

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MOTOROLA SOLUTIONS, INC.,

Petitioner,

v.

STA GROUP LLC,

Patent Owner.

IPR2023-01293

U.S. Patent No.: 8,489,134 B2

**DECLARATION OF DR. SAYFE KIAEI IN SUPPORT OF PETITION
FOR *INTER PARTES* REVIEW OF CLAIMS 1-14 OF U.S. PATENT
NO. 8,489,134 B2**

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PETITIONER’S EXHIBIT LIST

Ex[No.]¹	Description of Documents
1001	U.S. Patent No. 8,489,134 (“’134 patent”)
1002	Declaration of Dr. Sayfe Kiaei in Support of Petition for <i>Inter Partes</i> Review of the ’134 Patent, with CV attached as Appendix A (“Kiaei Decl.”)
1003	Prosecution File History of the ’134 Patent (“’134 patent file history”)
1004	<i>Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP Interworking over Satellite; Multicasting</i> , ETSI TR 102 156 v1.1.1 (published April 2003) (“ETSI-156”)
1005	ETSI, Publicly Available Specifications (PAS), https://www.etsi.org/images/files/Brochures/ETSI-Brochure-PAS.pdf (last accessed August 3, 2023)
1006	<i>Resource ReSerVation Protocol (RSVP) – Version 1 Functional Specification</i> by Braden et. al. (published September 1997) (“RFC-2205”)
1007	U.S. Patent Publication 2006/0268824 (published November 30, 2006) (“Dhesikan”)
1008	U.S. Patent Publication 2005/0248652 (published November 10, 2005) (“Firestone”)

¹ Citations to issued patents (Exhibits 1001, 1030, and 1034) are made by column and line number. Citations to patent application publications (Exhibits 1007-1009, 1026-1027, and 1031) are made by paragraph number. Citations to Exhibit 1002 and 1016 are made by paragraph number. Citations to Exhibits 1004-1006, 1011-1013, 1019-1020, 1022-1025, 1033, 1035, and 1037 are to the original page numbering in the exhibits. Citations to Exhibits 1003, 1010, 1014-1015, 1017-1018, 1021, 1028-1029, 1032, and 1036 are to the page number added by the exhibit label.

Ex[No.] ¹	Description of Documents
1009	U.S. Patent Publication 2007/0036118 (published February 15, 2007) (“Shaffer”)
1010	RFC-Editor, Publication Process, https://www.rfc-editor.org/pubprocess/ (last accessed August 3, 2023)
1011	<i>Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP Interworking over satellite; Performance, Availability and Quality of Service</i> , ETSI TR 102 157 v1.1.1 (published July 2003) (“ETSI-157”)
1012	<i>Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP over Satellite</i> , ETSI TR 101 985 v1.1.2 (published November 2002) (“ETSI-985”)
1013	<i>RTP: A Transport Protocol for Real-Time Applications</i> by Schulzrinne et al. (published July 2003) (“RFC 3550”)
1014	<i>The BGAN Extension Programme</i> , The European Space Agency (ESA) Bulletin 124 (Nov. 2005) (“BGAN”)
1015	Web archive for <i>The BGAN Extension Programme</i> , https://web.archive.org/web/20061009113656/https://www.esa.int/esapub/bulletin/bulletin124/bul124j_rivera.pdf (Oct. 9, 2006)
1016	Declaration of Dr. Sylvia Hall-Ellis
1017	ETSI, <i>Technical Committee (TC) Satellite Earth Stations and Systems (SES)</i> , https://www.etsi.org/committee/1412-ses (last accessed Aug. 3, 2023)
1018	Docket Control Order, <i>STA Group LLC v. Motorola Solutions, Inc.</i> , No. 2:22-CV-0381-JRG-RSP, Dkt. 35 (E.D. Tex. Feb. 3, 2023)
1019	Sastri L. Kota, <i>Broadband Satellite Networks: Trends and Challenges</i> , IEEE Wireless Communications and Networking Conference, Vol. 3, pp. 1472-78 (2005) (“Kota”)
1020	Eylem Ekici et al., <i>A Multicast Routing Algorithm for LEO Satellite IP Networks</i> , IEEE/ACM Transactions on Networking, Vol. 10, No. 2, pp. 183-92 (2002) (“Ekici”)

Ex[No.] ¹	Description of Documents
1021	Jiangchuan Liu et al., <i>Adaptive Video Multicast over the Internet</i> , IEEE MultiMedia, Vol. 10, No. 1, pp. 22-33, (2003) (“Liu”)
1022	Plaintiff’s First Amended Disclosure of Asserted Claims and Infringement Contentions and Document Production Accompanying Disclosure Pursuant to P.R. 3-1 & 3-2, <i>STA Group LLC v. Motorola Solutions, Inc.</i> , No. 2:22-CV-0381-JRG-RSP (E.D. Tex. June 15, 2023).
1023	<i>Host Extensions for IP Multicasting</i> by Deering (published August 1989) (“RFC-1112”)
1024	<i>Internet Group Management Protocol, Version 3</i> by Cain et al. (published October 2002) (“RFC-3376”)
1025	<i>Protocol Independent Multicast – Sparse Mode (PIM-SM): Protocol Specification (Revised)</i> by Fenner et al. (published August 2006) (“RFC-4601”)
1026	U.S. Patent Publication 2005/0047582 (published March 3, 2005) (“Shaffer”)
1027	U.S. Patent Publication 2005/0086302 (published April 21, 2005) (“Aggarwal”)
1028	Celestri Multimedia LEO System, Federal Communications Commission Filing (June 1997) (“Celestri”)
1029	Iridium System Application, Federal Communications Commission Filing (December 3, 1990) (“Iridium”)
1030	U.S. Patent 6,104,925 (issued August, 15, 2000) (“Grube”)
1031	U.S. Patent Publication 2005/0021726 (published January 27, 2005) (“Denoual”)
1032	<i>Comparisons of Conventional and Trunked Systems</i> , Public Safety Wireless Network, May 1999
1033	<i>Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; Part 1: Survey on Standardization Objectives</i> , ETSI TR 101 374-1 v1.2.1 (published October 1998) (“ETSI-374”)
1034	U.S. Patent No. 6,477,150 (issued Nov. 5, 2002) (“Maggenti”)
1035	Wayback Machine capture of <i>Resource ReSerVation Protocol (RSVP) – Version 1 Functional Specification</i> by Braden et. al. (published September 1997) (“RFC-2205”) from October 10, 2004
1036	Parties’ Local P.R. 4-2 Disclosure of Preliminary Proposed Constructions of Claim Terms and Preliminary Identification of Extrinsic Evidence

Ex[No.] ¹	Description of Documents
1037	Katherine K. Vidal, <i>Memorandum: Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation</i> (June 21, 2022)

I, Dr. Sayfe Kiaei, declare as follows:

I. INTRODUCTION

1. I am a professor at Arizona State University, and I have been retained on behalf of Motorola Solutions, Inc. (“MSI” or “Petitioner”) as an independent consultant in connection with the above-captioned *inter partes* review (“IPR”) of Claims 1-14 of U.S. Patent No. 8,489,134 (the “’134 patent” or “Challenged Patent”), entitled “System and Method for Providing Presence Based Trunking in a Network Environment,” by named inventors Zeeshan Khan, Keith Edmund O’Brien, and Shmuel Shaffer. I understand that the ’134 patent is assigned to STA Group LLC (the “Patent Owner”). I have been asked to provide technical review, analysis, insights, and opinions regarding the ’134 patent and the prior art references that form the basis for the grounds of invalidity set forth in the Petition for *Inter Partes* Review of the ’134 patent (the “Petition”). I have been asked to provide a declaration regarding my opinions on the validity of Claims 1-14 of the ’134 patent.

2. This declaration sets forth the opinions I have formed and provides the bases and reasons for those opinions. This declaration is based on information currently available to me. All of my opinions stated in this declaration are based on my own personal knowledge and professional judgment, and I declare that I have personal knowledge of the facts set forth in this declaration and, if called to testify as a witness, could and would do so competently. In forming my opinions, I have

relied on my education, experience, and knowledge. A copy of my current curriculum vitae, which details my education and professional and academic experience, is included as Appendix A to this declaration.

3. I am being compensated at my usual consulting rate of \$475 per hour for my work on this matter. I am also being reimbursed for any incurred expenses. My compensation is in no way dependent upon my opinions or testimony or the outcome of this proceeding.

II. PROFESSIONAL BACKGROUND AND QUALIFICATIONS

4. The following provides an overview of some of my experience that is relevant to the matters set forth in this declaration.

5. I received my Ph.D. in Electrical and Computer Engineering from Washington State University in 1987. I have several patents and over 100 journal and international conference publications. I have graduated over 70 MS and PhD students working under my supervision on their thesis, and many of them are professors in academia or have senior positions in industry. My research is funded by various sources, including industry and federal agencies, such as NSF, USAID, DARPA, JPL, and NASA.

6. Since 2001, I have held the position of Motorola² Endowed Chair Professor in Analog and Radio Frequency Integrated Circuitry at the School of Electrical, Computer, and Energy Engineering at Arizona State University (“Arizona State”) in Tempe, Arizona.

7. I am also the Director of the National Science Foundation Center, Connection One. Connection One is a research center focused on developing wireless communication system and networking technologies.

8. I have been involved in research, teaching, and developing products in the areas of communications, networking, wireless systems, satellite systems, analog and digital circuits, linear and switching power management integrated circuits (PMIC), sensors, electronics, and related areas for the last 30 years.

9. From 1987 to 1993, I was an assistant/associate professor at Oregon State University (“Oregon State”).

10. From 1997 to 2002, I was also an adjunct professor at the University of Texas at Austin.

² This position refers to a historical endowment established in 1998 for supporting communication, manufacturing, and supply chain programs at Arizona State. The objective of this endowment was to strengthen Arizona State’s capabilities in these technologies. Three other Arizona State professors have this endowment title in manufacturing, communication, and supply management. I do not receive any funding from Motorola and have not since I joined Arizona State.

