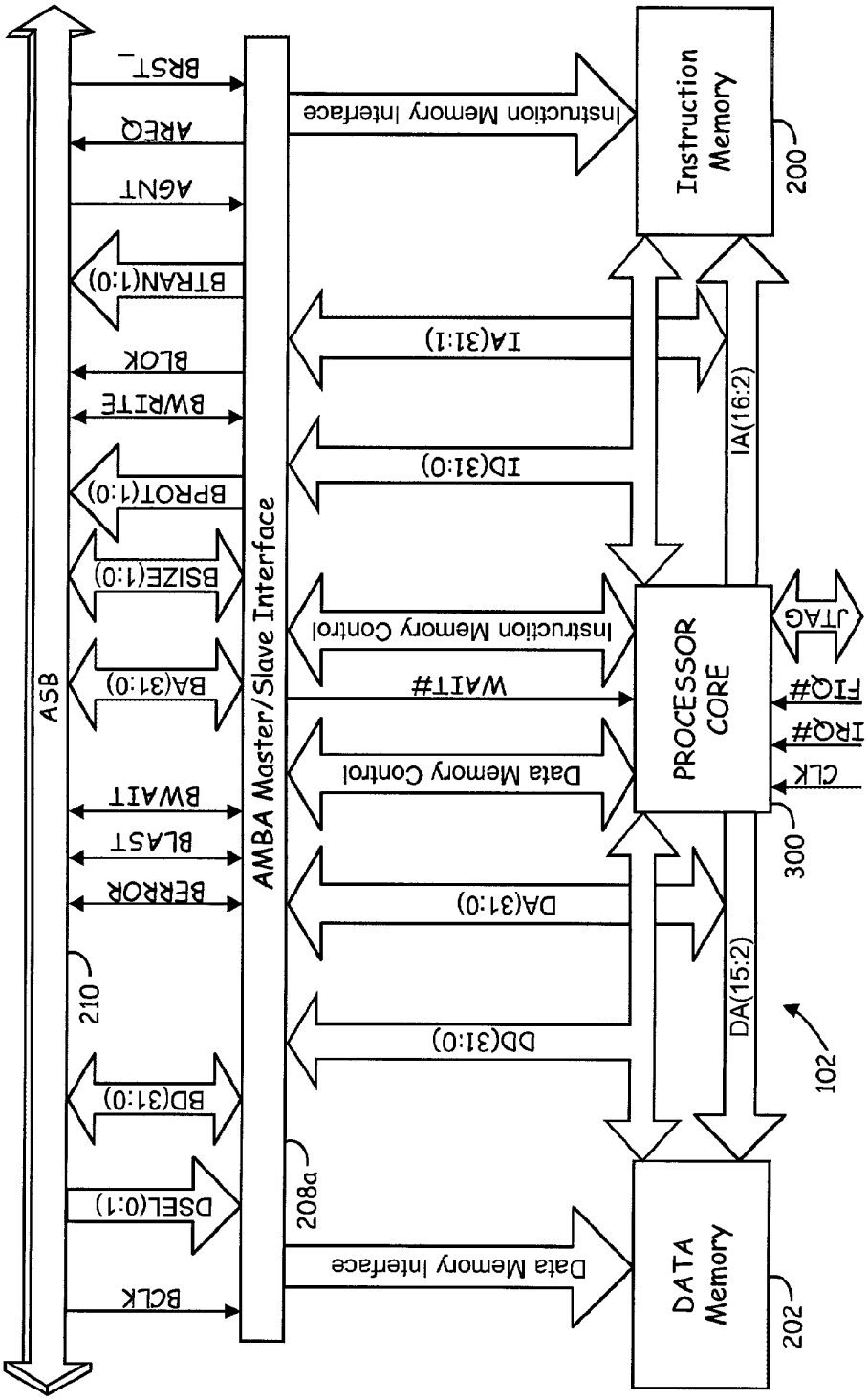

ASB
BRST_
AREQ
AGNT
BTRAN(1:0)
BLOK
BWRITE
BPROT(1:0)
BSIZE(1:0)
BA(31:0)
BWAIT
BLAST
BERROR
210
BD(31:0)
DSEL(0:1)
BCLK
AMBA Master/Slave Interface
208a
Instruction Memory Interface
IA(31:1)
ID(31:0)
Instruction Memory Control
WAIT#
Data Memory Control
DA(31:0)
DD(31:0)
Data Memory Interface
Instruction Memory
200
IA(16:2)
PROCESSOR CORE
300
JTAG
FIQ#
IRQ#
CLK
DA(15:2)
102
DATA Memory
202

Fig. 3

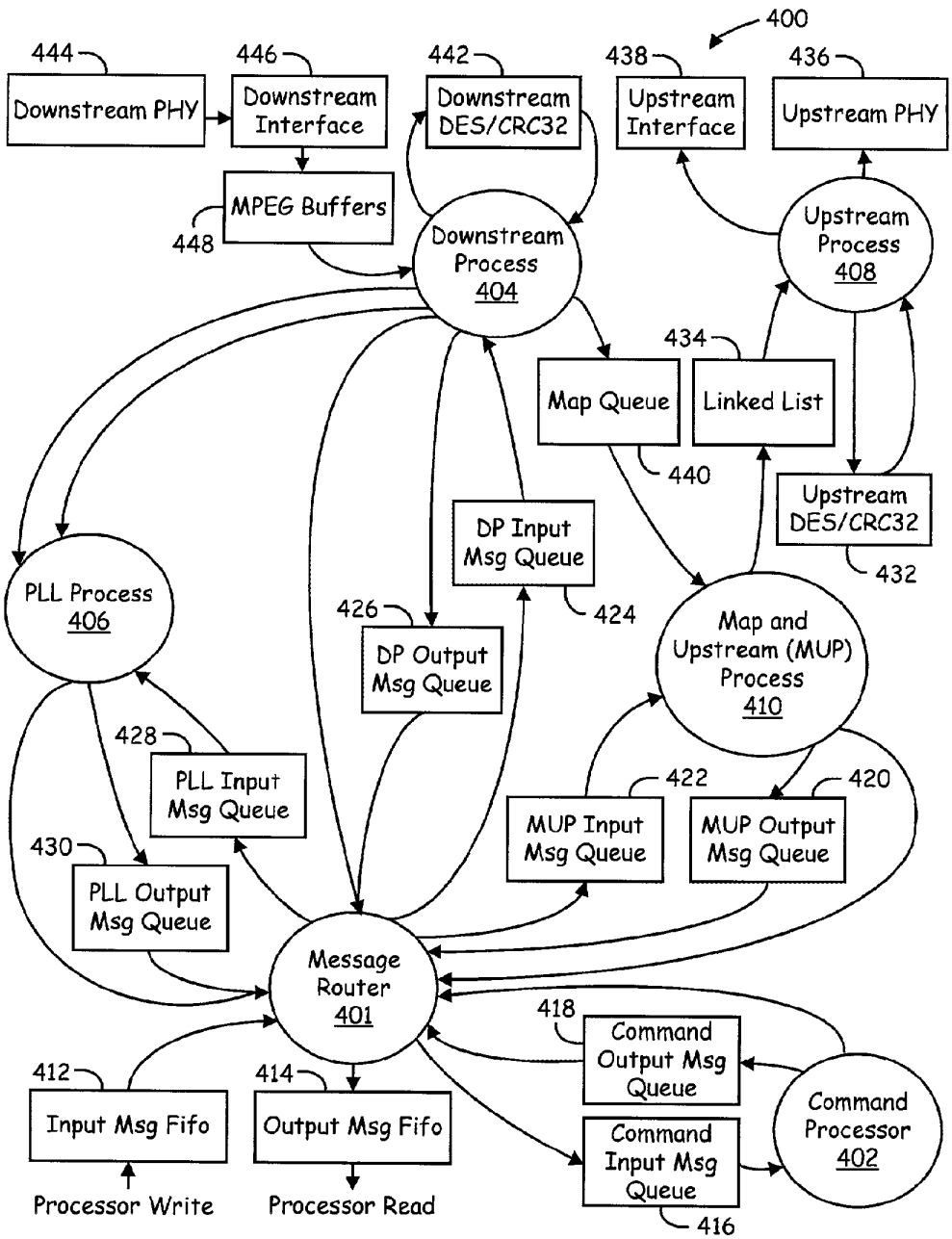

400
444
Downstream PHY
446
Downstream Interface
442
Downstream DES/CRC32
438
Upstream Interface
436
Upstream PHY
MPEG Buffers
448
Downstream Process 404
Upstream Process 408
434
Map Queue
Linked List
440
Upstream DES/CRC32
432
DP Input Msg Queue
424
PLL Process 406
426
DP Output Msg Queue
Map and Upstream (MUP) Process 410
428
PLL Input Msg Queue
422
420
MUP Input Msg Queue
MUP Output Msg Queue
430
PLL Output Msg Queue
Message Router 401
418
Command Output Msg Queue
Command Processor 402
412
Input Msg Fifo
414
Output Msg Fifo
Command Input Msg Queue
416
Processor Write
Processor Read

Fig. 4

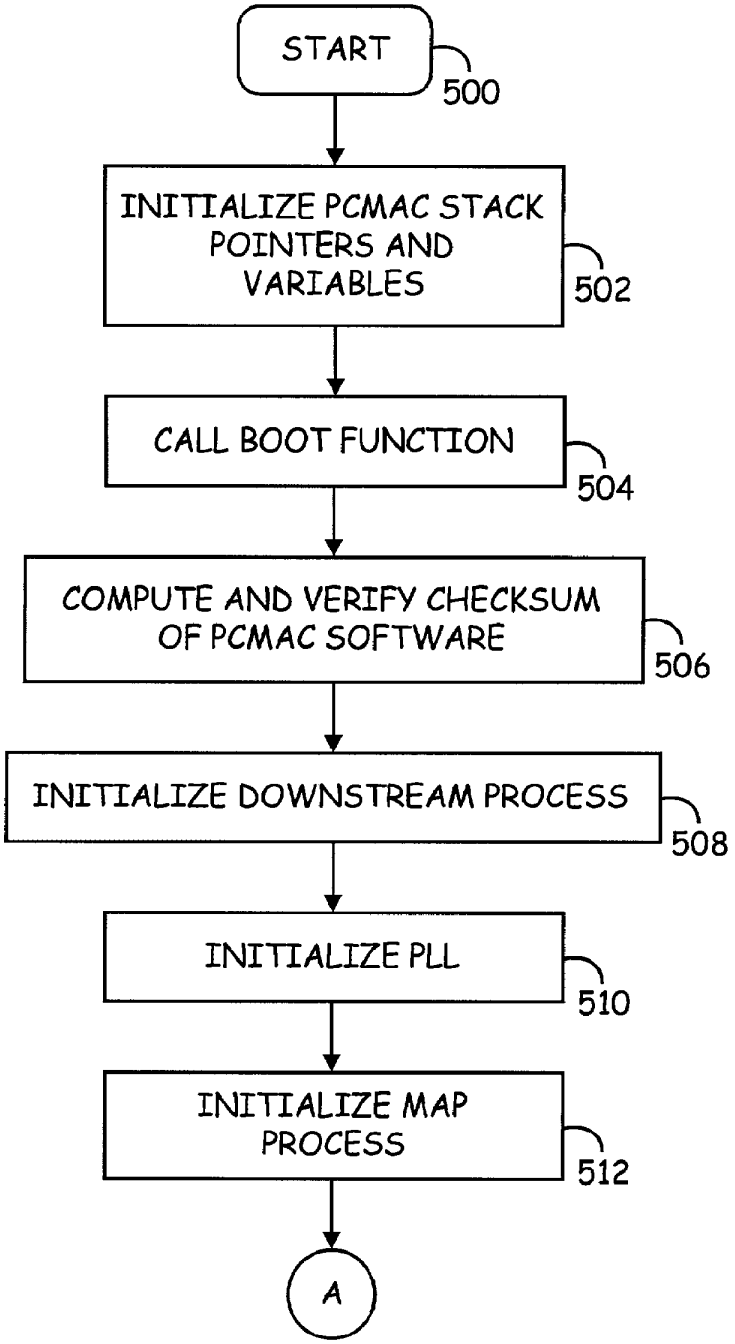

START
500
INITIALIZE PCMAC STACK POINTERS AND VARIABLES
502
CALL BOOT FUNCTION
504
COMPUTE AND VERIFY CHECKSUM OF PCMAC SOFTWARE
506
INITIALIZE DOWNSTREAM PROCESS
508
INITIALIZE PLL
510
INITIALIZE MAP PROCESS
512
A