11. At Oregon State, the University of Texas, and Arizona State, I taught courses in the areas of communication systems; wireless systems; networks; systems and circuits; digital integrated circuits, including HDL, Verilog, and VHDL; digital signal processing; and related areas. At Arizona State, I also developed a new course on wireless transceiver systems. I have been doing research in the wireless communication and transceiver design for 2G-5G, SATCOM, Networking, WiFi, and wireless sensors since I joined Arizona State in 2001. My research has been funded by the National Science Foundation, DOD, DARPA, and industry in the wireless communication system.

12. During my work in industry, I have designed and contributed to the design of many communications wireless systems including 2-way radios, trunking systems, satellite communications, cellular systems, GPS and Bluetooth. Many of my designs are still in use today in products manufactured by the companies I have worked for, including Motorola, Intel, and Sony.

13. I represented Motorola and regularly attended many standards including ITU (International Telecommunication Unit), ETSI (European Telecommunications Standards Institute), and other standards as a technical expert. I also worked on the interaction of the Iridium satellite system with the cellular and LAN system networking.

14. I have over 200 journal and conference publications, 9 patents (and applications), and standards contributions. Several of these patents and publications are in the areas of communications and networking. The list of my publications is included in my resume.

15. I have been an active member of IEEE communication, radio frequency, and networking societies since 1985 and have published, organized sessions, and been on various IEEE committees. I am an IEEE Fellow, which is the highest level of IEEE membership awarded by the IEEE directors to recognize a high level of demonstrated extraordinary accomplishments. The IEEE Fellow Award is a special recognition for members with extraordinary accomplishments in the IEEE technical fields. To ensure that the recognition is extraordinary, the total number of recipients each year cannot exceed 0.1% of the total higher grade membership. The IEEE is the Institute of Electrical and Electronics Engineers, the world's largest association of technical professionals whose objectives include the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering, and related disciplines.

16. I am a member of the IEEE Circuits and Systems Society, IEEE Solid State Circuits Society, IEEE Signal Processing Society, and IEEE Communication Society. I am also a member of the IEEE RF and Microwave committees, IEEE Low Power Symposium Committee, and IEEE Fellow Selection Committee. I was one of

the key organizers establishing the IEEE Radio Frequency Integrated Circuits (RFIC) symposium in 1995, and I have been on the executive and technical committees of RFIC for the last 16 years. The RFIC Symposium is now the premier international symposium in the world where the latest RF circuits and components are presented. I have been involved in several international conferences in the areas of RF, Communication, Signal Processing, and IC design.

17. I have received several awards including the Carter Best Teacher Award, the IEEE Darlington Award (which is given for the best technical paper on circuits and systems in the IEEE Circuits and Systems Society), and the Motorola 10X Rapid Design Cycle Reduction Award.

III. MATERIALS CONSIDERED

18. The analysis that I provide in this declaration is based on my education, research, experience, and professional judgment, as well as the documents I have considered, including the '134 patent (Exhibit 1001) and its prosecution history (Exhibit 1003). I have reviewed and am familiar with the specification of the '134 patent. I have reviewed and am familiar with the file history of the '134 patent.

19. In preparing this declaration, I have also reviewed and am familiar with the following prior art used in the Petition and in my declaration below:

- **Exhibit 1004** – *Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP interworking over satellite; Multicasting,*

ETSI TR 102 156 v1.1.1 (“ETSI-156”), which was published April 2003, which is more than one year before the September 2, 2008 priority date of the ’134 patent. I understand from counsel for Petitioner that ETSI-156 qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).

- **Exhibit 1006** – *Resource ReSerVation Protocol (RSVP) – Version 1 Functional Specification* by Braden et. al. (“RFC-2205”), which was filed on published September 1997, which is more than one year before the September 2, 2008 priority date of the ’134 patent. I understand from counsel for Petitioner that RFC-2205 qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).
- **Exhibit 1007** – U.S. Patent Application Publication No. 2006/0268824 A1 by Subhasri Dhesikan et al., entitled “System and Method for Preserving Bandwidth in a RSVP Environment” (“Dhesikan”), which was filed on August 31, 2005, and published on November 30, 2006, which is more than one year before the September 2, 2008 priority date of the ’134 patent. I understand from counsel for Petitioner that Dhesikan qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).

- **Exhibit 1008** – U.S. Patent Application Publication No. 2005/0248652 A1 by Scott E. Firestone et al., entitled “System and Method for Performing Distributed Video Conferencing” (“Firestone”), which was filed on July 12, 2005, and published November 10, 2005, which is more than one year before the September 2, 2008 priority date of the ’134 patent. I understand from counsel for Petitioner that Firestone qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).
- **Exhibit 1011** – *Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP Interworking over satellite; Performance, Availability and Quality of Service*, ETSI TR 102 157 v1.1.1 (“ETSI-157”), which was published July 2003, which is more than one year before the September 2, 2008 priority date of the ’134 patent. I understand from counsel for Petitioner that ETSI-157 qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).
- **Exhibit 1012** – *Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP over Satellite*, ETSI TR 101 985 v1.1.2 (“ETSI-985”), which was published November 2002, which is more than one year before the September 2, 2008 priority date of the ’134

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patent. I understand from counsel for Petitioner that ETSI-985 qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).

- **Exhibit 1014** – *The BGAN Extension Programme*, The European Space Agency (ESA) Bulletin 124 (Nov. 2005) (“BGAN”), which was published November 2005, and available on the Internet Archives as of October 9, 2006, which is more than one year before the September 2, 2008 priority date of the ’134 patent. I understand from counsel for Petitioner that BGAN qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).

20. In forming the opinions expressed in this declaration, I have considered the materials listed in the table below (which includes the materials identified above) as well as any other document cited in this declaration.

Ex[No.]	Description of Documents
1001	U.S. Patent No. 8,489,134 (“’134 patent”)
1003	Prosecution File History of the ’134 Patent (“’134 patent file history”)
1004	<i>Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP Interworking over Satellite; Multicasting</i> , ETSI TR 102 156 v1.1.1 (published April 2003) (“ETSI-156”)
1005	ETSI, Publicly Available Specifications (PAS), https://www.etsi.org/images/files/Brochures/ETSI-Brochure-PAS.pdf (last accessed August 3, 2023)

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Ex[No.]	Description of Documents
1006	<i>Resource ReSerVation Protocol (RSVP) – Version 1 Functional Specification</i> by Braden et. al. (published September 1997) (“RFC-2205”)
1007	U.S. Patent Publication 2006/0268824 (published November 30, 2006) (“Dhesikan”)
1008	U.S. Patent Publication 2005/0248652 (published November 10, 2005) (“Firestone”)
1009	U.S. Patent Publication 2007/0036118 (published February 15, 2007) (“Shaffer”)
1010	RFC-Editor, Publication Process, https://www.rfc-editor.org/pubprocess/ (last accessed August 3, 2023)
1011	<i>Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP Interworking over satellite; Performance, Availability and Quality of Service</i> , ETSI TR 102 157 v1.1.1 (published July 2003) (“ETSI-157”)
1012	<i>Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP over Satellite</i> , ETSI TR 101 985 v1.1.2 (published November 2002) (“ETSI-985”)
1013	<i>RTP: A Transport Protocol for Real-Time Applications</i> by Schulzrinne et al. (published July 2003) (“RFC 3550”)
1014	<i>The BGAN Extension Programme</i> , The European Space Agency (ESA) Bulletin 124 (Nov. 2005) (“BGAN”)
1015	Web archive for <i>The BGAN Extension Programme</i> , https://web.archive.org/web/20061009113656/https://www.esa.int/esapub/bulletin/bulletin124/bul124j_rivera.pdf (Oct. 9, 2006)
1016	Declaration of Dr. Sylvia Hall-Ellis
1017	ETSI, <i>Technical Committee (TC) Satellite Earth Stations and Systems (SES)</i> , https://www.etsi.org/committee/1412-ses (last accessed Aug. 3, 2023)

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Ex[No.]	Description of Documents
1018	Docket Control Order, <i>STA Group LLC v. Motorola Solutions, Inc.</i> , No. 2:22-CV-0381-JRG-RSP, Dkt. 35 (E.D. Tex. Feb. 3, 2023)
1019	Sastri L. Kota, <i>Broadband Satellite Networks: Trends and Challenges</i> , IEEE Wireless Communications and Networking Conference, Vol. 3, pp. 1472-78 (2005) (“Kota”)
1020	Eylem Ekici et al., <i>A Multicast Routing Algorithm for LEO Satellite IP Networks</i> , IEEE/ACM Transactions on Networking, Vol. 10, No. 2, pp. 183-92 (2002) (“Ekici”)
1021	Jiangchuan Liu et al., <i>Adaptive Video Multicast over the Internet</i> , IEEE MultiMedia, Vol. 10, No. 1, pp. 22-33, (2003) (“Liu”)
1022	Plaintiff’s First Amended Disclosure of Asserted Claims and Infringement Contentions and Document Production Accompanying Disclosure Pursuant to P.R. 3-1 & 3-2, <i>STA Group LLC v. Motorola Solutions, Inc.</i> , No. 2:22-CV-0381-JRG-RSP (E.D. Tex. June 15, 2023).
1023	<i>Host Extensions for IP Multicasting</i> by Deering (published August 1989) (“RFC-1112”)
1024	<i>Internet Group Management Protocol, Version 3</i> by Cain et al. (published October 2002) (“RFC-3376”)
1025	<i>Protocol Independent Multicast – Sparse Mode (PIM-SM): Protocol Specification (Revised)</i> by Fenner et al. (published August 2006) (“RFC-4601”)
1026	U.S. Patent Publication 2005/0047582 (published March 3, 2005) (“Shaffer”)
1027	U.S. Patent Publication 2005/0086302 (published April 21, 2005) (“Aggarwal”)
1028	Celestri Multimedia LEO System, Federal Communications Commission Filing (June 1997) (“Celestri”)
1029	Iridium System Application, Federal Communications Commission Filing (December 3, 1990) (“Iridium”)
1030	U.S. Patent 6,104,925 (issued August, 15, 2000) (“Grube”)
1031	U.S. Patent Publication 2005/0021726 (published January 27, 2005) (“Denoual”)
1032	<i>Comparisons of Conventional and Trunked Systems</i> , Public Safety Wireless Network, May 1999

Ex[No.]	Description of Documents
1033	<i>Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; Part 1: Survey on Standardization Objectives</i> , ETSI TR 101 374-1 v1.2.1 (published October 1998) (“ETSI-374”)
1034	U.S. Patent No. 6,477,150 (issued Nov. 5, 2002) (“Maggenti”)
1035	Wayback Machine capture of <i>Resource ReSerVation Protocol (RSVP) – Version 1 Functional Specification</i> by Braden et. al. (published September 1997) (“RFC-2205”) from October 10, 2004
1036	Parties’ Local P.R. 4-2 Disclosure of Preliminary Proposed Constructions of Claim Terms and Preliminary Identification of Extrinsic Evidence
1037	Katherine K. Vidal, <i>Memorandum: Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation</i> (June 21, 2022)

IV. LEGAL STANDARDS

21. Although I am not an attorney, I have a general understanding of the applicable legal standards pertaining to the patentability issues presented in this proceeding. My understanding of legal principles as described in this section is based on communication of those principles to me by Petitioner’s legal counsel. The analysis in this declaration is in accordance with the legal principles outlined below.