Fig. 5A

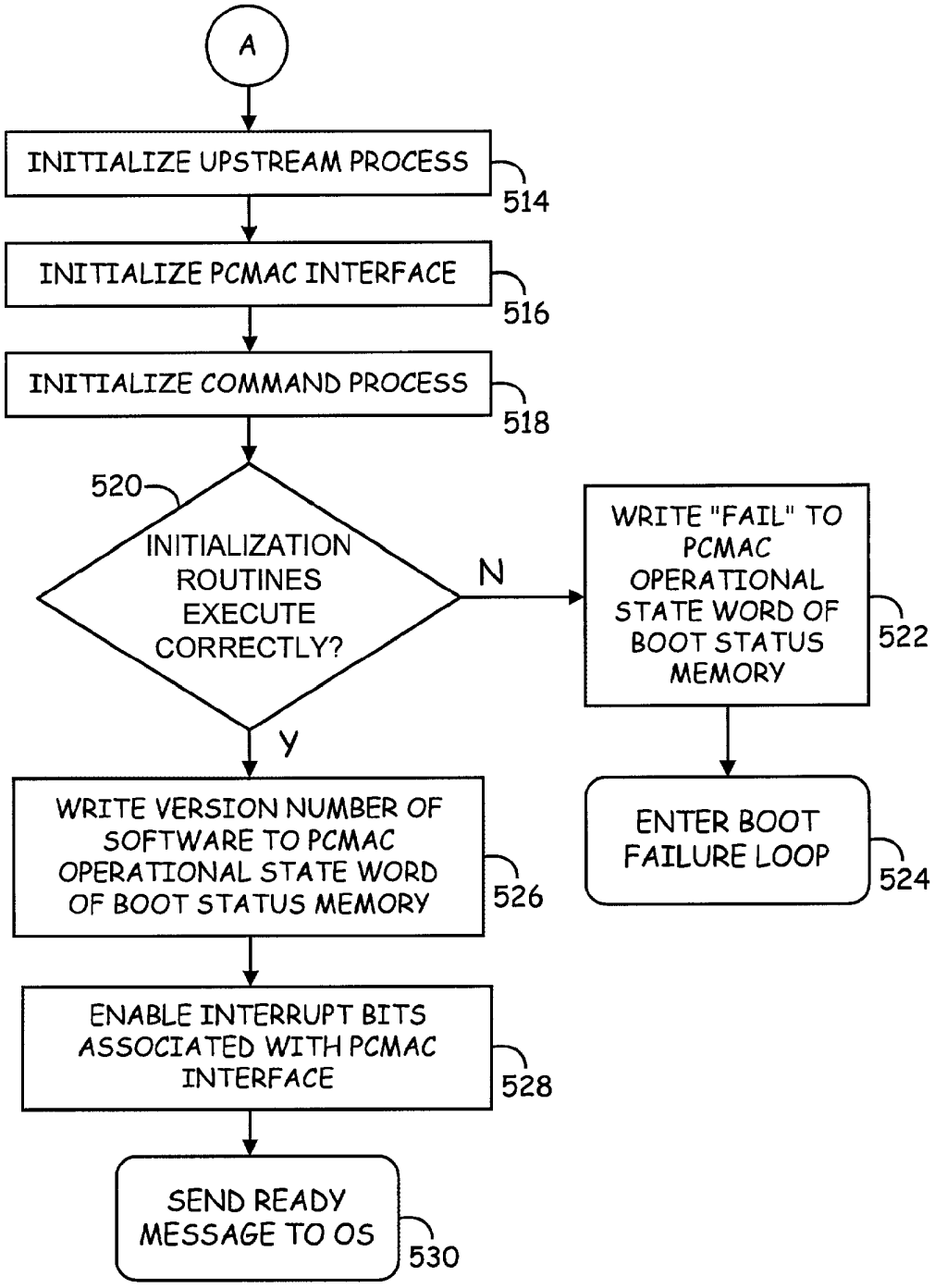

A
INITIALIZE UPSTREAM PROCESS
514
INITIALIZE PCMAC INTERFACE
516
INITIALIZE COMMAND PROCESS
518
520
INITIALIZATION ROUTINES EXECUTE CORRECTLY?
N
WRITE "FAIL" TO PCMAC OPERATIONAL STATE WORD OF BOOT STATUS MEMORY
522
Y
ENTER BOOT FAILURE LOOP
524
WRITE VERSION NUMBER OF SOFTWARE TO PCMAC OPERATIONAL STATE WORD OF BOOT STATUS MEMORY
526
ENABLE INTERRUPT BITS ASSOCIATED WITH PCMAC INTERFACE
528
SEND READY MESSAGE TO OS
530

Fig. 5B

CABLE MODEM HAVING A PROGRAMMABLE MEDIA ACCESS CONTROLLER

BACKGROUND

[0001] 1. Technical Field

[0002] The present invention relates generally to a cable modem; and, more particularly, it relates to a cable modem having a programmable media access controller.

[0003] 2. Related Art

[0004] In recent years, cable television networks have become more widespread. A typical cable TV system can carry many television stations, and is effectively a high bandwidth system. Because of the increasing availability of cable television infrastructure, the use of television cables as the medium for computer data networks has the potential for giving users high bandwidth at a reasonable cost. A cable TV system, however, requires several enhancements in order to function as a data network.

[0005] In its classic form, a cable TV system carries information in only one direction—from the cable system headend to the individual user. The user interface to the system generally comprises a receiver such as a television or a stereo. The headend transmits television or stereo channels simultaneously. In general, the user has no influence on what is transmitted and can only choose among the channels the headend is transmitting.

[0006] In contrast, a data network carries data from the headend to the user (the downstream path) and from the user to the headend (the upstream path). The individual user requires equipment, such as a cable modem, that can both receive from the headend and transmit to it. A cable data network must be able to handle many individual users simultaneously, each of whom have control over what they receive and transmit.

[0007] Cable modems offer greatly improved bandwidth capable of delivering services hundreds, or even thousands, of times faster than conventional modems. Cable modems can achieve data-transfer rates of up to 40 Mbits/s by connecting directly to coaxial lines as opposed to dial-in modems, that use twisted-pair copper telephone lines.

[0008] In order for a cable TV network to operate as a data network, it requires a headend capable of both transmitting and receiving data. To ensure that each user receives the data they require, a network protocol must be implemented to allow independent users of the network to utilize the shared headend and the distribution network without interference from or receiving the data of other users.

[0009] The network protocol places requirements on both the headend and the user end. Generally, the headend serves as the network controller, and the user's cable modem must be able to respond to commands from the headend. In cable modems adhering to the well-known OSI reference model, the lowest layer is the Physical layer (PHY), while the next layer up is the Data Link layer. The Data Link layer is segmented into two parts, the Medium Access Controller (MAC), which interfaces with the PHY, and the Logical Link Control (LLC), which interfaces to the MAC and to higher layers. In general, the MAC and LLC provide the following Data Link functionality: transmit and receive data encapsulation, including framing (frame boundary delimitation, frame synchronization), addressing (management of source and destination address), and error detection (detection of physical medium transmission errors); and media access management, including collision avoidance and handling. A physical address or MAC address is a unique Data Link layer address that is assigned to every port or device that connects to a network. Other devices in the network use these addresses to locate specific ports in the network and to create and update routing tables and data structures.

[0010] In an effort to coordinate the development of multimedia high-speed data services and the interoperability of network devices, cable operators have formed the Multimedia Cable Network Systems (MCNS) Group in cooperation with the industry research and development consortium CableLabs. The MCNS group has promulgated the Data Over Cable Service Interface Specification (DOCSIS). Other standards, such as DAVIC/DVB have likewise been created. Such standards continue to evolve over time, with the frequent inclusion of additional feature sets.

[0011] Previously, integrated cable modem devices have only included physical-layer functions and a fixed-function MAC. These devices are generally compliant with a single specification or a version of a specification. Thus, any changes to the underlying specification require hardware modifications for the MAC to be compliant, resulting in lengthy and expensive product development cycles.

[0012] Further limitations and disadvantages of conventional and traditional systems will become apparent to one of skill in the art through comparison of such systems with the present invention as set forth in the remainder of the present application with reference to the drawings.

SUMMARY OF THE INVENTION

[0013] Briefly, the present invention relates to a cable modem having a programmable media access controller (MAC). In one embodiment of the invention, a single cable modem device is provided that includes all necessary MAC functions. The cable modem device advantageously allows the MAC functions to be programmed to support evolving standards (e.g., DOCSIS) without requiring expensive hardware upgrades. The cable modem device may also include data-conversion components, a complete PHY that is compliant with both United States and European standards, an Ethernet MAC, a Universal Serial Bus (USB) transceiver, an encryption engine(s), key memory components and other peripheral functions.

[0014] The cable modem device of a disclosed embodiment of the invention utilizes a bifurcated microprocessor architecture in which first processing circuitry (e.g., an embedded processor core) is programmed to implement the desired MAC functionality for processing information flowing to and from cable media interface circuits. A second embedded processor core or host system processor provides operating system functionality and controls the boot process for the first embedded processor core. In a further embodiment, separate processor cores are provided for implementing MAC functionality for the downstream and upstream data paths, respectively. The embedded microprocessor cores may be Advanced RISC Machines (ARM) microprocessors or any other suitable microprocessor cores.

[0015] In a disclosed embodiment of the invention, cable media interface circuitry, as well as other peripheral cir-

cuitry, are coupled to a peripheral bus. The peripheral bus is linked by a bridge circuit to a system bus. The processing circuitry of the programmable MAC is communicatively coupled to the system bus. A novel centralized DMA controller is provided to direct transfer of data between the peripheral bus and the system bus as determined, at least in part, by the programmable MAC.

[0016] A cable modem device having a programmable MAC according to the present invention provides a software upgrade path to permit support for new versions of standards as they are adapted. Further, the programmable nature of the cable modem device permits individual manufacturers to differentiate products at the MAC layer without having to modify or replace hardware.

[0017] Other aspects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] A better understanding of the present invention can be obtained when the following detailed description of various exemplary embodiments is considered in conjunction with the following drawings:

[0019] **FIG. 1** is a block diagram of an exemplary cable modem device having a programmable cable media access controller according to the present invention;

[0020] **FIG. 2** is a schematic block diagram providing exemplary details of the cable modem device of **FIG. 1**;

[0021] **FIG. 3** is a schematic block diagram providing exemplary details of processing circuitry of **FIG. 1** capable of being programmed to implement media access controller functionality in accordance with the present invention;

[0022] **FIG. 4** is a state diagram providing details of an exemplary programmable cable media access controller software architecture implemented by the cable modem device of **FIG. 1**; and

[0023] **FIGS. 5A and 5B** are flow diagrams of an exemplary boot process for a programmable cable media access controller according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0024] **FIG. 1** is a block diagram of an exemplary cable modem device **100** having a programmable cable media access controller (hereinafter referred to as a programmable MAC) in accordance with the present invention. The cable modem device **100** permits MAC functions to be programmed to support evolving standards, such as DOCSIS, without concomitant hardware upgrades. The disclosed circuitry may be part of a single integrated circuit, or a combination of integrated circuits. Alternatively, host system circuitry may be leveraged to perform certain of the functions described below.

[0025] The cable modem device **100** can be implemented in a variety of products, including external or internal cable modems with Ethernet and/or USB connections, multifunction home-networking products, interactive set-top-box solutions, digital satellite receivers, wireless networking devices having antennas, Small Office/Home Office (SOHO) equipment and Internet Protocol (IP) telephony products. Accordingly, various embodiments of the invention may interface with non-traditional "cable" media (e.g., any type of media capable of transporting MPEG packets), and the precise nature of the data transmission media is not considered critical to the invention. The cable modem device **100** may be compliant with any of a number of standards, including but not limited to, DOCSIS, DAVIC/DVB (Digital Video Broadcasting) and Voice Over IP (VOIP) standards. In the case of DOCSIS, typical MAC functionality includes MPEG and MCNS decoding and frame synchronization.