22. I understand that, in this IPR, Petitioner has the burden of proving that each challenged claim is unpatentable by a preponderance of the evidence.

A. Claim Construction

23. I understand that the first step in determining whether a patent claim would have been anticipated or obvious is to ascertain how a person of ordinary skill in the art (“POSITA”) would have understood the claim terms.

24. I understand that a patent may include two types of claims: independent claims and dependent claims. An independent claim stands alone and includes only the limitations it recites. A dependent claim can depend from an independent claim, or it can further depend from another dependent claim. I understand that a dependent claim includes all the limitations that it recites, in addition to all the limitations recited in the claim(s) from which it depends.

25. It is my understanding that in proceedings before the USPTO, the claims of a patent are to be construed under what is referred to as the “*Phillips* standard.” I understand that this means that claim terms of a patent are given the ordinary and customary meaning the terms would have to a POSITA, in view of the description provided in the patent itself and the patent’s file history.

26. I understand that to determine how a POSITA would understand a claim term, one should look to those sources available that show what a POSITA would have understood the disputed claim language to mean. I understand that, in construing a claim term, one looks primarily to the intrinsic patent evidence, including the words of the claims themselves, the remainder of the patent, and the patent’s prosecution history. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims.

27. I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else. In making this determination, the claims, the remainder of the patent, and the prosecution history are of paramount importance. Additionally, the patent and its prosecution history must be consulted to confirm whether the patentee has acted as its own lexicographer (i.e., provided its own special meaning to any disputed terms), or intentionally disclaimed, disavowed, or surrendered any claim scope.

B. Obviousness

28. I understand that a patent claim is unpatentable if, at the time of the invention, it would have been obvious to one of ordinary skill in the art to combine the teachings of the prior art to yield the patent claim. I also understand that it is not required (although it is acceptable) that each element of a patent claim be found in a single reference in order to find a patent claim obvious. This means that even if all of the requirements of the claim cannot be found in a single prior art reference that would anticipate the claim, the claim can still be invalid. For a patent claim to be found obvious, all the elements of the patent claim may be found in a combination of references at which a POSITA would have been reasonably expected to arrive.

29. I understand that the following factors should be considered in analyzing obviousness: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims; (3) the level of ordinary skill in the pertinent

art; and (4) other objective considerations identified below. I understand that an invention is obvious when 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 to a POSITA at the time the invention was made. I also understand that a POSITA is not an automaton but is a person having ordinary creativity.

30. For example, I understand that two or more prior art references (*e.g.*, prior art articles, patents, or publications) that each disclose fewer than all elements of a patent claim may nevertheless be combined to render a patent claim obvious if the combination of the prior art collectively discloses all elements of the claim and a POSITA at the time would have been motivated to combine the prior art in such a way. I understand that this motivation to combine need not be explicit in any of the prior art but may be inferred from the knowledge of a POSITA at the time the patent was filed.

31. I further understand that one or more prior art references, articles, patents, or publications that disclose fewer than all of the elements of a patent claim may render a patent claim obvious if including the missing element would have been obvious to a POSITA (*e.g.*, the missing element represents only an insubstantial difference over the prior art or a reconfiguration of a known system). For example, I understand that a claim may be deemed invalid for obviousness in light of a single prior art reference, without the need to combine references, if the elements of the

claim that are not found in the reference can be supplied by the knowledge or common sense of a POSITA.

32. I understand that a POSITA is assumed to have knowledge of all prior art references. I also understand that when considering the obviousness of a patent claim, one may consider whether a teaching, suggestion, or motivation to combine the references exists so as to avoid impermissibly applying hindsight when considering the prior art. I understand this test should not be rigidly applied, but that the test can be important to avoiding such hindsight.

33. I understand that even if a *prima facie* case of obviousness is established, the final determination of obviousness must also consider objective indicia of nonobviousness, which I understand are also referred to as “secondary considerations,” if presented. I understand that these objective indicia can be important evidence as to whether a patent is obvious or nonobvious. These secondary considerations of non-obviousness may include, for example:

- a long felt but unmet need in the prior art that was satisfied by the claimed invention;
- commercial success of processes claimed by the patent;
- unexpected results achieved by the invention;
- praise of the invention by others skilled in the art;
- the taking of licenses under the patent by others; and

- deliberate copying of the invention.

34. I further understand that secondary considerations evidence is only relevant if the offering party establishes a connection, or nexus, between the evidence and the claimed invention.

35. It is also my understanding that there are additional considerations that may be used as further guidance as to when the above factors will result in a finding that a claim is obvious, including the following:

- the claimed subject matter is simply a combination of prior art elements according to known methods to yield predictable results;
- the claimed subject matter is a simple substitution of one known element for another to obtain predictable results;
- the claimed subject matter uses known techniques to improve similar devices or methods in the same way;
- the claimed subject matter applies a known technique to a known device or method that is ready for improvement to yield predictable results;
- the claimed subject matter would have been “obvious to try” choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;

- there is known work in one field of endeavor that may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to a POSITA;
- there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent's claims; and
- there is some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed subject matter.

36. I also understand that “obviousness” is a legal conclusion based on the underlying factual issues of the scope and content of the prior art, the differences between the claimed invention and the prior art, the level of ordinary skill in the prior art, and any objective indicia of non-obviousness. For that reason, my testimony addresses the underlying facts and factual analysis that would support a legal conclusion of obviousness, and when I use the term obvious, I am referring to the perspective of a POSITA at the time of invention.

C. Level of Ordinary Skill in the Art

37. I understand that my assessment of the claims of the '134 patent and the teachings of the prior art and my analysis and opinions herein must be undertaken from the perspective of what would have been known or understood by a person

having ordinary skill in the art, reading the '134 patent on its priority date and in light of the specification and file history of the '134 patent. I refer to such a person as a "POSITA."

38. I further understand that in determining the level of ordinary skill in the art, I may consider factors including:

- (a) the type of problems encountered in the art or field of invention,
- (b) prior art solutions to those problems,
- (c) the rapidity with which innovations are made,
- (d) sophistication of the technology, and
- (e) the educational level of active workers in the field.

39. I understand that a person of ordinary skill in the art is not a specific real individual, but rather a hypothetical individual having the qualities reflected by the factors above. This hypothetical person has knowledge of all prior art in the relevant field and takes from each reference what it would teach to a person having the skills of a POSITA.

40. I understand that a POSITA is a person of ordinary creativity, but not an automaton, and that a POSITA can often fit multiple patents or prior art references together like pieces of a puzzle as a result of this ordinary creativity. I also understand that I may consider the inferences and creative steps that a POSITA would employ. In addition, I understand that a POSITA would necessarily have been

capable of understanding the scientific and engineering principles applicable to the pertinent art.

V. OVERVIEW OF THE '134 PATENT

A. Priority Date

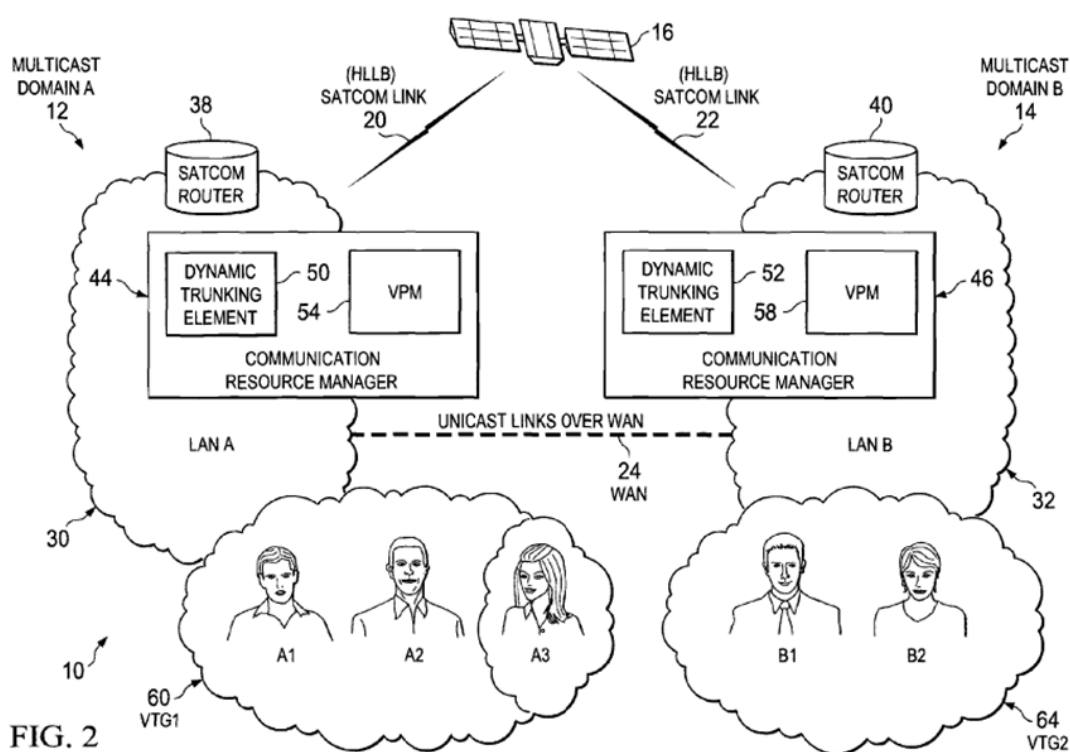
41. The '134 patent was filed as Application No. 12/202,450 on September 2, 2008. For purposes of this proceeding, I have assumed that the '134 patent is entitled to a priority date of September 2, 2008 and have applied this date in considering the prior art and the viewpoint of a POSITA.

B. The Subject Matter of the Challenged Patent

42. The '134 patent is titled "System and Method for Providing Presence Based Trunking in a Network Environment." As shown in FIG. 2 below, the "communication system" includes "multicast domain A" and "multicast domain B" connected by a "SatCom link." Ex[1001], FIG. 2. Public and private groups may utilize endpoints and communication networks that use different technologies. *Id.*, 3:34-41. Interoperability solutions provide communications among different endpoints and different networks using virtual talk groups (VTGs). *Id.*, 3:11-26.

43. Each multicast domain (A and B) includes a "communication resource manager," which monitors its respective domains for the presence of users and includes dynamic trunking elements to bring up the satellite link. *Id.*, 2:21-30, 3:57-59. When a communication resource manager detects at least one user in both domains, a "SatCom link" is brought up with the "bandwidth required for the

applications used by the user.” *Id.* 3:57-4:8, 4:13-16. The “dynamic trunking elements 50 and 52” also select a transcoding for the application “based on the available bandwidth.” *Id.*, 4:25-28. The link is maintained “as long as the [virtual talk group (“VTG”)] is active” and the “communication resource managers” “detect that users are present in both locations.” *Id.* 3:57-4:8. When the “communication resource managers 44 and 46 on either side detect that they have no users present in a given multi-location VTG,” they “tear down the SatCom link.” *Id.*, 4:8-12.



44. The “communication resource managers 44 and 46 bring up links having only the bandwidth required for the applications used by the user.” *Id.*, 4:13-16. Additionally, “dynamic trunking elements 50 and 52 . . . automatically configure

the system to select transcoding based on the available bandwidth.” *Id.*, 4:25-28. In doing so, “the endpoints are dynamically configured to ramp down the codec on the SatCom link, based on the available bandwidth over the SatCom link.” *Id.*, 4:28-30.

45. The “communication resource managers 44 and 46” each include “virtual presence managers” (VPMs) and “track the number of present users and their bandwidth needs.” *Id.*, 3:11-56, 4:33-38, FIG. 3. The communication resource managers may “increase the bandwidth between the two locations based on the number of users present at each location.” *Id.*, 4:33-38. When the “communication resource managers 44 and 46 on either side detect that they have no users present in a given multi-location VTG,” they “tear down the SatCom link.” *Id.*, 4:8-12. As I will describe, nothing in the claims recites any specific type of satellite communication link, much less a novel one.

C. The Challenged Claims of the ’134 Patent

46. Claims 1-14 of the ’134 patent (“Challenged Claims”) are set forth below. Some of the claim elements have been further sub-divided for ease of reference. I will refer throughout this declaration to the elements of the claims with reference to the number and letter designations that have been added in the left column (e.g., “1[Pre],” “1[a],” “1[b],” etc.).

Claim Element	Claim Language from the ’134 Patent
1[Pre]	An apparatus, comprising:
1[a]	a first communication resource manager located in a first domain and

	operable to interact with a second communication resource manager located in a second domain, wherein the first communication resource manager is configured to:
1[b]	determine to establish a link for multicasting between users in the first domain and users in the second domain based on presence data of at least one user in the first domain and at least one user in the second domain;
1[c]	determine an application to be used in a communication session over the link;
1[d]	allocate a bandwidth level to be used for the link to accommodate the application;
1[e]	increase the bandwidth level for the link based on a change in the application and based on an identification of additional presence data for additional users that have joined the communication session,
1[f]	wherein the communication resource managers each includes respective trunking element that is automatically configured to select a transcoding based on available bandwidth;
1[g]	adjust the bandwidth level based on a determination which of the additional users and the users in the first and second domains can transmit data simultaneously during the communication session;
1[h]	detect an absence of active users in the first domain and the second domain; and
1[i]	tear down the link based on the absence;
1[j]	wherein the link is a satellite communication link.
2	The apparatus of claim 1, wherein the users of the first domain comprise a virtual talking group (VTG).
3	The apparatus of claim 1, wherein the additional presence data relates to whether a given end user has logged into their respective system.
4	The apparatus of claim 1, wherein the communication resource managers each includes respective virtual talk group (VTG) presence managers (VPMs), each of which is operable to monitor their users who are present in their respective domains.
5	The apparatus of claim 4, wherein information received from the VPMs is used to maintain a designated link bandwidth allocation.
6	The apparatus of claim 4, wherein if either one of the VPMs determine that there are no active users logged into their respective systems, then the VPMs tear down the link.
7	The apparatus of claim 1, further comprising: a router that establishes the link based on direction from the communication resource manager.

8[Pre]	A method to be executed in conjunction with a processor to perform the steps of, comprising:
8[a]	interacting, via a first communication resource manager located in a first domain, with a second communication resource manager located in a second domain;
8[b]	determining to establish a link for multicasting between users in the first domain and users in the second domain based on presence data of at least one user in the first domain and at least one user in the second domain;
8[c]	determining an application to be used in a communication session over the link;
8[d]	allocating a bandwidth level to be used for the link to accommodate the application;
8[e]	increasing the bandwidth level for the link based on a change in the application and based on an identification of additional presence data for additional users that have joined the communication session,
8[f]	wherein the communication resource managers each includes respective trunking element that is automatically configured to select a transcoding based on available bandwidth;
8[g]	adjusting the bandwidth level based on a determination which of the additional users and the users in the first and second domains can transmit data simultaneously during the communication session;
8[h]	detecting an absence of active users in the first domain and the second domain; and
8[i]	tearing down the link based on the absence;
8[j]	wherein the link is a satellite communication link.
9	The method of claim 8, wherein the link is a satellite communication link, and wherein the users of the first domain comprise a virtual talking group (VTG).
10	The method of claim 8, further comprising: detecting whether a given end user has logged into their respective system in order to identify the additional presence data.
11	The method of claim 8, further comprising: maintaining a designated link bandwidth allocation based on a number of users who are logged into their respective systems.
12[Pre]	Non-transitory media that include instructions for execution and when executed by a processor operable to:
12[a]	interact, via a first communication resource manager located in a first domain, with a second communication resource manager located in a

	second domain;
12[b]	determine to establish a link for multicasting between users in the first domain and users in the second domain based on presence data of at least one user in the first domain and at least one user in the second domain;
12[c]	determine an application to be used in a communication session over the link;
12[d]	allocate a bandwidth level to be used for the link to accommodate the application;
12[e]	increase the bandwidth level for the link based on a change in the application and based on an identification of additional presence data for additional users that have joined the communication session,
12[f]	wherein the communication resource managers each includes respective trunking element that is automatically configured to select a transcoding based on available bandwidth;
12[g]	adjust the bandwidth level based on a determination which of the additional users and the users in the first and second domains can transmit data simultaneously during the communication session;
12[h]	detect an absence of active users in the first domain and the second domain; and
12[i]	tear down the link based on the absence;
12[j]	wherein the link is a satellite communication link.
13	The non-transitory media of claim 12, wherein the instructions for execution and when executed by the processor is further operable to: detect whether a given end user has logged into their respective system in order to identify the additional presence data.
14	The non-transitory media of claim 12, wherein the instructions for execution and when executed by the processor is further operable to: maintain a designated link bandwidth allocation based on a number of users who are logged into their respective systems.

D. Prosecution History

47. The '134 patent was filed as Application No. 12/202,450 on September 2, 2008. For purposes of this Petition, I assume that the '134 patent is entitled to a priority date of September 2, 2008. The Examiner rejected all original claims as obvious. Ex[1003], pp.67-74. To overcome these rejections, applicants amended

claim 1 to include the limitations “detect an absence of active users in the first domain and the second domain” and “tear down the link based on the absence.” *Id.*, p.91. The Examiner again rejected all claims as obvious. *Id.*, pp.106-13. In response, applicants again amended claim 1 to include the limitations “determine an application to be used in a communication session over the link,” “allocate a bandwidth level to be used for the link to accommodate the application,” and “increase the bandwidth level for the link based on a change in the application and based on an identification of additional presence data for additional users.” *Id.*, p.128. Applicant also canceled dependent claims 8, 15, 19, and 20. *Id.*, pp.129, 131-33.

48. Once again, in the third office action, the Examiner rejected all remaining claims as obvious. *Id.*, pp.146-55. The applicant again amended claim 1 to include the limitations “adjust the bandwidth level based on a determination about which of the additional users and the users in the first and second domains can transmit data simultaneously during the communication session.” *Id.*, p.165. In the final office action, the Examiner again rejected all claims as obvious. *Id.*, pp.182-95. The applicants amended claim 1 to include the limitation “wherein the communication resource managers each include respective trunking elements that can select transcoding based on available bandwidth.” *Id.*, p.206.

49. On April 10, 2013, the Examiner allowed the pending claims, but only after an Examiner’s Amendment which specifically added the requirement:

“wherein the link is a satellite communication link” to each independent claim. *Id.*, pp.229-31.

50. As demonstrated below, none of the limitations of the Challenged Claims were novel or non-obvious by the alleged priority date of the '134 patent.