[0026] In the cable modem device **100** of **FIG. 1**, a first processor **102** is programmed to implement the desired MAC functionality, while a second processor **104** provides operating system support. The first processor **102** of the disclosed embodiment is designed for high performance data processing. In addition to executing an operating system, the second processor **104** may manage some message processing and scheduling. The second processor **104** preferably utilizes a real-time operating system, such as VxWorks®.

[0027] Data passed between the first and second processors **102** and **104** and other components of the cable modem device **100** may be stored in random access memory (RAM) **106**. The RAM **106**, as well as the first and second processors **102** and **104**, are communicatively coupled to a system bus **108**. The system bus **108** is linked to a peripheral bus **112** via a bridge **110**.

[0028] Bi-directional communication between the cable modem device **100** and cable media **134** is conducted by physical layer devices coupled to the peripheral bus **112**. More particularly, downstream data communicated from the cable media **134** is received by analog-to-digital conversion circuitry **116**. The digital output of the analog-to-digital circuitry **116** is provided to a cable downstream PHY circuitry **114** that performs demodulation and forward error correction functions. The output of the cable downstream PHY circuitry **114** is provided to peripheral bus **112** for processing by the programmable MAC.

[0029] Upstream data to be communicated to the cable media **134** is provided from the peripheral bus **112** to cable upstream PHY circuitry **118** that modulates the upstream data, and may also perform error correction operations. The output of the cable upstream PHY circuitry **118** is communicated to a digital-to-analog converter **120** for provision to the cable media **134**.

[0030] The cable modem device **100** of **FIG. 1** may also include a number of optional interfaces for communicating with a host system or external devices. For example, a host interface **122** and expansion memory interface **124** may be coupled to the system bus **108**. Likewise, the peripheral bus **112** may support a Media Independent Interface (MII) **126**, a General Purpose Input/Output (GPIO) interface **128**, a USB port **130**, and a UART port **132**. As will be appreciated, many other types of interfaces may be provided, and the precise nature of supported devices is not considered critical to the invention.

[0031] Various alternate embodiments of the cable modem device **100** are contemplated. For example, the programmable MAC could be implemented by a pair of processors, with the upstream code handled by one processor and the

downstream code handled by another processor. Such a configuration may provide advantages in terms of software partitioning.

[0032] **FIG. 2** is a schematic block diagram providing exemplary details of the cable modem device **100** of **FIG. 1**. In this embodiment of the invention, the cable modem device **100** utilizes the Advanced System Bus (ASB **210**) and Advanced Peripheral Bus (APB **214**) protocol and bus architecture as specified in the Advanced Microcontroller Bus Architecture (AMBA) specification. The AMBA specification defines an on-chip communication standard for designing high-performance embedded microcontrollers. The ASB **210** is generally utilized for high-performance system modules, supporting the efficient connection of processors, on-chip memories, and off-chip external memory interfaces with low-power peripheral/macrocell functions. The APB **214** is generally utilized with low-power peripherals, and is optimized for minimal power consumption and reduced interface complexity in supporting peripheral fuuctions.

[0033] Another bus defined by the AMBA specification is the Advanced High-Performance Bus (AHB). The AHB is generally utilized with high-performance, high-frequency system modules. The AHB may act as the high-performance system backbone bus, and supports the efficient connection of processors, on-chip memories, and off-chip external memory interfaces with low-power peripheral macrocell functions.

[0034] In the disclosed embodiment of the invention, the ASB **210** is utilized as the system bus **108**, although it is contemplated that other buses such as the AHB may also be used. The ASB **210** is the bus on which the first and second processors **102** and **104**, RAM memory **106**, and other direct memory access (DMA) devices reside. The ASB **210** provides a high-bandwidth interface between the system elements that are involved in the majority of data transfers. An ASB-APB bridge/centralized DMA controller **212** is provided for linking the ASB **210** to the lower bandwidth APB **214**, where most of the peripheral devices in the cable modem device **100** are located. As discussed in greater detail below, the ASB-APB bridge/centralized DMA controller **212** is both an ASB **210** master and an APB **214** master, and utilizes burst transfers and pipelining of data to optimize bus efficiency.

[0035] The APB **214** provides the basic peripheral macrocell communications infrastructure. Such peripherals typically have interfaces which are memory-mapped registers, have few high-bandwidth interfaces, and are accessed under program control (such as the programmable MAC). In the disclosed embodiment of the invention, certain performance enhancements have been made to the APB and ASB, as well as the device interfaces to these buses, as set forth in greater detail in previously incorporated patent applications entitled, "System and Method for Providing an Improved Synchronous Operation of an Advanced Peripheral Bus with Backward Compatibility", and "Asochronous Centralized Multi-Channel DMA Controller".

[0036] Although the disclosed cable modem device **100** utilizes the AMBA bus architecture, in a broader implementation the programmable MAC may be configured to operate with a wide variety of buses and interface with any type of peripheral device. For example, in a host processor-based implementation, the ASB **210** may be replaced with a PCI bus or other type of bus typically found in computer systems.

[0037] In this embodiment of the invention, the first processor **102** includes a microprocessor macrocell providing a high-performance integer core RISC engine that utilizes an instruction memory **200** and a data memory **202**. The second processor **104** of this embodiment is a cached microprocessor macrocell (e.g., an ARM940T macrocell by Advanced RISC Machines) providing a high-performance integer core RISC engine. The second processor **104** has a separate instruction cache **204** and data cache **206**, as well as a memory configuration and protection unit. The instruction and data caches **204** and **206** of the second processor **104** support concurrent processing. In addition, the second processor **104** is capable of performing random read/write ASB accesses and cache line fills, as well as buffered burst writes. The first processor **102** and second processor **104** communicate with the ASB **210** via an AMBA Interface **208***a* and **208***b*, respectively.

[0038] The first processor **102** and second processor **104** each have two interrupt inputs FIQ# and IRQ# that are active-low level-sensitive. In the disclosed embodiment of the invention, the FIQ# interrupt is of higher priority than the IRQ# interrupt and is serviced first when both interrupts are asserted in unison. Servicing an FIQ# interrupt disables an IRQ# interrupt until the FIQ# interrupt handler exits or re-enables the IRQ# interrupt.

[0039] In addition to RAM **106**, a read only memory (ROM) **216** may be provided on the ASB **210**. Further, an ASB arbiter **218** is coupled to the ASB **210**. The ASB arbiter **218** determines which ASB master has access to the ASB **210**. In this embodiment, there are four ASB masters capable of requesting the ASB **210**: the first processor **102**, the second processor **104**, the host interface **122**, and the DMA controller **212**. The arbitration scheme utilized by the ASB arbiter **218** is based on priority. The DMA controller **212** has the highest priority in order to minimize system latency and data buffering for certain peripherals. The host interface **122** has second priority since its access may be less frequent. The first processor **102** has next priority since its accesses may be generally more time critical than those of the second processor **104**. Of course, other arbitration schemes may be utilized.

[0040] The host interface **122** may also function as a test interface controller (TIC) that provides a parallel test access port to the first and second processor **102** and **104**, as well as the ASB **210**. The TIC allows externally applied test vectors to be converted into internal bus transfers. More than one host interface **122** may be maintained by the cable modem device **100**. For example, in addition to the host interface **122**, a PCI or similar interface may added for communicating to a host system, while the host interface **122** communicates with other peripherals such as voice attachments. The host interface **122** supports a slave mode which provides an external host processor access to its internal memory, as well as memory-mapped register set. The host interface **112** also supports a master mode which allows control signals to access external slave devices such as flash memory or data peripherals.

[0041] An ASB decoder **220** is also coupled to the ASB **210**. The ASB decoder **220** decodes addresses on the ASB

210, and provides selection signals to each ASB slave. The expansion memory interface **124** includes an expansion memory access controller (XMAC) that provides an interface to support external memory. In the disclosed embodiment of the invention, the expansion memory interface **124** is a 16-bit synchronous interface, although many variations are possible.

[**0042**] As previously mentioned, a number of physical interfaces to external data sources are coupled to the APB **214**. In particular, a cable media access controller (CMAC) **224**, including a system timer and interfaces to the cable downstream PHY circuitry **114** and cable upstream PHY circuitry **118**, is provided to support communications with a cable media **134**. The CMAC **224** hardware and firmware combine to support a desired specification (e.g., a DOCSIS feature set for the MAC sub-layer of an MCNS cable modem). In general, CMAC **224** aligns incoming packets and prepends a time stamp and appends a pattern recognition trailer structure to form word packets to be delivered to memory by the DMA controller **212**. The CMAC **224** is also responsible for requesting data from the DMA controller **212** at the appropriate time, calculating checksums, and encrypting all or part of the upstream data and bursting the data to the upstream cable upstream PHY circuitry **118**. Exemplary details of the later operation are provided in the previously-incorporated patent application entitled "Method and Apparatus for Upstream Burst Transmission Synchronization in Cable Modems." Delta sigma converter circuitry **228** is also coupled to the CMAC **224** to provide automatic gain control and other functionality for the cable PHY layer.

[**0043**] A pair of DES/CRC engines **222***a* and **222***b* are provided as peripherals to the APB **214**. The DES/CRC engines **222***a* and **222***b* are capable of performing DES encryption or decryption, and/or cyclic-redundancy-checks on a stream of data supplied by the DMA controller **212**. Providing more than one DES/CRC engine **222** permits a plurality of data flow threads to be processed simultaneously.

[**0044**] An Ethernet external datalink is also coupled to the APB **214**, and is comprised of an Ethernet media access controller (EMAC) **226** and the MII **126**. In the disclosed embodiment of the invention, the EMAC **226** supports the MAC sublayer of the IEEE 802.3 specification and allows it to be connected to an IEEE 802.3 10/100 Mbps (100Base-T and 10Base-T) MII compatible EPHY device or seven-wire HomeLan PHY device. The MII **126** provides a port to transmit and receive data that is media independent, multi-vendor interoperable, and supports all data rates and physical standards. The port consists of datapaths that are generally four bits wide in each direction, as well as control and management signals. The MII **126** can be configured as a glueless connection to support Ethernet or HomeLan serial mode.

[**0045**] A USB interface **132** is also coupled to the APB **214**. The USB interface **132** can couple to any of a number of compliant external devices. In the disclosed embodiment of the invention, the USB interface **132** supports receive and transmit signaling of 12-Mb/s.

[**0046**] A number of other miscellaneous peripherals may also be coupled to the APB **214**. For example, a UART **132** may be provided to receive and transmit data, for example, over a telephone line. In addition, a CRC engine **230** is provided to perform single-cycle computations on input data up to 32 bits at a time. This CRC engine **230** is intended to provide high-performance Header Check Sequence (HCS) calculations, as used in both downstream and upstream CMAC operations.

[**0047**] Programmable timer circuitry **232** is also coupled to the APB **214**, and may perform a number of functions. For example, the programmable timer circuitry **232** may generate real-time interrupts, as well as perform system "watchdog" operations. The programmable timer circuitry **232** may also be used as an external event counter.

[**0048**] A pair of interrupt controllers **234** may be provided, one for each of the first processor **102** and second processor **104**. All peripheral interrupt sources are routed through the interrupt controllers **234**, and reduced to two active low inputs to the first and second processors **102** and **104**—FIQ# and IRQ#—which are asserted in response to specified data operations. Software control interrupts may also be provided.

[**0049**] A general purpose I/O bus **128** and I^2C serial bus **236** are also coupled to the APB **214**. It is contemplated that two of the I/O pins of the general purpose I/O bus **128** may be enabled for software controlled I^2C operations via a control register. Pins of the general purpose I/O bus **128** can also serve as external interrupt inputs.

[**0050**] **FIG. 3** is a schematic block diagram providing exemplary details of the first processor **102** of **FIG. 1**. Again, the first processor **102** is capable of being programmed to implement MAC functionality in accordance with the present invention.