E. Level of Ordinary Skill in the Art

51. I have been asked to consider the level of ordinary skill in the field that someone would have had at the time the claimed invention of the '134 patent was made. My opinions regarding the level of ordinary skill in the art are based on, among other things, my nearly 30 years of experience in the field of networking and communication systems, as well as: the levels of education and experience of persons working in the field, the types of problems encountered in the field; and the sophistication of the technology.

52. Based on my review and analysis of the '134 patent, the prior art cited herein, and the ordinary skill factors described in Section IV.C, in my opinion, a POSITA in the field of the '134 patent at the time of the earliest alleged priority date (September 2, 2008) would have had at least a bachelor's degree in computer science, electrical engineering, or a similar field, and would have had approximately three years industry experience in networking or communication systems, in particular addressing interoperability between different types of networks and satellite communications. Additional education in the fields of electrical engineering

or computer science, such as a masters or doctorate degree, may serve as a substitute for experience in the field. A person with less or different education but more relevant practical experience, or vice versa, may also meet this standard. The prior art also evidences the level of skill in the art.

53. Based on my education and experience, I meet this definition of one of ordinary skill in the art, and I believe that I am qualified to provide opinions about how a POSITA at the relevant time would have interpreted and understood the '134 patent and the prior art relied upon herein. Although my qualifications and experience exceed those of a POSITA, both in September 2008 and today, I have nevertheless applied the perspective of a POSITA in rendering my opinions below.

54. My opinions below explain how a POSITA would have understood the technology described in the '134 patent and the prior art references I have identified herein around the September 2, 2008 timeframe. For purposes of this declaration, in general, and unless otherwise noted, my testimony below refers to the knowledge of one of ordinary skill in the art during the time period around the September 2, 2008 priority date of the '134 patent (which I have assumed). I would have been a person with at least ordinary skill in the art at that time.

F. Claim Construction of Terms in the Challenged Claims

55. It is my understanding that in order to properly evaluate the '134 patent, the terms of the claims must first be interpreted. It is my understanding that the

Petition for *Inter Partes* Review of U.S. Patent No. 8,489,134

claims are to be construed according to the same claim construction standard that district courts use. For most terms in the Challenged Claims, I have applied their ordinary and customary meaning as understood by one of ordinary skill in the art at the time of the invention in light of the specification and the prosecution history.

56. I understand the specification of the '134 patent describes or further defines certain terms related to the Challenged Claims, stating that (a) “[m]ulticast” is “the delivery of information to a group of destinations simultaneously using the most efficient strategy,” Ex[1001], 1:14-16; and (b) “presence information” refers to “a status indicator that conveys an ability and/or willingness of a potential communication partner to communicate.” *Id.*, 6:41-44. I apply these descriptions herein.

57. I have been informed by counsel for Petitioner that, in district court, Patent Owner and Petitioner have proposed constructions for several terms. Ex[1036]. The proposals are set forth below. I have considered both party’s constructions, and my conclusions would not change under either party’s proposal. In other words, under either party’s proposal, I believe the prior art discloses the claim limitations, such that my opinions would not change.

Term	Petitioner Proposal	Patent Owner Proposal
communication resource manager	“software and/or hardware that controls a satellite link for	Plain and ordinary meaning

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(Claim 8)	multicasting and tracks presence data”	
link for multicasting between users in the first domain and users in the second domain (Claim 8)	“satellite link that simultaneously delivers information between a group of users in the first domain and a group of users in the second domain using the most efficient strategy”	Plain and ordinary meaning
presence data of at least one user in the first domain and at least one user in the second domain (Claim 8)	“presence data of both of at least one user in the first domain and at least one user in the second domain”	Plain and ordinary meaning
presence data (Claim 8)	“a status indicator that conveys an ability and/or willingness of a potential communication partner to communicate”	Plain and ordinary meaning
communication session (Claim 8)	Plain and ordinary meaning	Plain and ordinary meaning
trunking element (Claim 8)	“software and/or hardware in the communication resource manager that establishes, tears down, and controls the bandwidth of the satellite link”	Plain and ordinary meaning
virtual talk group (VTG) (Claim 9)	“a talk group that communicates using an IP address”	Plain and ordinary meaning

Order of steps (Claims 8, 9)	The steps must be performed in the recited order.	Plain and ordinary meaning
domain (Claim 8)	Plain and ordinary meaning	Plain and ordinary meaning
absence (Claim 8)	Plain and ordinary meaning	Plain and ordinary meaning

58. Ultimately, it is my opinion that the prior art discussed herein discloses the Challenged Claims under any reasonable construction.

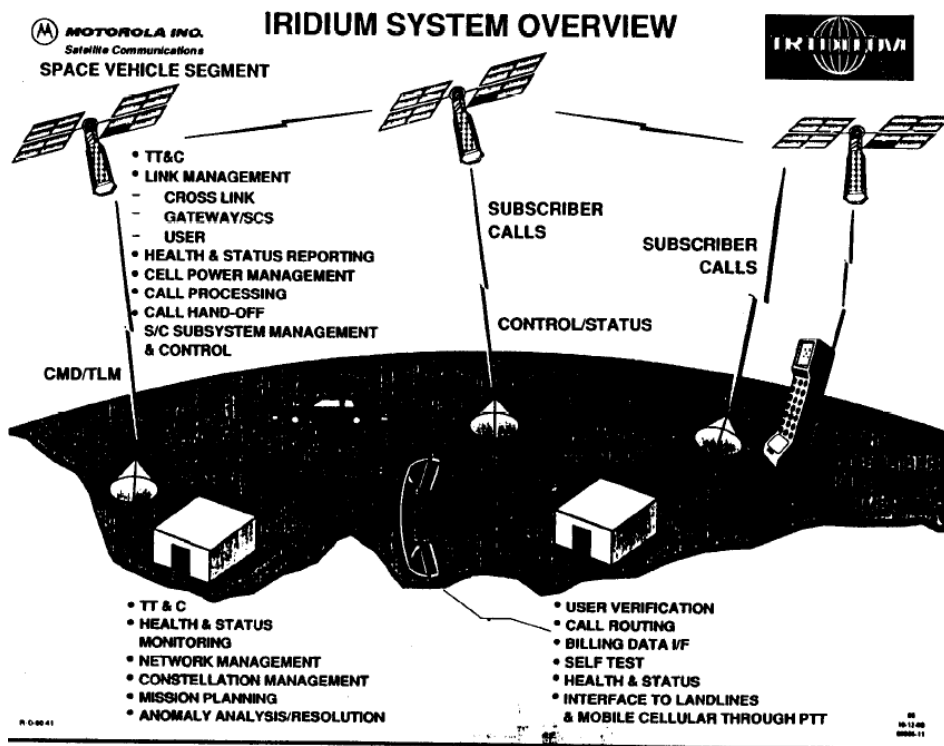
VI. TECHNOLOGY BACKGROUND AND STATE OF THE ART

59. In the subsections below, I describe some of the features of satellite, networking, and monitoring systems that would have been well-known to a POSITA as of the September 2, 2008 assumed priority date of the '134 patent.

A. Satellite Networks

60. Satellite systems have been well-known for decades to establish communications across a global network for several different types of applications, including broadband transmissions for Internet access, video-conferencing, and video streaming. Indeed, the '134 patent admits that, by the time of the assumed 2008 priority date, “many systems” had provided “communication over SatCom.” Ex[1001], 2:58-60.

61. For example, Motorola itself had developed several satellite systems in the 1990s. As one example, Iridium was a satellite system developed by Motorola and described, for example, in a December 3, 1990 filing to the Federal Communications Commission (“FCC”). Ex[1029], p.2. The Iridium satellite system was a then “state-of-the-art global personal communications system” aimed at providing “millions of users throughout the world advanced mobile digital voice and data communications by 1997.” *Id.*, p.23. The Iridium system included “77 low earth orbit satellites circling the globe” and provided “continuous line-of-sight communications from and to any point on the earth’s surface, as well as all points within an altitude of 100,000 feet above mean sea level.” *Id.* The Iridium system was meant to “provide global telecommunications service on a continuous basis” and included both “voice and data services.” *Id.*, p.44.



Id., FIG. I-1.

62. A few years later, Motorola described Celestri, a low earth orbit (“LEO”) satellite system, in a June 1997 FCC filing (referred to herein as “Celestri”). Ex[1028], p.2. Celestri described a “global satellite system” with “a wide range of real-time broadband communication services in the Fixed-Satellite Service (“FSS”). *Id.* Celestri for example disclosed “63 satellites in 7 inclined orbital planes” and “relatively small, low power and low cost earth terminals for real-time services.” *Id.*, p.16. The Celestri system was designed to provide applications including “Internet access, video-conferencing, financial transaction processing, home entertainment, distance learning and tele-medicine.” *Id.*, pp.16-17. Celestri also disclosed

“multinational corporations and terrestrial carriers to aggregate voice and data signals.” *Id.*, p.17. Celestri’s architecture was meant to support different services including “broadcast and multicast services using variable service areas and communication rates.” *Id.*, p.5.

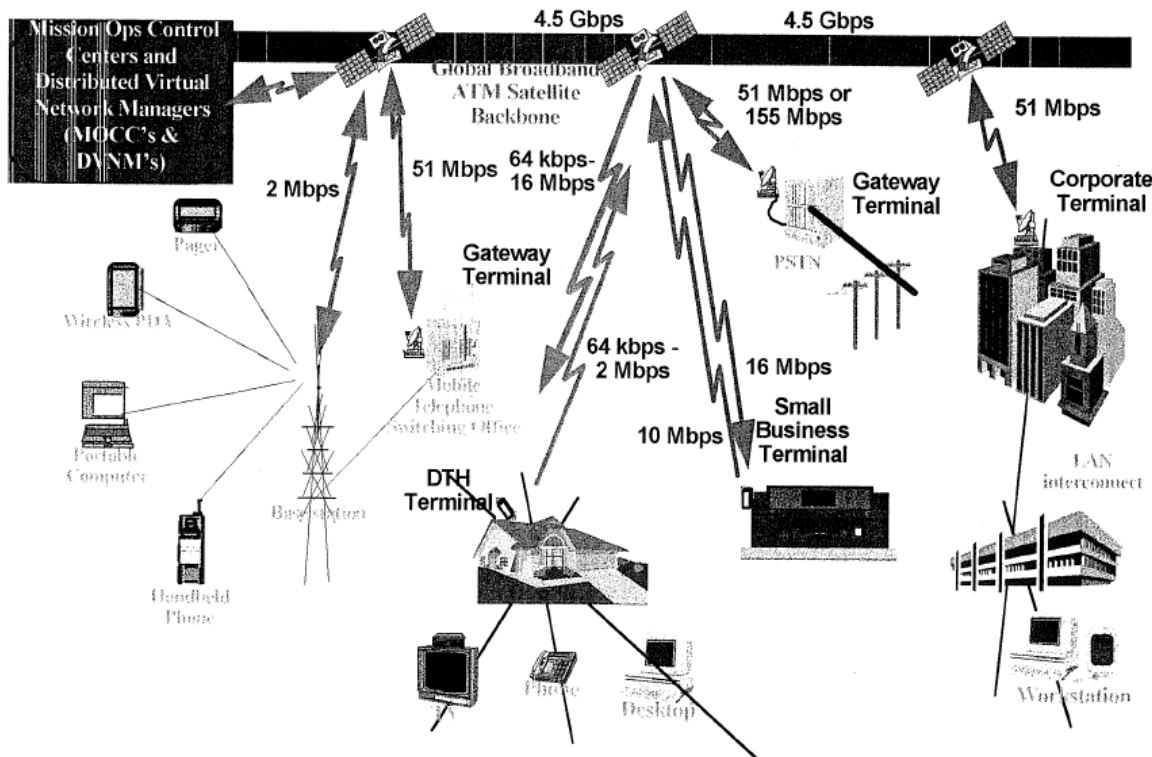


Figure IV-1: Celestri LEO System Architecture

Id., p.45.

63. Moreover, by 2003, the European Telecommunications Standards Institute (“ETSI”) had published a number of technical reports presenting a Broadband Satellite Multimedia (“BSM”) network. Ex[1004], p.7. FIG. 2 of ETSI-157 (below) discloses the basic components of a BSM network, including “one or more satellites” connecting various networks. Ex[1011], p.19-20. For example, a

local area network (LAN) of end users can connect to a satellite terminal (ST) that can manage communications with another wide area network of end users (*e.g.*, the Internet) connected to a satellite gateway. *Id.*, p.20.

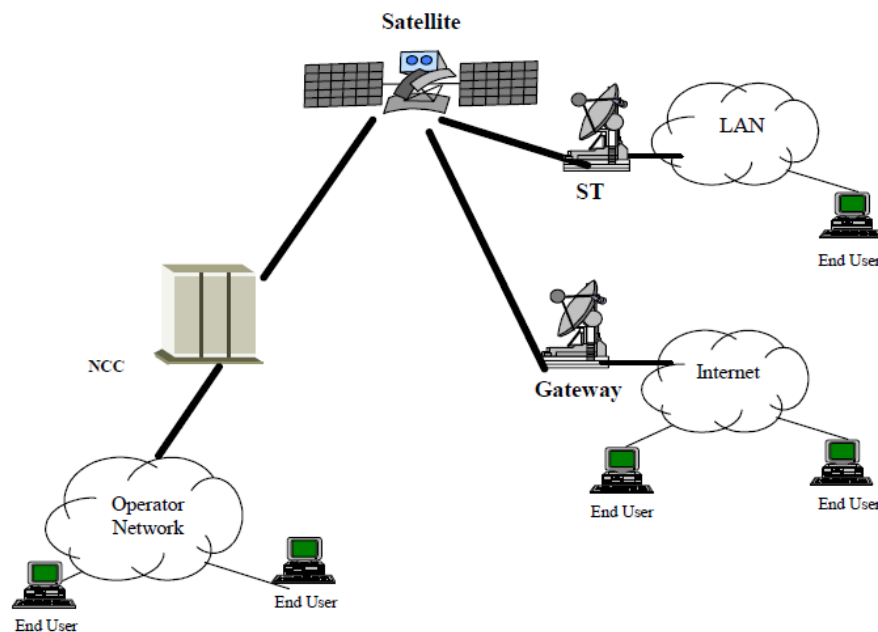


Figure 2: Generic BSM system

64. There are numerous other examples of satellite systems and disclosures before September 2008, including others developed by Motorola (*e.g.*, Millenium and M-Star) as well as other systems developed by Lockheed Martin (Astrolink), mobile telecommunications networks (*e.g.*, ICO), Loral Space and Alcatel (CyberStar), and many others. Ex[1033], pp.41, 45, 52, 54, 67. Likewise, the GlobalStar satellite system, a joint venture between Loral and Qualcomm, launched in the late 1990s. Ex[1034], 41:6-16 (describing use of GlobalStar for group communications). Further, as I describe in detail below, in 2005, Inmarsat also

launched the BGAN, or Broadband Global Area Network, family of satellite services, an on-demand commercial broadband satellite service for the “modern office” that enabled teleconferencing and other services. Ex[1014], p.2.

65. Traditional satellite communication systems have played a significant role in supporting services such as television broadcasting, digital messaging, enterprise Virtual Private Networks (VPNs), and point-to-point telecommunications and data services. However, by 2005, the growth of wireless, wireline, and backbone internet networks resulted in higher throughput multicast satellite communication systems interacting with multiple networks. *See, generally*, Ex[1019] (providing an overview of satellite communication systems connecting multiple domains ranging from mobile infrastructure to WAN and internet); *see also id.*, FIG. 1 (below). Kota provides overview of the SATCOM system interacting with multiple domain network managers running multiple applications with dynamic processing payload, IP multicasting, QoS mechanisms, dynamic bandwidth allocation, and other network management techniques to meet the driving applications and requirements. *Id.*, pp.1472-74.

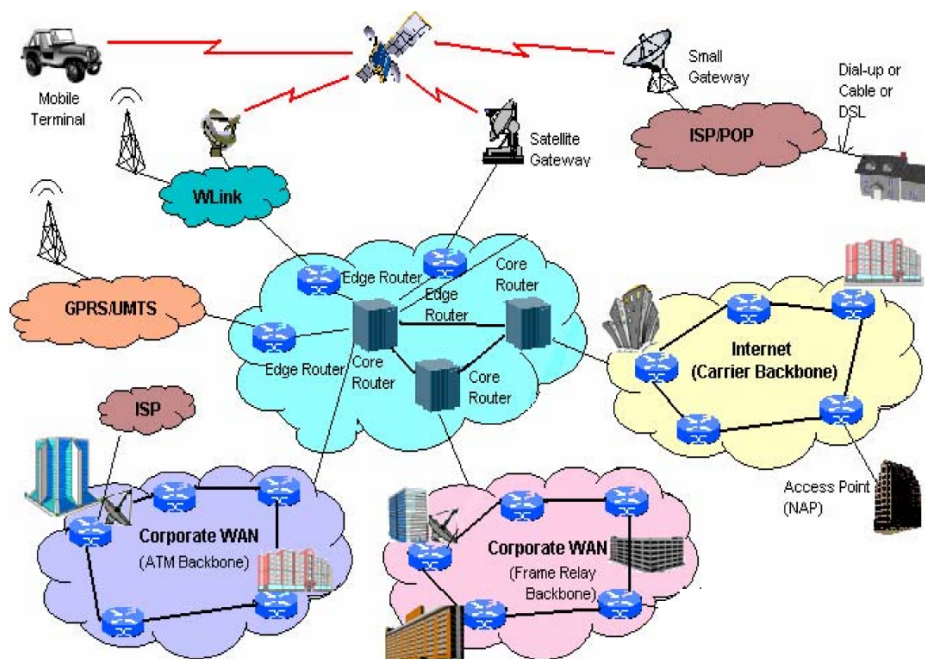


Figure 1: Global Communication Network Scenario

B. Link for Multicasting, Including in Satellite Networks

66. Internet Protocol (IP) Multicasting was a well-known technology prior to the September 2, 2008 for delivering information to multiple users at the same time.

67. For example, RFC-1112, published in August 1989, explains that IP multicasting is the transmission of an IP datagram to a “host group,” a set of hosts identified by a single IP destination address. Ex[1023], p.1. A multicast datagram is delivered to all members of its destination host group with the same “best-efforts” reliability as regular unicast IP datagrams. *Id.* The membership of a host group is dynamic, allowing hosts to join and leave groups at any time. *Id.* Hosts may be

members of more than one group simultaneously, and a host can send datagrams to a group without being a member of that group. *Id.*

68. IP multicasting is achieved through host extensions and protocols like the Internet Group Management Protocol (“IGMP”). *Id.* at p.11. IGMP is used to report IP multicast group memberships to multicast routers. Ex[1024], p.2; Ex[1023], p.11. Using IGMP, hosts in a multicast session may join or leave the multicast group. Ex[1024], p.4; Ex[1023], p.14. Multicast routers send out Host Membership Query messages in order to determine which hosts are present in a multicast session. Ex[1023], p.12. In response to a Host Membership Query, hosts send a Host Membership Report message in order to tell the multicast router which host groups they belong to. *Id.* When a host first joins a new host group, that host immediately sends a Host Membership Report for that group. *Id.*, p.13. Additionally, a host may leave the group by sending a Leave Group message. Ex[1024], p.8.

69. PIM-SM is another protocol “for efficiently routing multicast groups that may span wide-area (and inter-domain) internets.” Ex[1025], p.5. PIM-SM relies on a Multicast Routing Information Base, “used to determine the next-hop neighbor to which any PIM Join/Prune message is sent.” *Id.*, p.7. PIM-SM implements the multicast service model in three phases. *Id.* In phase one, “a multicast receiver expresses” interest in receiving traffic, and a Rendezvous Point Tree is formed, which involves the sending of PIM-SM Join and Prune messages.