[**0051**] As discussed generally above, the first processor **102** comprises a processor core **300**, an instruction memory **200**, and a data memory **202**. Each of these elements communicates with the ASB **210** via the AMBA interface **208***a*. In one contemplated embodiment of the invention, the processor core **300** is a high-performance integer core such as that used in the ARM940T processor macrocell. In one embodiment of the invention, the instruction memory **200** comprises a 20K×32 SRAM coupled to the instruction address and data busses IA and ID. The data memory **202** of the this embodiment comprises a 12K×32 SRAM coupled to the data and address buses DD and DA.

[**0052**] Inputs to the processor core **300** include a JTAG test bus, a clock signal CLK, and the interrupts FIQ# and IRQ#. The processor core **300** also interfaces with an instruction memory control bus and data memory control bus coupled to the AMBA interface **208***a*. In accordance with the ASB specification, a number of control, address and data signals are communicated between the AMBA interface **208** and the ASB **210**.

[**0053**] **FIG. 4** is a state diagram providing details of an exemplary programmable MAC **400** software architecture implemented by the cable modem device **100** of **FIG. 1**. The programmable MAC **400** software of this embodiment of the invention is composed of several software processes that perform various tasks and functions. A number of the programmable MAC **400** processes communicate with each other via shared memory regions, functions, or subroutines. Other programmable MAC **400** processes communicate with the operating system via a programmable MAC interface. The programmable MAC interface may be imple-

mented as a reserved region of data memory or message queues, an interrupt controller, and predefined messages to pass data, configuration parameters, and status information across the interfaces. The programmable MAC **400** processes may span one or more processor contexts. Transitions between programmable MAC **400** processes may occur via external hardware interrupts (IRQ or FIQ), or via a software interrupt causing a change of context. In general, a process executing within a given context will execute linearly until completion or until another context switch occurs.

[**0054**] The exemplary programmable MAC **400** software of **FIG. 4** comprises six (6) major process: a message router process **401**, a command processor **402**, a downstream process **404**, a PLL process **406**, an upstream process **408**, and a map and upstream (MUP) process **410**. These processes are provided by way of example, and it is contemplated that a greater number or a fewer number of processes could be implemented without departing from the spirit or scope of the invention.

[**0055**] The message router **401** is primarily responsible for managing the flow of information into and out of the programmable MAC. This includes placing programmable MAC downstream data (protocol data units (PDU) and MAC management messages (MMM)) and status messages in the programmable MAC output message FIFO **414**. The message router **401** is also responsible for retrieving programmable MAC upstream data and configuration messages from the programmable MAC input message FIFO **412**. Messages retrieved by the message router **401** are then routed to the appropriate programmable MAC **400** process. The message router **401** is further responsible for managing programmable MAC status interrupts.

[**0056**] The message router **401** also interacts with a command processor that receives and processes MCNS and other commands. Commands directed to the command processor **402** are placed in the command input message queue **416**, while a command output message queue **418** is used to store output messages from the command processor **402**.

[**0057**] The downstream process **404** manages and monitors the flow of downstream data. More particularly, the downstream process **404** of the disclosed embodiment of the invention is responsible for: MPEG synchronization, MPEG frame header verification, MCNS frame header verification, extraction of MCNS extended header information, SID perfect filtering, MAC address perfect filtering, imperfect multi-cast address filtering, information element filter, DES decryption, CRC validation, downstream data transfer to the appropriate destination (PLL, MAP processor, or programmable MAC external interface), and downstream statistics.

[**0058**] Messages from the message router **401** to the downstream process **404** are placed in a downstream process input message queue **424**, while messages from the downstream process **404** to the message router **401** are placed in a downstream process output message queue **426**. The downstream process **404** communicates with a downstream PHY **440** via a downstream interface **446** and MPEG buffers **448**. The downstream process **404** further utilizes a downstream DES/CRC engine **442** to provide decryption and validation functionality.

[**0059**] The PLL process **406** functions to provide a local clock reference that is phase-locked to a CMTS clock. The PLL process **406** further provides conversion functions to convert between system time and the local hardwire time. In addition, the PLL process **406** communicates status information to the second processor **104** and the other programmable MAC processes. Messages from the message router **401** to the PLL process **406** are placed in a PLL input message queue **428**. Messages from the PLL process **406** to the message router **401** may be placed in a PLL output message queue **430**.

[**0060**] The upstream process **408** manages the transmission of upstream data. More particularly, the upstream process **408** handles: concatenation/fragmentation of upstream frames, checksum or CRC computation, DES encryption, programming the upstream physical layer or PHY **436**, and ensuring time-to-send requirements are met. The upstream process **408** utilizes an upstream DES/CRC function **432** to coordinate encryption and validation of upstream data. The upstream process **408** further communicates with an upstream interface **438**, and receives linked list data **434** from the MUP process **410**.

[**0061**] The MUP process **410** handles the processing of downstream MAP frames, manages the scheduling of upstream frame transmission, and handles the ranging process used to optimize communications with a cable headend. The MUP process **410** of the disclosed embodiment of the invention has two entry points: a MUP input message queue **422** that is called by the message router **401** when a new input message is available in the queue, and a MAP queue **440** that is called by the downstream process **404** when new MAP is available. MUP output message queue **420** is also provided for passing data to the message router **401**.

[**0062**] It is contemplated that additional functions may be added to the exemplary programmable MAC **400** software architecture of **FIG. 4**, and that other functions may be implemented in hardware.

[**0063**] **FIGS. 5A and 5B** are flow diagrams of an exemplary boot process for a programmable MAC according to the present invention. The boot process of the disclosed embodiment of the invention maintains a boot status memory area at a fixed address in memory to allow the second processor **104** to monitor the boot status of the programmable MAC. The boot status memory region preferably resides at a fixed, word-line address in the processor data memory. The programmable MAC updates words in the boot status region with non-zero values as it proceeds through the boot process. The boot process may be conducted by the second processor **104**, by a host system via a host system interface **122**, or by other circuitry of the cable modem device **100**.

[**0064**] Following commencement of the boot process at step **500**, the programmable MAC stack pointers and variables are initialized at step **502**. The programmable MAC can maintain separate stacks for each of the separate contexts or operating modes of the processor **102**. These stacks, as well as processor data memory variables, are initialized in this step.

[**0065**] Next, in step **504**, the boot process calls a boot function to perform the remainder of the disclosed programmable MAC boot process. The boot function of the boot process proceeds to step **506**, where a checksum is performed on the programmable MAC software loaded into the

processor instruction memory. The computed checksum is then compared to a value stored in a global memory variable. Next, beginning with step **508**, all programmable MAC software processes are initialized via initialization routines called by the boot process. The downstream process is first initialized in step **508**, followed by initialization of PLL in step **510**. The MAP process is next initialized in step **512**.

[**0066**] The boot process continues at step **514** (**FIG. 5B**) where the upstream process is initialized. The programmable MAC interface is next initialized in step **516**, followed by initialization of the command process in step **518**.

[**0067**] Following initialization of the programmable MAC software processes, the boot process determines if the initialization routines executed correctly. If not, the boot process writes a "fail" value to the operating state word of the boot status memory. Next, a boot failure loop is entered in step **524**, although it is contemplated that step **522** may be performed upon entry into the boot failure loop. In addition, if the boot process fails, a power-on reset may be applied by the second processor **104**.

[**0068**] If the initialization routines executed correctly as determined in step **520**, the boot process proceeds to step **526** and a version number of the programmable MAC software is written to the operating state word of the boot state status memory. Next, in step **528**, the boot process enable interrupt bits associated with the programmable MAC interface or message router **401**. Finally, the boot process sends a message to the operating system indicating that the power on processes is complete and the programmable MAC is ready for operation.

[**0069**] Thus, a cable modem having a programmable MAC has been described. The programmable MAC features of the cable modem provide a software upgrade path to permit support for new versions and variations of cable modem standards, thereby reducing or eliminating hardware development costs.

[**0070**] In view of the above detailed description of the present invention and associated drawings, other modifications and variations will now become apparent to those skilled in the art. It should also be apparent that such other modifications and variations may be effected without departing from the spirit and scope of the present invention.

What is claimed is:

1. A cable modem having a programmable media access controller, comprising:

a system bus;

a plurality of processors, each of the plurality of processors is communicatively coupled to the system bus, that perform a plurality of processing functions, the plurality of processing functions are partitioned, at least in part, between at least two of the plurality of processors;

a peripheral bus that is operable to perform transfer of cable media;

a bridge that communicatively couples the system bus and the peripheral bus; and

a peripheral processing device, communicatively coupled to the peripheral bus, that is operable to perform processing of a selectively off-loaded portion of the cable media.

2. The cable modem of claim 1, wherein one of the plurality of processors supports upstream data transfer of cable media received by the cable modem; and

at least one other of the plurality of processors supports downstream data transfer of the cable media transmitted by the cable modem.

3. The cable modem of claim 1, wherein one of the plurality of processors is operable to perform at least one of message processing and scheduling.

4. The cable modem of claim 1, wherein the bridge comprises a direct memory access controller that is operable selectively to provide a portion of the cable media to one of the plurality of processors and to provide the off-loaded portion of the cable media to the peripheral processing device.

5. The cable modem of claim 1, further comprising at least one additional peripheral processing device, communicatively coupled to the peripheral bus, that is operable to perform processing of at least one additional selectively off-loaded portion of the cable media.

6. The cable modem of claim 1, wherein the plurality of processing functions comprises operating system functionality.

7. The cable modem of claim 1, wherein the plurality of processing functions comprises media access control functionality.

8. The cable modem of claim 1, wherein one of the plurality of processors employs embedded code to support media access control functionality.

9. A cable modem device, comprising:

a bifurcated bus structure comprising a first bus and a second bus;

a partitioned processor structure, communicatively coupled to the first bus, comprising a plurality of processors, that is operable to perform a plurality of processing functions;

a co-processor, communicatively coupled to the second bus, that is operable to support processing of cable media that is selectively off-loaded from at least one of the plurality of processors;

an input/output interface, communicatively coupled to the second bus, that is operable to perform data transfer of a plurality of data to the second bus; and

a direct memory access controller that communicatively couples the first bus and the second bus and that is operable to support off-loading of at least one function of the plurality of functions to the co-processor.

10. The cable modem device of claim 9, further comprising at least one additional coprocessor, communicatively coupled to the second bus, that is also operable to support processing of cable media that is selectively off-loaded from at least one of the plurality of processors.

11. The cable modem device of claim 9, wherein the first bus employs an Advanced System Bus protocol; and

the second bus employs an Advanced Peripheral Bus protocol.

12. The cable modem device of claim 9, wherein one of the plurality of processors supports upstream data transfer of cable media received by the cable modem; and

at least one other of the plurality of processors supports downstream data transfer of the cable media transmitted by the cable modem.

13. The cable modem device of claim 9, wherein the co-processor is operable to perform at least one of DES encryption and DES decryption.

14. The cable modem device of claim 9, wherein the plurality of processing functions comprises operating system functionality and media access control functionality.

15. The cable modem device of claim 9, wherein the second bus operates consuming power at a rate lower than a rate at which the first bus consumes power.

16. The cable modem device of claim 9 manufactured as an integrated circuit.

17. A method to perform processing within a cable modem, the method comprising:

performing cable media processing using a plurality of processors, the cable media processing is partitioned, at least in part, between at least two of the plurality of processors;

selectively off-loading a portion of the cable media from at least one of the plurality of processors to a co-processor; and

processing the off-loaded portion of the cable media using the co-processor.

18. The method of claim 17, wherein the method is performed within an integrated circuit.

19. The method of claim 17, wherein at least one of the plurality of processors comprises embedded code that is substantially operable for media access control functionality.

20. The method of claim 17, further comprising directing upstream and downstream communications of cable media using at least two of the plurality of processors.

* * * * *

EXHIBIT D

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EXAMINER	
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ART UNIT	PAPER NUMBER
2469	

NOTIFICATION DATE	DELIVERY MODE
04/03/2018	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mhmpto@mcandrews-ip.com

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 15/866,106	Applicant(s) Ling et al.	
	Examiner DUNG B HUYNH	Art Unit 2469	AIA Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 01/09/2018.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-18 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-18 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 01/09/2018 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Drawings

2. The drawings were received on 02/16/2017 are accepted for examination purpose.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory

double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Note that the applicant filling of the continuing application is voluntary and not direct, unmodified result of restriction requirement under 35 U.S.C. 121 (i.e. without a restriction requirement by the examiner) and the claims of the second application (continuing application) are drawn to the "same" invention" as the first application or patent.

4. **Claims 1-18 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-18 of U.S. Patent No. 9,577,886 B2 to Ling et al.**

Although the claims at issue are not identical, they are not patentably distinct from each other for the reasons set forth below.

Regarding **claim 1**, although the claims at issue are not identical, they are not patentably distinct from each other because claim 1 of the instant application merely broadens the scope of the claim 1 of the Ling Patent by eliminating the elements and their respective functions of the claims as set forth below.

Claim 1 of Instant application	Claim 1 of US Patent No. 9,577,886 B2
Limitation 1 : A method comprising: determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;	**Limitation 1 :** A method comprising: determining, by a cable modem termination system (CMTS), for a *plurality of cable modems* served by said CMTS, a corresponding plurality of signal-to-noise ratio (SNR) related metrics *comprising SNR versus frequency profiles*;
Limitation 2 : assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;	**Limitation 2 :** assigning, by said CMTS, said *plurality of cable modems* among a plurality of service groups based on said plurality of SNR-related metrics;
Limitation 3 : generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups;	**Limitation 3 :** generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based on a portion of said plurality of SNR-related metrics corresponding to said one of said plurality of service groups;
Limitation 4 : selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and	**Limitation 4 :** selecting, by said CMTS, physical layer communication parameters to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
Limitation 5 : communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter.	**Limitation 5 :** communicating, by said CMTS, with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using said selected physical layer *communication parameters*.

Claim 1 of Instant application	Claim 1 of US Patent No. 9,577,886 B2
Limitation 6 : NONE	**Limitation 6 :** *wherein said composite SNR related metric is a worst-case SNR versus frequency profile for said one of said plurality of service groups.*

In view of the above, it is clear that the conflicting claims are not patentably distinct from each other because claim 1 of the instant application merely broadens the scope of the claim 1 of the Ling Patent by eliminating the italicized and underlined portion of limitations 1, 2 and 5 of Ling Patent's claim 1 and entire limitation 6 of Ling Patent's claim 1.

Instant application	US Patent No. 9,577,886 B2
Claim 2: The method of claim 1, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.	**Claim 2:** The method of claim 1, wherein said physical layer communication parameters include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.
Claim 3: The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.	**Claim 3:** The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.
Claim 4: The method of claim 3, comprising selecting, by said CMTS, said one or more physical layer communication parameter on a per-OFDM-subcarrier basis.	**Claim 4:** The method of claim 3, comprising selecting, by said CMTS, said physical layer communication parameters on a per-OFDM-subcarrier basis.
Claim 5: The method of claim 4, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.	**Claim 5:** The method of claim 4, wherein said physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.

Instant application	US Patent No. 9,577,886 B2
Claim 6: The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus frequency profile; and said assigning said each cable modem among said plurality of service groups comprises, for the particular cable modem: assigning said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assigning said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.	**Claim 6:** The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a third cable modem has a particular SNR versus frequency profile; and said assigning said plurality of cable modems among said plurality of service groups comprises: assigning said third cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assigning said third cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.
Claim 7: The method of claim 1, comprising assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.	**Claim 7:** The method of claim 1, comprising assigning said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems.
Claim 8: The method of claim 1, comprising assigning any particular one of said cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.	**Claim 8:** The method of claim 1, comprising assigning any particular one of said plurality of cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.
Claim 9: The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises: transmitting a probe message to each	**Claim 9:** The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises: transmitting a probe message to each

Instant application	US Patent No. 9,577,886 B2
cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and receiving a metric reporting message from each cable modem.	said plurality of cable modems, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and receiving a metric reporting message from each of said plurality of cable modems.

In view of the above, the conflicting claims are not patentably distinct from each other because claims 2-9 of the instant application are merely similar to the scope of the claims 2-9 of the Ling Patent.

Claim 10 of Instant application	Claim 10 of US Patent No. 9,577,886 B2
Limitation 1 : A system comprising: circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:	**Limitation 1 :** A system comprising: circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:
Limitation 2 : said processor is configured to determine, for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;	**Limitation 2 :** said processor is configured to determine, for a plurality of cable modems served by said CMTS, a corresponding plurality of signal-to-noise ratio (SNR) related metrics *comprising SNR versus frequency profiles*;
Limitation 3 : said processor is configured to assign each of said cable modems among a plurality of service groups based on a respective corresponding SNR-related metric;	**Limitation 3 :** said processor is configured to assign said *plurality of cable modems* among a plurality of service groups based on said plurality of SNR-related metrics;
Limitation 4 : said processor is configured to generate, for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups;	**Limitation 4 :** said processor is configured to generate, for each one of said plurality of service groups, a composite SNR-related metric based on a portion of said plurality of SNR-related metrics corresponding to said one of said plurality of service groups;
Limitation 5 : said processor is configured to select one or more physical layer communication parameter to be used for	**Limitation 5 :** said processor is configured to select physical layer communication parameters to be used for communicating with said one of said

Claim 10 of Instant application	Claim 10 of US Patent No. 9,577,886 B2
communicating with said one of said plurality of service groups based on said composite SNR-related metric; and	plurality of service groups based on said composite SNR-related metric; and
Limitation 6 : said network interface is configured to communicate with one or more cable modems corresponding to said one of said plurality of service groups using the one or more selected physical layer communication parameter.	**Limitation 6 :** said network interface is configured to communicate with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using *the selected physical layer communication parameters.*
Limitation 7 : NONE	**Limitation 7 :** *wherein said composite SNR related metric is a worst-case SNR versus frequency profile for said one of said plurality of service groups.*

In view of the above, it is clear that the conflicting claims are not patentably distinct from each other because claim 10 of the instant application merely broadens the scope of the claim 10 of the Ling Patent by eliminating the italicized and underlined portion of limitations 2, 3 and 6 of Ling Patent's claim 10 and entire limitation 7 of Ling Patent's claim 10.

Instant application	US Patent No. 9,577,886 B2
Claim 11: The system of claim 10, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.	**Claim 11:** The system of claim 10, wherein said physical layer communication parameters include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.
Claim 12: The system of claim 10, wherein said network interface and said cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers.	**Claim 12:** The system of claim 10, wherein said network interface and said plurality of cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers.
Claim 13: The system of claim 12, wherein said network interface is	**Claim 13:** The system of claim 12, wherein said network interface is

Instant application	US Patent No. 9,577,886 B2
configured such that at least one of said one or more physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.	configured such that said physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.
Claim 14: The system of claim 12, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.	**Claim 14:** The system of claim 12, wherein said physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.
Claim 15: The system of claim 10, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus frequency profile; said assignment of said each cable modem among said plurality of service groups comprises, for the particular cable modem: assignment of said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assignment of said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.	**Claim 15:** The system of claim 10, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a third cable modem has a particular SNR versus frequency profile; said assignment of said plurality of cable modems among said plurality of service groups comprises: assignment of said third cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assignment of said third cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.
Claim 16: The system of claim 10, wherein said processor is configured to assign said cable modems among said plurality of service groups based on	**Claim 16:** The system of claim 10, wherein said processor is configured to assign said plurality of cable modems among said plurality of service groups

Instant application	US Patent No. 9,577,886 B2
respective distances between said CMTS and said cable modems.	based on distances between said CMTS and said plurality of cable modems.
Claim 17: The system of claim 10, wherein said processor is configured to assign each of said cable modems among said plurality of service groups based on one or more branch amplifier that serves said each of said cable modems.	**Claim 17:** The system of claim 10, wherein said processor is configured to assign said plurality of cable modems among said plurality of service groups based on a branch further branch amplifier that serves each of said plurality of cable modems.
Claim 18: The system of claim 10, wherein said determination of said plurality of SNR-related metrics comprises: transmission, via said network interface, of a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and reception, via said network interface of said CMTS, of a metric reporting message from each cable modem.	**Claim 18:** The system of claim 10, wherein said determination of said plurality of SNR-related metrics comprises: transmission, via said network interface, of a probe message to each said plurality of cable modems, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and reception, via said network interface of said CMTS, of a metric reporting message from each of said plurality of cable modems.

In view of the above, the conflicting claims are not patentably distinct from each other because claims 11-18 of the instant application are merely similar to the scope of the claims 11-18 of the Ling Patent.

5. **Claims 1-18 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-18 of U.S. Patent No. 9,419,858 B2 to Ling et al.** *(hereafter refers as Ling Patent'858).* Although the claims at issue are not identical, they are not patentably distinct from each other for the reasons set forth below.

Regarding **claim 1**, although the claims at issue are not identical, they are not patentably distinct from each other because claim 1 of the instant application merely

broadens the scope of the claim 1 of the Ling Patent'858 by eliminating the elements and their respective functions of the claims as set forth below.

Claim 1 of Instant application	Claim 1 of Ling Patent'858
Limitation 1 : A method comprising: determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;	**Limitation 1 :** A method comprising: determining, by a cable modem termination system (CMTS), for a plurality of cable modems served by said CMTS, a corresponding plurality of signal-to-noise ratio (SNR) related metrics;
Limitation 2 : assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;	**Limitation 2 :** assigning, by said CMTS, said *plurality of cable modems* among a plurality of service groups based on said plurality of SNR-related metrics;
Limitation 3 : generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups;	**Limitation 3 :** generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based on a portion of said plurality of SNR-related metrics corresponding to said one of said plurality of service groups;
Limitation 4 : selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and	**Limitation 4 :** selecting, by said CMTS, physical layer communication parameters to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
Limitation 5 : communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter.	**Limitation 5 :** communicating, by said CMTS, with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using said *selected physical layer communication parameters*
Limitation 6 : NONE	**Limitation 6 :** *wherein: each of said SNR-related metrics is signal-to-noise ratio (SNR) versus frequency profile; and said composite SNR related metric is a worst-case SNR versus frequency profile for said one of said plurality of service groups.*

In view of the above, it is clear that the conflicting claims are not patentably distinct from each other because claim 1 of the instant application merely broadens the scope of the claim 1 of the Ling Patent'858 by eliminating the italicized and underlined portion of limitations 2 and 5 of the Ling Patent'858's claim 1 and the entire limitation 6 of Ling Patent'858's claim 1.

Instant application	Ling Patent'858
Claim 2: The method of claim 1, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.	**Claim 2:** The method of claim 1, wherein said physical layer communication parameters include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.
Claim 3: The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.	**Claim 3:** The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.
Claim 4: The method of claim 3, comprising selecting, by said CMTS, said one or more physical layer communication parameter on a per-OFDM-subcarrier basis.	**Claim 4:** The method of claim 3, comprising selecting, by said CMTS, said physical layer communication parameters on a per-OFDM-subcarrier basis.
Claim 5: The method of claim 4, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.	**Claim 5:** The method of claim 4, wherein said physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.
Claim 6: The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a	**Claim 6:** The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a

Instant application	Ling Patent'858
particular cable modem has a particular SNR versus frequency profile; and said assigning said each cable modem among said plurality of service groups comprises, for the particular cable modem: assigning said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assigning said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.	third cable modem has a particular SNR versus frequency profile; and said assigning said plurality of cable modems among said plurality of service groups comprises: assigning said third cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assigning said third cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.
Claim 7: The method of claim 1, comprising assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.	**Claim 7:** The method of claim 1, comprising assigning said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems.
Claim 8: The method of claim 1, comprising assigning any particular one of said cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.	**Claim 8:** The method of claim 1, comprising assigning any particular one of said plurality of cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.
Claim 9: The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises: transmitting a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and receiving a metric reporting message from each cable modem.	**Claim 9:** The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises: transmitting a probe message to each said plurality of cable modems, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and receiving a metric reporting message from each of said plurality of cable modems.