Id., p.8. Phase two involves encapsulating data packets and sending them directly to the Rendezvous Point, “a router that has been configured to be used as the root of the non-source-specific distribution tree for a multicast group.” *Id.*, pp.5, 8. At the end of phase 2, traffic will be flowing from the source along a source-specific tree to the Rendezvous Point, and from there along the shared tree to the receivers. *Id.*, p.9. Phase three introduces the Shortest-Path Tree where a router may initiate a transfer to a source-specific Shortest-Path Tree for optimized paths. *Id.*, pp.9-10. At the end of phase 3, “the receiver will be receiving traffic from [the source] along the shortest-path tree between the receiver and [the source].” *Id.*, pp.10.

70. Providing multicast services (including IGMP and PIM-SM) over a satellite link was also well-known prior to September 2, 2008, as I described above. For example, Celestri disclosed a satellite system for multicasting, as did other systems such as CyberStar. Ex[1028], p.5.; Ex[1033], p.67. In addition, Inmarsat’s BGAN provided both “live video applications like video conferencing or video streaming,” as well as “multicast service capabilities.” Ex[1014], pp.3, 5. The “BGAN Multicast Service” specifically provided “reliable and secure multicast transport protocols ensuring quality of service for individual multicast flows.” *Id.*, p.6. Further, as early as 2003, the ETSI technical reports relating to BSM networks specifically designed standards for satellite-based IP multicasting. Ex[1004], p.7; Ex[1012], p.7. I describe these standards in detail in the context of Ground 1 below.

C. Establishing and Tearing Down Links and Trunking, Including in Satellite Networks

71. By September 2, 2008, it was widespread and commonplace to establish and tear down links in a communication session, including for teleconferencing and video conferencing sessions. As just one example, Dhesikan, which I describe in detail below, discloses multiple protocols for establishing a link between endpoints for a communication session for telephone or video conferencing. *See* Ex[1007], ¶¶[0023], [0040]-[0041]. In general, for conferencing systems, the links allowed for full duplex communications, such that multiple endpoints communicating in a session can transmit at the same time. For example, Dhesikan describes multiple users in a conference securing a link for transmitting. Ex[1007], FIG.8 (illustrating “a conference call situation” with multiple users), ¶[0063].

72. Moreover, by 2008, trunking was a known method for establishing links for communication sessions between users, including in a land mobile radio network. Generally, “a trunk is a shared voice or data traffic path between two points,” and “[t]runked systems use access control schemes to share channel capacity among many users.” Ex[1032], p.13. Some trunking systems include “some type of access control (whether in each mobile unit or centralized at a base station site).” *Id.*, p.14. When a user wants to contact other users, the user receives an indication of an available channel from a controller, and all the users (transmitting and receiving) all switch to that channel for communication. *Id.*

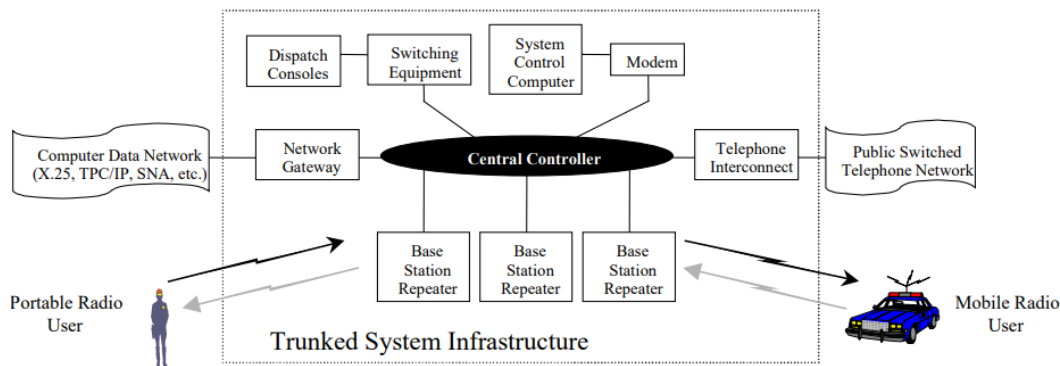
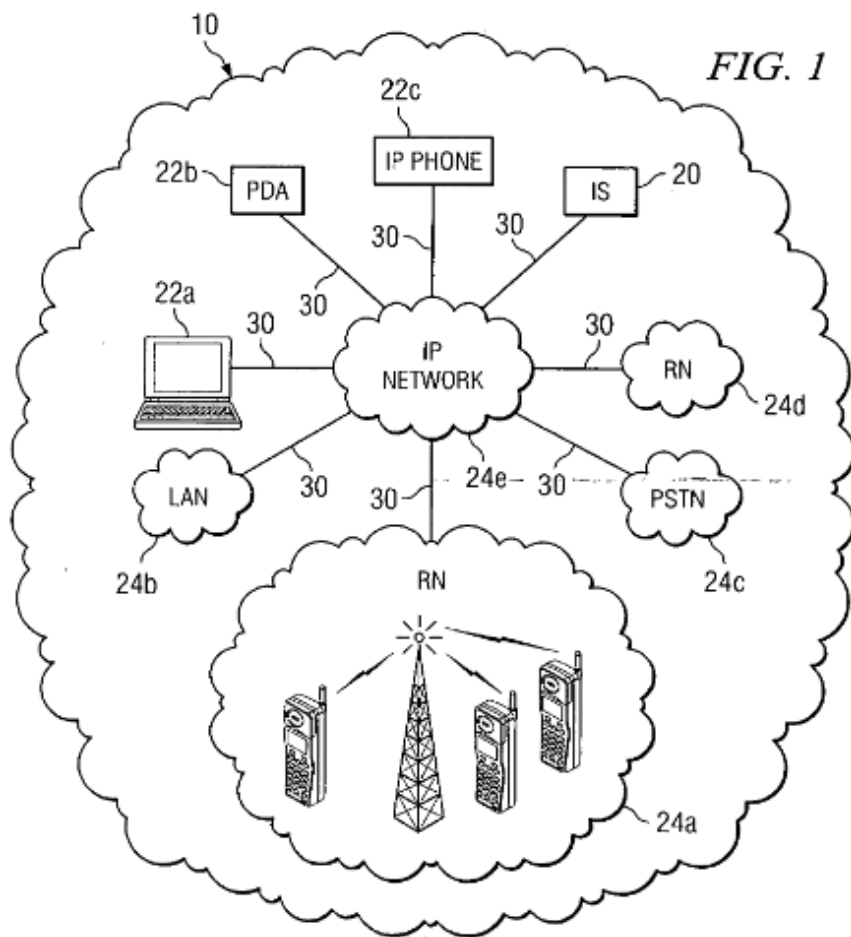


Exhibit 6 Typical Configuration of a Centralized Trunked System

Id., p.14.

73. It would also have been well understood by a POSITA that such systems could have been implemented with satellite links. For example, U.S. Patent Application Publication No. 2007/0036118 (“Shaffer”), which was filed in 2005 and published in 2007, describes a system for setting up a conference between two or more users of different types of endpoints (e.g., radios, IP phones) in different networks at different locations (e.g., 24a-24d in FIG. 1, below). *E.g.*, Ex[1009], ¶¶[0021], [0050]. In Shaffer, the different networks can communicate with each other via a communicating IP network 24e, which can be any “global distributed network” such as cellular networks or a “satellite network.” *Id.*, ¶¶[0025], [0027], [0030]-[0031] (emphasis added).



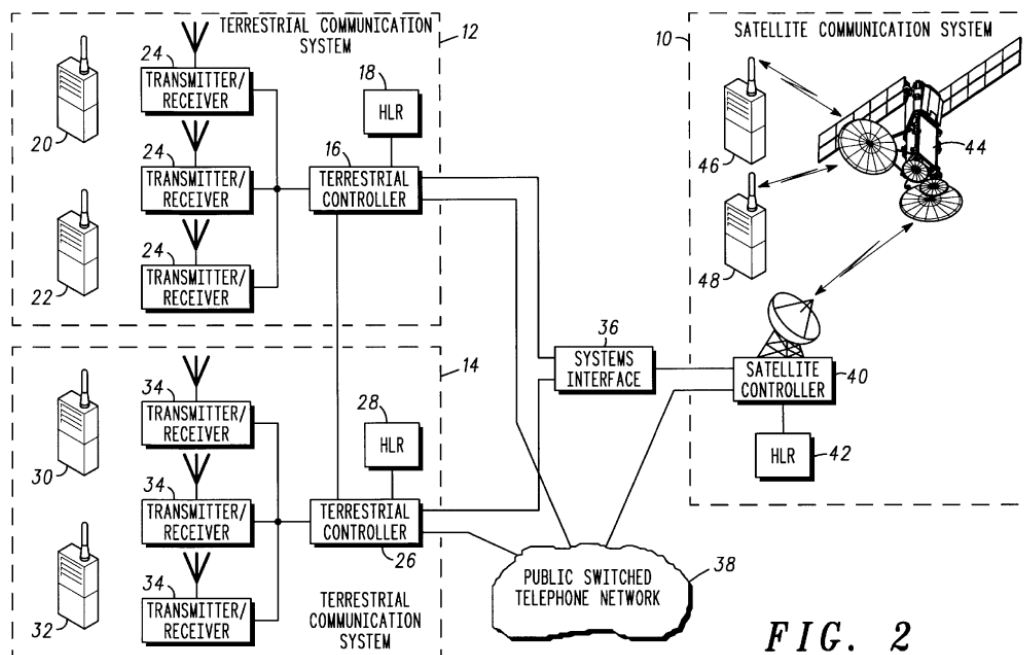
Id., FIG. 1.

74. As another example, Ekici gives an overview of the teardown process for SATCOM. See Ex[1020], p.183. Ekici provides an overview and algorithm for the teardown of the termination of the multicast session. *Id.*, p.186. The process in this case consists of “[a] the tear-down message” “sent on the branches of the [multicast] tree.” *Id.* “Satellites receiving this message delete the entry for that multicast session from their routing tables and forward the tear-down message in the tree.” *Id.* “If the satellites along the path are also destination satellites, then they send

a message to the recipients on Earth, informing them about the termination of the multicast session.” *Id.*

75. Similarly, U.S. Patent No. 6,477,150 (“Maggenti”), which issued on November 5, 2002 and was assigned to Qualcomm, describes “group communication services” implemented using multiple types of communication networks, including Qualcomm’s Globalstar satellite system and Motorola’s Iridium satellite system. Ex[1034], 41:6-16.