In view of the above, the conflicting claims are not patentably distinct from each other because claims 2-9 of the instant application are merely similar to the scope of the claims 2-9 of the Ling Patent'858.

Claim 10 of Instant application	Claim 10 of Ling Patent'858
Limitation 1 : A system comprising: circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:	**Limitation 1 :** A system comprising: circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:
Limitation 2 : said processor is configured to determine, for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;	**Limitation 2 :** said processor is configured to determine, *for a plurality of cable modems* served by said CMTS, a corresponding plurality of signal-to-noise ratio (SNR) related metrics;
Limitation 3 : said processor is configured to assign each of said cable modems among a plurality of service groups based on a respective corresponding SNR-related metric;	**Limitation 3 :** said processor is configured to assign *said plurality of cable modems* among a plurality of service groups based on said plurality of SNR-related metrics;
Limitation 4 : said processor is configured to generate, for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups;	**Limitation 4 :** said processor is configured to generate, for each one of said plurality of service groups, a composite SNR-related metric based on a portion of said plurality of SNR-related metrics corresponding to said one of said plurality of service groups;
Limitation 5 : said processor is configured to select one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and	**Limitation 5 :** said processor is configured to select physical layer communication parameters to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
Limitation 6 : said network interface is configured to communicate with one or more cable modems corresponding to said one of said plurality of service groups using the one or more selected physical layer communication parameter.	**Limitation 6 :** said network interface is configured to communicate with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using the *selected physical layer communication parameters*

Claim 10 of Instant application	Claim 10 of Ling Patent'858
Limitation 7 : NONE	**Limitation 7 :** *wherein: each of said SNR-related metrics is signal-to-noise ratio (SNR) versus frequency profile; and said composite SNR related metric is a worst-case SNR versus frequency profile for said one of said plurality of service groups.*

In view of the above, it is clear that the conflicting claims are not patentably distinct from each other because claim 10 of the instant application merely broadens the scope of the claim 10 of the Ling Patent'858 eliminating the italicized and underlined portion of limitations 2, 3 and 6 of Ling Patent'858's claim 10 and by eliminating the entire limitation 7 of Ling Patent'858's claim 10.

Instant application	Ling Patent'858
Claim 11: The system of claim 10, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.	**Claim 11:** The system of claim 10, wherein said physical layer communication parameters include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.
Claim 12: The system of claim 10, wherein said network interface and said cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers.	**Claim 12:** The system of claim 10, wherein said network interface and said plurality of cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers.
Claim 13: The system of claim 12, wherein said network interface is configured such that at least one of said one or more physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.	**Claim 13:** The system of claim 12, wherein said network interface is configured such that said physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.
Claim 14: The system of claim 12, wherein said one or more physical layer communication parameter	**Claim 14:** The system of claim 12, wherein said physical layer communication parameters include one

Instant application	Ling Patent'858
includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.	or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.
Claim 15: The system of claim 10, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus frequency profile; said assignment of said each cable modem among said plurality of service groups comprises, for the particular cable modem: assignment of said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assignment of said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.	**Claim 15:** The system of claim 10, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a third cable modem has a particular SNR versus frequency profile; said assignment of said plurality of cable modems among said plurality of service groups comprises: assignment of said third cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assignment of said third cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.
Claim 16: The system of claim 10, wherein said processor is configured to assign said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.	**Claim 16:** The system of claim 10, wherein said processor is configured to assign said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems.
Claim 17: The system of claim 10, wherein said processor is configured to assign each of said cable modems among said plurality of service groups based on one or more branch amplifier	**Claim 17:** The system of claim 10, wherein said processor is configured to assign said plurality of cable modems among said plurality of service groups based on a branch further branch

Instant application	Ling Patent'858
that serves said each of said cable modems.	amplifier that serves each of said plurality of cable modems.
Claim 18: The system of claim 10, wherein said determination of said plurality of SNR-related metrics comprises: transmission, via said network interface, of a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and reception, via said network interface of said CMTS, of a metric reporting message from each cable modem.	**Claim 18:** The system of claim 10, wherein said determination of said plurality of SNR-related metrics comprises: transmission, via said network interface, of a probe message to each said plurality of cable modems, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and reception, via said network interface of said CMTS, of a metric reporting message from each of said plurality of cable modems.

In view of the above, the conflicting claims are not patentably distinct from each other because claims 11-18 of the instant application are merely similar to the scope of the claims 11-18 of the Ling Patent'858.

6. **Claims 1-18 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-18 of U.S. Patent No. 9,866,438 B2 to Ling et al.** *(hereafter refers as Ling Patent'438).* Although the claims at issue are not identical, they are not patentably distinct from each other for the reasons set forth below.

Regarding **claim 1**, although the claims at issue are not identical, they are not patentably distinct from each other because claim 1 of the instant application merely broadens the scope of the claim 1 of the Ling Patent'438 by eliminating the elements and their respective functions of the claims as set forth below.

Claim 1 of Instant application	Claim 1 of Ling Patent'438
Limitation 1 : A method comprising: determining, by a cable modem termination system (CMTS), for each	**Limitation 1 :** A method comprising: determining, by a cable modem termination system (CMTS), for *a plurality*

Claim 1 of Instant application	Claim 1 of Ling Patent'438
cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;	*of cable modems* served by said CMTS, a corresponding plurality of signal-to-noise ratio (SNR) related metrics;
Limitation 2 : assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;	**Limitation 2 :** assigning, by said CMTS, said *plurality of cable modems* among a plurality of service groups based on said plurality of SNR-related metrics;
Limitation 3 : generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups;	**Limitation 3 :** generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said plurality of SNR-related metrics corresponding to said one of said plurality of service groups;
Limitation 4 : selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and	**Limitation 4 :** selecting, by said CMTS, *physical layer communication parameters* to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
Limitation 5 : communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter.	**Limitation 5 :** communicating, by said CMTS, with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using said selected *physical layer communication parameters.*

In view of the above, it is clear that the conflicting claims are not patentably distinct from each other because claim 1 of the instant application merely broadens the scope of the claim 1 of the Ling Patent'438 by eliminating the italicized and underlined portion of limitations 1, 2, 4 and 5 of Ling Patent'438's claim 1.

Instant application	Ling Patent'438
Claim 10: The method of claim 1, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation	**Claim 2:** The method of claim 1, wherein said physical layer communication parameters include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order,

Instant application	Ling Patent'438
order, forward error correction (FEC) type, and FEC code rate.	forward error correction (FEC) type, and FEC code rate.
Claim 11: The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.	**Claim 3:** The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.
Claim 12: The method of claim 3, comprising selecting, by said CMTS, said one or more physical layer communication parameter on a per-OFDM-subcarrier basis.	**Claim 4:** The method of claim 3, comprising selecting, by said CMTS, said physical layer communication parameters on a per-OFDM-subcarrier basis.
Claim 13: The method of claim 4, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.	**Claim 5:** The method of claim 4, wherein said physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.
Claim 14: The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus frequency profile; and said assigning said each cable modem among said plurality of service groups comprises, for the particular cable modem: assigning said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assigning said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second	**Claim 6:** The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a third cable modem has a particular SNR versus frequency profile; and said assigning said plurality of cable modems among said plurality of service groups comprises: assigning said third cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assigning said third cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus

Instant application	Ling Patent'438
composite SNR versus frequency profile than to said first composite SNR versus frequency profile.	frequency profile than to said first composite SNR versus frequency profile.
Claim 15: The method of claim 1, comprising assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.	**Claim 7:** The method of claim 1, comprising assigning said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems.
Claim 16: The method of claim 1, comprising assigning any particular one of said cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.	**Claim 8:** The method of claim 1, comprising assigning any particular one of said plurality of cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.
Claim 17: The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises: transmitting a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and receiving a metric reporting message from each cable modem.	**Claim 9:** The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises: transmitting a probe message to each said plurality of cable modems, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and receiving a metric reporting message from each of said plurality of cable modems.

In view of the above, the conflicting claims are not patentably distinct from each other because claims 2-9 of the instant application are merely similar to the scope of the claims 2-9 of the Ling Patent'438.

Claim 10 of Instant application	Claim 10 of Ling Patent'438
Limitation 1 : A system comprising: circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:	**Limitation 1 :** A system comprising: circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:
Limitation 2 : said processor is configured to determine, for each cable modem served by said CMTS, a	**Limitation 2 :** said processor is configured to determine, *for a plurality of cable modems* served by said

Claim 10 of Instant application	Claim 10 of Ling Patent'438
corresponding signal-to-noise ratio (SNR) related metric;	CMTS, a corresponding plurality of signal-to-noise ratio (SNR) related metrics;
Limitation 3 : said processor is configured to assign each of said cable modems among a plurality of service groups based on a respective corresponding SNR-related metric;	**Limitation 3 :** said processor is configured to assign *said plurality of cable modems* among a plurality of service groups based on said plurality of SNR-related metrics;
Limitation 4 : said processor is configured to generate, for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups;	**Limitation 4 :** said processor is configured to generate, for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR of said plurality of SNR-related metrics corresponding to said one of said plurality of service groups;
Limitation 5 : said processor is configured to select one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and	**Limitation 5 :** said processor is configured *to select physical layer communication parameters* to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
Limitation 6 : said network interface is configured to communicate with one or more cable modems corresponding to said one of said plurality of service groups using the one or more selected physical layer communication parameter.	**Limitation 6 :** said network interface is configured to communicate with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using the *selected physical layer communication parameters.*

In view of the above, it is clear that the conflicting claims are not patentably distinct from each other because claim 10 of the instant application merely broadens the scope of the claim 10 of the Ling Patent by eliminating the italicized and underlined portion of limitations 2, 3, 5 and 6 of Ling Patent'438's claim 10.

Instant application	Ling Patent'438
Claim 11: The system of claim 10, wherein said one or more physical layer communication parameter	**Claim 11:** The system of claim 10, wherein said physical layer communication parameters include one

Instant application	Ling Patent'438
includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.	or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.
Claim 12: The system of claim 10, wherein said network interface and said cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers.	**Claim 12:** The system of claim 10, wherein said network interface and said plurality of cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers.
Claim 13: The system of claim 12, wherein said network interface is configured such that at least one of said one or more physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.	**Claim 13:** The system of claim 12, wherein said network interface is configured such that said physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.
Claim 14: The system of claim 12, wherein said one or more physical layer communication parameter includes one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.	**Claim 14:** The system of claim 12, wherein said physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.
Claim 15: The system of claim 10, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a particular cable modem has a particular SNR versus frequency profile; said assignment of said each cable modem among said plurality of service groups comprises, for the particular cable modem: assignment of said particular cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first	**Claim 15:** The system of claim 10, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a third cable modem has a particular SNR versus frequency profile; said assignment of said plurality of cable modems among said plurality of service groups comprises: assignment of said third cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus

Instant application	Ling Patent'438
composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assignment of said particular cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.	frequency profile than to said second composite SNR versus frequency profile; and assignment of said third cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.
Claim 16: The system of claim 10, wherein said processor is configured to assign said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.	**Claim 16:** The system of claim 10, wherein said processor is configured to assign said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems.
Claim 17: The system of claim 10, wherein said processor is configured to assign each of said cable modems among said plurality of service groups based on one or more branch amplifier that serves said each of said cable modems.	**Claim 17:** The system of claim 10, wherein said processor is configured to assign said plurality of cable modems among said plurality of service groups based on a branch further branch amplifier that serves each of said plurality of cable modems.
Claim 18: The system of claim 10, wherein said determination of said plurality of SNR-related metrics comprises: transmission, via said network interface, of a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and reception, via said network interface of said CMTS, of a metric reporting message from each cable modem.	**Claim 18:** The system of claim 10, wherein said determination of said plurality of SNR-related metrics comprises: transmission, via said network interface, of a probe message to each said plurality of cable modems, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and reception, via said network interface of said CMTS, of a metric reporting message from each of said plurality of cable modems.

In view of the above, the conflicting claims are not patentably distinct from each other because claims 11-18 of the instant application are merely similar to the scope of the claims 11-18 of the Ling Patent'438.

It has been held that the omission an element and its function is an obvious expedient if the remaining elements perform the same function as before. *In re Karlson*, 136 USPQ 184 (CCPA). Also note *Ex parte Rainu*, 168 USPQ 375 (Bd.App.1969); omission of a reference element whose function is not needed would be obvious to one skilled in the art. Moreover, the doctrine of double patenting seeks to prevent the unjustified extension of patent exclusivity beyond the term of a patent.

Allowable Subject Matter

7. **Claims 1-18 would be allowable** if overcome the rejections **on the ground of nonstatutory double patenting** set forth in this Office action.

8. The following is an examiner's statement of reasons for allowance:

Claims 1-18 are allowed over the prior arts, since the prior arts taken individually or in combination fail to particular disclose, fairly suggest, or render obvious the following under limitation:

In claims 1 and 10, "...*a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups*...." in combination with other limitations recited in the claims.

Noted that the **first closes prior art US Patent 8,743,933 B2** to Prodan et al. *(hereafter refers as Prodan)*, teaches a method *(a method for allocating frequency spectrum and modulation scheme for each of the cable modems, see abstract)* comprising:

determining, by a cable modem termination system (CMTS) *(the method is performed by a cable modem termination system, CMTS, col. 7, lines 10-15 and col. 8, lines 4-9)*, for a plurality of cable modems served by said CMTS *(determining for each of the cable modems, CMs, connected to the CMTS, col. 4, lines 56-62)*, a corresponding plurality of signal-to-noise ratio (SNR) related metrics *(SNR vs. frequency profile for each of the CMs, col. 3, lines 50-55, col. 4, lines 56-62, col. 7, lines 10-22)*;

assigning, by said CMTs, said plurality of cable modems among a plurality of service groups based on said plurality of SNR-related metrics *(assigning each of plurality of CMs into one of the categories based on the plurality of SNR vs. frequency profiles and **a SNR profile** of each of the categories, col. 5, lines 5-20, col. 7, lines 10-20 and Fig. 2, 5)*;

generating, by said CMTS for each one of said plurality of service groups, a composite SNR related metric corresponding to said one of said plurality of service groups *(the CMTS retrieves SNR profile for each of the categories, col. 5, lines 10-20, and Fig. 5)*;

selecting, by said CMTS, physical layer communication parameters to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric *(assigning each of the plurality of cable modems, a respective modulation scheme and frequency spectrum to be used, based on SNR vs. frequency profile of the assigned group, Fig. 4, col. 5, lines 5-20 and col. 7, lines 23-54)*; and

communicating, by said CMTS, with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using said selected

physical layer communication parameters *(the CMTS/headend assigns a respective frequency allocation based on category of each of the CMs to each of the CMs, col. 5, lines 50-67, col. 7, lines 23-45, thereby enable the CMTS/headend to communicate with each of the CMs based on the frequency allocation to each of the CMs, col. 7, lines 23-45)*.

Thus, Prodan teaches a conventional technique of selecting physical layer communication parameters to each of the plural of cable modems based on SNR profile(s). However, Prodan does not teach a composite SNR-related metric based "**at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups**". Therefore, Prodan does not teach the underlined limitation above when such limitation is incorporated with other limitations of the independent claims.

Noted that the **second closest prior art US 2009/0219856 A1 to Richardson et al.** *(hereafter refers as Richardson)* teaches a method comprising:

determining, by a modem termination system *(AP, Fig. 2, access point 200)*, for a plurality of terminals served by the modem, a corresponding plurality of signal-to-noise ratio (SNR) related metrics *(the AP determines for each of the terminal served by the AP, Fig. 5A, a corresponding SNR value, paragraph [0043])*;

assigning, by said modem termination system, said plurality of terminals among a plurality of service groups based on said plurality of SNR-related metrics *(the AP assigns each of the terminals to a corresponding group based on the average SNR value of each group, paragraphs [0070, 0074] and claim 24)*; and

generating, by said modem termination system, a composite SNR related metric **based on a portion of said plurality of SNR related metrics corresponding to a particular group** *(the AP retrieves an average SNR value for each group, paragraphs [0070, 0074] and claim 24, thus the average SNR value of a group is based on a plurality of SNR values for each of the terminals in the group).*

However, Richardson does not teach that the composite SNR related metric based "**at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups**". Therefore, Richardson does not teach the underlined limitation above when such limitation is incorporated with other limitations of the independent claims.

In view of the foregoing, **Prodan and Richardson**, when taken individually or in combination fail to particular disclose, fairly suggest, or render obvious the underlined limitations when such limitation is incorporated with other limitations of the base claims. Hence, **Claims 1-18 are allowable over the prior arts.**

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DUNG B. HUYNH whose telephone number is (571)270-7642. The examiner can normally be reached on M-F 9:00 AM - 6:00 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an

interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ian N. Moore can be reached on 571-272-3085. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/DUNG B HUYNH/
Primary Examiner, Art Unit 2469
March 29, 2018

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	17956889
	Filing Date	2022-09-30
	First Named Inventor	Madhukar Reddy
	Art Unit	
	Examiner Name	
	Attorney Docket Number	28427US16

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	Attorney Docket Number	28427US16

	1	ENTROPIC COMMUNICATIONS, LLC, v. CHARTER COMMUNICATIONS, INC., Civil Action No. 2:22-cv-00125-JRG PLAINTIFF'S OPENING CLAIM CONSTRUCTION BRIEF, May 9, 2023.	☐
	2	ENTROPIC COMMUNICATIONS, LLC, v. CHARTER COMMUNICATIONS, INC., Civil Action No. 2:22-cv-00125-JRG CHARTER'S RESPONSIVE CLAIM CONSTRUCTION BRIEF, May 23, 2023.	☐
	3	ENTROPIC COMMUNICATIONS, LLC, v. CHARTER COMMUNICATIONS, INC., Civil Action No. 2:22-cv-00125-JRG PLAINTIFF'S REPLY CLAIM CONSTRUCTION BRIEF, May 30, 2023.	☐
	4	ENTROPIC COMMUNICATIONS, LLC, v. CHARTER COMMUNICATIONS, INC., Civil Action No. 2:22-cv-00125-JRG REBUTTAL EXPERT DECLARATION OF RICHARD A. KRAMER PH.D. REGARDING CLAIM CONSTRUCTION, June 12, 2023.	☐
	5	ENTROPIC COMMUNICATIONS, LLC, v. CHARTER COMMUNICATIONS, INC., Civil Action No. 2:22-cv-00125-JRG CLAIM CONSTRUCTION MEMORANDUM OPINION AND ORDER, June 26, 2023.	☐

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	Filing Date	2022-09-30
	First Named Inventor	Madhukar Reddy
	Art Unit	
	Examiner Name	
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Signature	/Wayne H. Bradley/	Date (YYYY-MM-DD)	2023-08-18
Name/Print	Wayne H. Bradley	Registration Number	39916

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CHICAGO, IL 60661

EXAMINER
JACKSON, BLANE J

ART UNIT	PAPER NUMBER
2644	

DATE MAILED: 08/28/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/956,889	09/30/2022	Madhukar Reddy	28427US16	8470

TITLE OF INVENTION: SYSTEM AND METHOD FOR RECEIVING A TELEVISION SIGNAL

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	11/28/2023

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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/956,889	09/30/2022	Madhukar Reddy	28427US16	8470

TITLE OF INVENTION: SYSTEM AND METHOD FOR RECEIVING A TELEVISION SIGNAL

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	11/28/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
JACKSON, BLANE J	2644	348-731000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via Patent Center or EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/956,889	09/30/2022	Madhukar Reddy	28427US16	8470

23446 7590 08/28/2023

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER	
JACKSON, BLANE J	
ART UNIT	PAPER NUMBER
2644	

DATE MAILED: 08/28/2023

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 17/956,889	Applicant(s) Reddy et al.	
	Examiner BLANE J JACKSON	Art Unit 2644	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the RCE filed 16 Auguat 2023.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 19-38 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/BLANE J JACKSON/
Primary Examiner, Art Unit 2644

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 18 August 2023 has been entered.

Allowable Subject Matter

Claims 19-38 are allowed. The prior art comprising Information Disclosure Statements filed 16 August 2023 and 18 August 2023 was considered by the Examiner in view of the instant application. Although the prior art is from the applicant's other patents, i.e. US 8223,775, as part of Entropic Communications, LLC, the applicant, v. Charter communications, Inc. Civil Action and Entropic Communications, LLC v. DirectTV, LLC and Dish Network Corp., Civil Action, the prior art was related to a cable modem system and architecture but not as claimed in the instant application.

The following is a statement of reasons for the indication of allowable subject matter: the prior art made of record teach a receiver for a wireless telecommunication system teach all of the adjacent frequency bands in the IF signal passed by a band pass filter in the radio frontend are converted to a digital signal by an ADC and then separated into their respective frequency bands by a channelizer where the separated frequency bands are processed in the normal manner by subsequent DSP devices, see Claxton et al. US 6,735,421. The prior art made of record do not teach selecting, by a digital frontend (DFE) coupled to the ADC, a plurality of desired channels from the digitized signal and outputting by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BLANE J JACKSON whose telephone number is (571)272-7890. The examiner can normally be reached 7:30-4:30 M-TH; 8-2 FRI.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kathy Wang-Hurst can be reached on 571 270 5371. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BLANE J JACKSON/
Primary Examiner, Art Unit 2644

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/956,889	Reddy et al.
	Examiner	**Art Unit**
	BLANE J JACKSON	2644

CPC						
Symbol					**Type**	**Version**
H04N	/	21	/	4263	F	2013-01-01
H04B	/	1	/	0014	I	2013-01-01
H04N	/	5	/	50	I	2013-01-01
H04N	/	21	/	4383	I	2013-01-01
H04N	/	21	/	454	I	2013-01-01
H04N	/	21	/	6193	I	2013-01-01
H04N	/	21	/	6143	I	2013-01-01
H04N	/	5	/	455	I	2013-01-01
H04N	/	21	/	4382	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE (Assistant Examiner) (Date)		**Total Claims Allowed:** 20	
/Blane J Jackson/ (Primary Examiner)	23 August 2023 (Date)	O.G. Print Claim(s) 19	O.G. Print Figure 2

U.S. Patent and Trademark Office Part of Paper No.: 20230823

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/956,889	Reddy et al.
	Examiner	**Art Unit**
	BLANE J JACKSON	2644

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04B	/	1	/	16
H04N	/	21	/	426

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 20	
/Blane J Jackson/ (Primary Examiner) 23 August 2023 (Date)	O.G. Print Claim(s) 19	O.G. Print Figure 2

U.S. Patent and Trademark Office Part of Paper No.: 20230823

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/956,889	Reddy et al.
	Examiner	**Art Unit**
	BLANE J JACKSON	2644

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10	1	19	10	28	19	37						
	2		11	2	20	11	29	20	38						
	3		12	3	21	12	30								
	4		13	4	22	13	31								
	5		14	5	23	14	32								
	6		15	6	24	15	33								
	7		16	7	25	16	34								
	8		17	8	26	17	35								
	9		18	9	27	18	36								

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/Blane J Jackson/	23 August 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	19	2

U.S. Patent and Trademark Office — Part of Paper No.: 20230823

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/956,889	Reddy et al.
	Examiner	Art Unit
	BLANE J JACKSON	2644

CPC - Searched*		
Symbol	Date	Examiner
H04B 1/001, 1/16, 1/0014	04/25/2023	BJJ
H04N 5/455, 21/41, 21/426, 21/4263	04/25/2023	BJJ

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Review of IDS & prior parent patents, DP with US 11,490,152 to FAOM	04/25/2023	BJJ
Review of TD, update SEARCH to issue	07/31/2023	BJJ
Review of IDS in RCE to issue	08/23/2023	BJJ

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	no interference listed symbol/ group	07/31/2023	BJJ

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	2	"11490152".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/25 11:20 AM
L2	2	"11399206".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/25 11:32 AM
L3	2	"10972781".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/25 11:34 AM
L4	8	"10313733".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/04/25 11:35 AM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L5	5	"9819992".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/25 11:37 AM
L6	8	"9210363".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/25 11:39 AM
L7	22	"9100622".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2023/04/25 11:40 AM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L8	3	"8526898".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/25 11:41 AM
L9	56	("10313733" OR "10972781" OR "11381866" OR "20030158614" OR "20030228855" OR "20040058661" OR "20040110522" OR "20050040909" OR "20050286562" OR "20070002961" OR "20070032220" OR "20070042742" OR "20070111661" OR "20070179649" OR "20070263754" OR "20090075613" OR "20090258629" OR "20110105068" OR "5280636" OR "5590156" OR "5705949" OR "5768268" OR "6253094" OR "6262981" OR "6282184" OR "6735421" OR "6760342" OR "6906498" OR "6920185" OR "6992855" OR "7095454" OR "7145972" OR "7167694" OR "7362178" OR "7373125" OR "7421259" OR "7599673" OR "8107916" OR	(US-PGPUB; USPAT)	OR	ON	ON	2023/04/25 11:44 AM

		"8285240" OR "8300681" OR "8331886" OR "8374568" OR "8374569" OR "8374570" OR "8526898" OR "8577319" OR "8666350" OR "8892225" OR "8909187" OR "9059672" OR "9100622" OR "9210362" OR "9210363" OR "9225373" OR "9819992" OR "9942598").pn.					
L10	81	Reddy-Madhukar.in.	(US-PGPUB; USPAT)	OR	ON	ON	2023/04/25 12:20 PM
L11	103	Reddy-Madhukar.in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/25 12:20 PM
L12	46	Reddy-Madhukar.in. AND DFE	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/25 12:21 PM
L13	938	Ling-Curtis.in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,	OR	ON	ON	2023/04/25 12:22 PM

			EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L14	81	Ling-Curtis.in. AND DFE	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/25 12:22 PM
L15	27	Gallagher-Tim.in. AND DFE	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/25 12:23 PM
L16	2	("7130576" OR "7542715").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/04/25 12:25 PM
L17	4	("20070098089" OR "6704372" OR "7265792" OR "7522901").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/08/23 09:19 AM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-22)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	17956889
Filing Date	2022-09-30
First Named Inventor	Madhukar Reddy
Art Unit	
Examiner Name	
Attorney Docket Number	28427US16

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6704372		2004-03-09	Zhang et al.	
	2	7265792		2007-09-04	Favrat et al.	
	3	7522901		2009-04-21	Dauphinee	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070098089		2007-05-03	Li et al.	

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	1							

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	2022-09-30
	First Named Inventor	Madhukar Reddy
	Art Unit	
	Examiner Name	
	Attorney Docket Number	28427US16

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
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EXAMINER SIGNATURE			
Examiner Signature	/BLANE J JACKSON/	Date Considered	08/22/2023

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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	First Named Inventor	Madhukar Reddy
	Art Unit	
	Examiner Name	
	Attorney Docket Number	28427US16

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Wayne H. Bradley/	Date (YYYY-MM-DD)	2023-08-16
Name/Print	Wayne H. Bradley	Registration Number	39916

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
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Application Number	17956889
Filing Date	2022-09-30
First Named Inventor	Madhukar Reddy
Art Unit	
Examiner Name	
Attorney Docket Number	28427US16

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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17/956,889 - GAU: 2644

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	Application Number	17956889
	Filing Date	2022-09-30
	First Named Inventor	Madhukar Reddy
	Art Unit	
	Examiner Name	
	Attorney Docket Number	28427US16

	1	ENTROPIC COMMUNICATIONS, LLC, v. CHARTER COMMUNICATIONS, INC., Civil Action No. 2:22-cv-00125-JRG PLAINTIFF'S OPENING CLAIM CONSTRUCTION BRIEF, May 9, 2023.	☐
	2	ENTROPIC COMMUNICATIONS, LLC, v. CHARTER COMMUNICATIONS, INC., Civil Action No. 2:22-cv-00125-JRG CHARTER'S RESPONSIVE CLAIM CONSTRUCTION BRIEF, May 23, 2023.	☐
	3	ENTROPIC COMMUNICATIONS, LLC, v. CHARTER COMMUNICATIONS, INC., Civil Action No. 2:22-cv-00125-JRG PLAINTIFF'S REPLY CLAIM CONSTRUCTION BRIEF, May 30, 2023.	☐
	4	ENTROPIC COMMUNICATIONS, LLC, v. CHARTER COMMUNICATIONS, INC., Civil Action No. 2:22-cv-00125-JRG REBUTTAL EXPERT DECLARATION OF RICHARD A. KRAMER PH.D. REGARDING CLAIM CONSTRUCTION, June 12, 2023.	☐
	5	ENTROPIC COMMUNICATIONS, LLC, v. CHARTER COMMUNICATIONS, INC., Civil Action No. 2:22-cv-00125-JRG CLAIM CONSTRUCTION MEMORANDUM OPINION AND ORDER, June 26, 2023.	☐

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EXAMINER SIGNATURE

Examiner Signature	/BLANE J JACKSON/	Date Considered	08/22/2023

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	First Named Inventor	Madhukar Reddy
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	Examiner Name	
	Attorney Docket Number	28427US16

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

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Signature	/Wayne H. Bradley/	Date (YYYY-MM-DD)	2023-08-18
Name/Print	Wayne H. Bradley	Registration Number	39916

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CC: patentcenter_eofficeaction@uspto.gov
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Mon Aug 28 05:56:31 EDT 2023

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Application	Document	Mailroom Date	Attorney Docket No.
17956889	NOA	08/28/2023	28427US16
17956889	1449	08/28/2023	28427US16
17956889	1449	08/28/2023	28427US16

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23446 7590 08/28/2023
MCANDREWS HELD & MALLOY, LTD
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Wayne H. Bradley	(Typed or printed name)
/Wayne H. Bradley/	(Signature)
September 5, 2023	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/956,889	09/30/2022	Madhukar Reddy	28427US16	8470

TITLE OF INVENTION: SYSTEM AND METHOD FOR RECEIVING A TELEVISION SIGNAL

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	11/28/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
JACKSON, BLANE J	2644	348-731000

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❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

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(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
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1 McAndrews, Held & Malloy, Ltd.
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Entropic Communications, LLC

(B) RESIDENCE: (CITY and STATE OR COUNTRY): New York, NY

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via Patent Center or EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 13-0017

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Wayne H. Bradley/ Date September 5, 2023

Typed or printed name Wayne H. Bradley Registration No. 39,916

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/956,889	**09/05/2023 04:11:24 PM ET**	**28427US16**

Title of Invention

SYSTEM AND METHOD FOR RECEIVING A TELEVISION SIGNAL

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8470	FILED BY	Laura Foley
PATENT CENTER #	62736287	FILING DATE	09/30/2022
CUSTOMER #	23446	FIRST NAMED INVENTOR	Madhukar Reddy
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Wayne Bradley

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
28427US16_Comments_on_Reasons_for_Allowance.pdf	2	Post Allowance Communication - Incoming	21 KB
28427US16_issue_fee_transmittal.pdf	1	Issue Fee Payment (PTO-85B)	292 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
28427US16_Comments_on_Reasons_for_Allowance.pdf	22799F10D5158465D8742E7CAF0E2C8DA5F1E6930B6EF43E1690ADABA22BB74181A8504C37B3818F7C147860010FD658E7F

	858067F99B17EC8CD25A3D292311C
28427US16_issue_fee_transmittal.pdf	63669E44ED745D9D2529DCC495C42175C776B05014D94A45476ED3EAE687A011D1EC2F3D4D9D490F799F7189EFCDB313D36D4AE759C30DE0790531E2F281CC76

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No.: 28427US16

Patent Application of:

Madhukar Reddy

Application No. 17/956,889

Filed: September 30, 2022

Title: SYSTEM AND METHOD FOR RECEIVING A TELEVISION SIGNAL

Examiner: JACKSON, BLANE J.

Group Art Unit: 2644

Confirmation No.: 8470

Filed electronically on September 5, 2023

COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE

Mail Stop: Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This paper responds to the Notice of Allowance mailed August 28, 2023 in the above-identified application (the "Application"). Applicants respectfully request entry of the following remarks in the record.

REMARKS

Claims 19-38 are allowed in the Notice of Allowance mailed on August 28, 2023. The Applicant thanks the Examiner for positive consideration of the claim.

However, during the course of prosecution of the Application the Examiner may have provided various reasons for allowing claims 19-38. The Applicants do not agree or disagree at this time with those reasons, but respectfully reserve the right to support or traverse those reasons should the need arise, and argue different reasons for the allowability of the claims.

Respectfully submitted,

Dated: September 5, 2023

/Wayne H. Bradley/
Wayne H. Bradley
Reg. No. 39,916

McAndrews, Held & Malloy, Ltd.
500 W. Madison Street
34th Floor
Chicago, Il 60661
Phone (312) 775-8000
Fax (312) 775-8100

UNITED STATES
PATENT AND TRADEMARK OFFICE

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/956,889	09/05/2023 04:11:24 PM ET	28427US16

Title of Invention

SYSTEM AND METHOD FOR RECEIVING A TELEVISION SIGNAL

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8470	FILED BY	Laura Foley
PATENT CENTER #	62736287	AUTHORIZED BY	Wayne Bradley
CUSTOMER #	23446	FILING DATE	09/30/2022
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Madhukar Reddy

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 9661	E202395G12099318	Laura Foley

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
130017	37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1501	UTILITY ISSUE FEE	1200.00	1	1200.00
			TOTAL AMOUNT:	$1,200.00

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New Applications Under 35 U.S.C. 111

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Receipt will establish the filing date of the application

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New International Application Filed with the USPTO as a Receiving Office

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/956,889	10/10/2023	11785275	28427US16	8470

23446 7590 09/20/2023

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

Madhukar Reddy, Carlsbad, CA;
Curtis Ling, Carlsbad, CA;
Tim Gallagher, Carlsbad, CA;

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

Entropic Communications, LLC, New York, NY;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

TO: mhmpto@mcandrews-ip.com
FROM: noreply@uspto.gov
CC: patentcenter_eofficeaction@uspto.gov
SUBJECT: USPTO: Patent Electronic System - Correspondence Notification for Customer Number 23446

Thu Sep 21 05:34:34 EDT 2023

Dear Patent Center Customer:

Correspondence Address:

MCANDREWS HELD &MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO,ILLINOIS,60661
UNITED STATES

This is a courtesy notification regarding the following USPTO patent application(s) associated with your Customer Number, 23446, that have new outgoing correspondence. This correspondence is now available for viewing in Patent Center.

The official date of notification of the outgoing correspondence will be indicated on the form (e.g., PTOL-90) accompanying the correspondence.

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Application	Document	Mailroom Date	Attorney Docket No.
17956889	ISSUE.NTF	09/20/2023	28427US16

To view your correspondence online, please sign in to Patent Center and then select Workbench/View correspondence. To update your email address(es), select Manage/Manage customer numbers.

If you have any questions, please contact the Patent Electronic Business Center (EBC) at ebc@uspto.gov or 866-217-9197 Monday – Friday, 6 a.m. to midnight ET.

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Sincerely,

The Patent Center Team

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/956,889	09/30/2022	Madhukar Reddy	28427US16	8470

23446 7590 10/10/2023

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER	
JACKSON, BLANE J	

ART UNIT	PAPER NUMBER
2644	

NOTIFICATION DATE	DELIVERY MODE
10/10/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mhmpto@mcandrews-ip.com

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United States Patent and Trademark Office
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APPLICATION NO.	ISSUE DATE	PATENT NO.
17/956,889	10-Oct-2023	11785275

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
CHICAGO, IL 60661

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

TO: mhmpto@mcandrews-ip.com
FROM: noreply@uspto.gov
CC: patentcenter_eofficeaction@uspto.gov
SUBJECT: USPTO: Patent Electronic System - eGrant Notification for Customer Number 23446

Tue Oct 10 16:38:42 EDT 2023

Dear Patent Center Customer:

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Application	Patent	Document	Mailroom Date	Attorney Docket No.
17956889	11785275	EGRANT.NTF	10/10/2023	28427US16

To examine your eGrant online, please access Patent Center then search using the listed application or patent number. To download, click on the eGrant link on the left-hand menu or select the "Download eGrant" link on the Application data page.

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