76. Moreover, U.S. Patent No. 6,104,925 (“Grube”), which was filed in 1998 and issued in 2000 and was assigned to Motorola, describes a satellite and terrestrial communication system in which a subscriber may request to participate in group communications with other subscribers. Ex[1030], 5:18-37. Grube explains that in response to the request, a systems interface “establish[es] satellite communication links for each subscriber located in the satellite communication system 10 and establishes a terrestrial communication link for subscribers in a terrestrial communication system 12.” *Id.* Additionally, Grube describes that a “controller 60 communicates with the terrestrial controllers 16, 26 and the satellite controller 40,” and that “[s]uch communication includes establishing the group communication, terminating the group communication, establishing communication links, and/or maintaining the group communication.” *Id.*, 5:54-59.



Id., FIG. 2.

D. Allocating and Adjusting Bandwidth, Including in Satellite Networks

77. Allocating and adjusting bandwidth for and during a communication session based on presence data and application was well-known prior to September 2, 2008.

78. For example, RSVP, first described decades ago, is “a resource reservations setup protocol” used to allocate resources such as bandwidth for a communication session based on application and user presence. Ex[1006], p.4. For example, “[t]he RSVP protocol is used by a host to request specific qualities of service from the network for particular application data streams or flows.” *Id.* The

allocated resources are also based on the presence of users, including membership in a group using the allocated resources for a communication session. *Id.*, p.6.

79. RSVP also describes that the allocated bandwidth can change during a session. For example, to accommodate dynamic group membership, “[t]he state maintained by RSVP is dynamic” and “to change any QoS request, a host simply starts sending revised Path and/or Resv messages.” *Id.*, p.23. RFC-2205 refers to this as “a ‘soft state’ approach to managing the reservation state in routers and hosts.” *Id.*, p.22. “RSVP soft state is created and periodically refreshed by Path and Resv messages,” *Id.*, p.22, and provides “graceful support for dynamic membership changes and automatic adaptation to routing changes.” *Id.*, p.6.

80. Determining presence of members of a group would have been well-known to a POSTA by 2008. Indeed, by 2008, numerous communications systems used “presence detection” in the context of conference calls or instant messaging applications to monitor the presence of users. *E.g.*, Ex[1026], ¶¶[0016]-[0017]; Ex[1027], Abstract. The use of “presence detection” enabled communications systems “to capture information about various communication devices, or endpoints, available to a user and their status, such as whether a cellular phone is switched on or whether a user is logged into a personal computer (PC).” Ex[1026], ¶[0024]. Presence detection could be performed by a “presence server.” *Id.*, ¶[0028]. Further,

“presence information” could also represent whether a user is “logged in” or “logged out” of their system. Ex[1027], ¶[0035].

81. I note that use of RSVP specifically in a satellite network was also well-known prior as of September 2, 2008. For example, ETSI-157 focuses on standardizing IP quality of service (QoS) procedures for BSM networks. Ex[1011], p.8. ETSI-157 describes “QoS parameters and management mechanisms” and how they apply to BSMs “to ensure that their required performance is met” and, in particular, discloses how bandwidth is allocated and adjusted based on various factors. Ex[1011], p.8. ETSI-157 defines bandwidth on demand (BoD) as “a bandwidth sharing mechanism that allocates bandwidth to [a] requesting session based on a number of parameters including priorities and other QoS-related mechanisms.” Ex[1011], p.31. Moreover, ETSI-157 discloses that a satellite gateway or satellite terminal can use RSVP, as defined in RFC-2205 (Ex[1006]), to allocate bandwidth on demand. Ex[1011], pp.34-35.

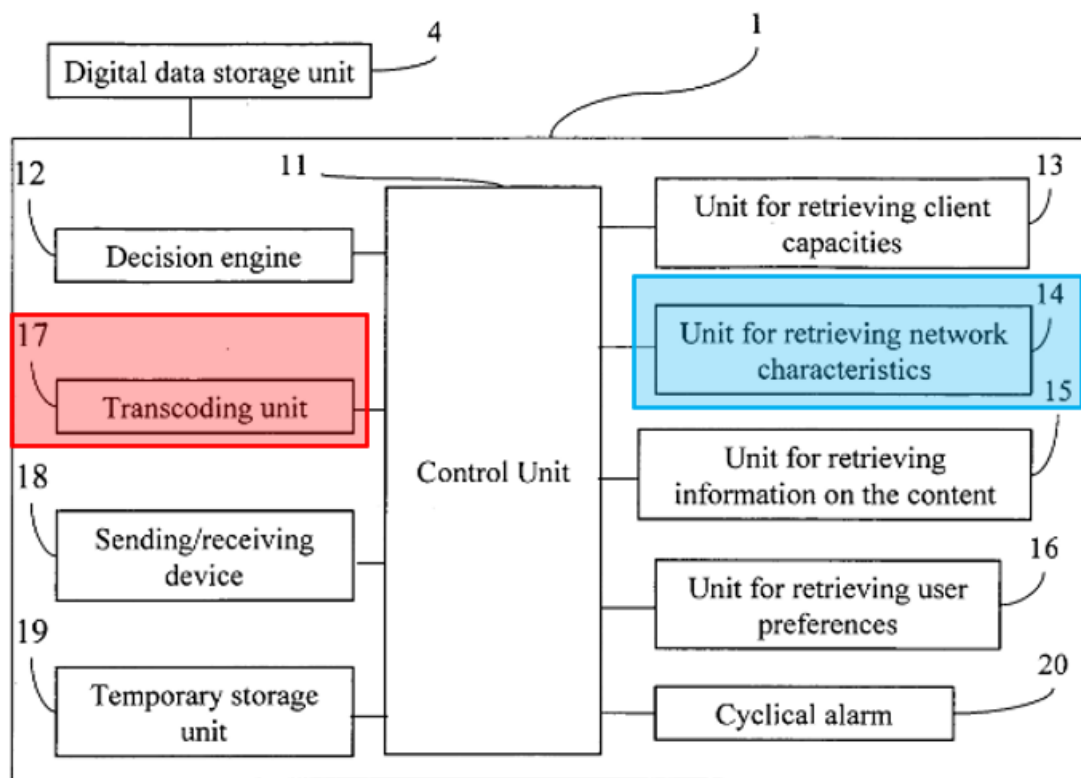
E. Transcoding, Including in Satellite Networks

82. Transcoding based on available bandwidth in a communication session was well-known prior to September 2, 2008.

83. For example, Liu gives an overview of transcoding for multicast networking systems for video applications. *See, generally*, Ex[1021]. The methods

described in Liu apply for various communication networks and applications including transcoding for IP multicast, video, and audio. *Id.*, pp. 1, 7.

84. As another example, U.S. Patent Application Publication No. 2005/0021726 (“Denoual”), which was filed in 2004 and published in 2005, explains that transcoding was used to “obtain a high Quality Of Service” by adapting video to the context in which it was transmitted. Ex[1031], ¶[0012]. Denoual explains that “[t]he average use of bandwidth” could be used “to anticipate a possible overload of the network and thus to react . . . by modifying the transcoding.” *Id.*, ¶[0018]. Denoual further explains that where “the rate necessary for the transmission of a [video] segment proves to be greater than the available bandwidth,” a method of transcoding is employed to adapt to the available bandwidth. *Id.*, ¶[0026]. Denoual provides a method wherein acceptable “transcoding methods” are determined and selected based on calculated bitstream rates. *Id.*, cl. 1. Figure 1, below, shows that the system disclosed in Denoual included both a “Transcoding unit” and a “Unit for retrieving network characteristics” (e.g., a unit for determining available bandwidth).



Id., FIG. 1 (annotated).

85. Transcoding was known to be particularly useful for satellite communications. Given the limited resources available, transcoding could be used to reduce the bit rate for a multimedia communication. For example, ETSI-157 discloses a “Codec Type” field included in the “QoS metadata” for a satellite link that can be used to accommodate available bandwidth. Ex[1011], p.68.

86. In my opinion, in light of the state of the art by September 2008, no individual elements of the Challenged Claims of the ’134 patent were novel at the time of the alleged invention, and there was nothing novel or inventive about the

manner in which those elements were combined in the Challenged Claims. Further, there were no technological barriers to combining these known elements to form the claimed inventions. Indeed, combining these elements would have yielded predictable results, as reflected in the systems I discuss further below.

VII. SUMMARY OF PRIOR ART

87. As previously stated, I have assumed, for the purposes of this analysis, that the Challenged Claims are entitled to a September 2, 2008 priority date.

A. ETSI-156 (Ex[1004]), ETSI-157 (Ex[1011]), ETSI-985 (Ex[1012])

88. In my opinion, a POSITA would have considered ETSI and its website – <http://www.etsi.org> – as reliable and useful sources of information for research, study, development, or design of systems providing a satellite link for multicasting between two domains and allocating and adjusting bandwidth for the link based on various factors.³ Based on my professional experience, in my opinion ETSI is a reliable authority for information regarding the research, study, development, or design of such networking and communication technology.

1. Status of ETSI-156

89. *Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP interworking over satellite; Multicasting*, ETSI TR 102 156 v1.1.1 (“ETSI-156”), was published April 2003, which is more than one year before the

³ <https://www.etsi.org/about>

assumed September 2, 2008 priority date of the '134 patent. I understand from counsel for Petitioner that ETSI-156 therefore qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b). ETSI-156 is the international standard developed on the standardization of Broadband Satellite Multimedia (BSM) multicast to be used as the technical specifications to be produced by ETSI.

2. Status of ETSI-157

90. *Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP Interworking over satellite; Performance, Availability and Quality of Service*, ETSI TR 102 157 v1.1.1 (“ETSI-157”), was published July 2003, which is more than one year before assumed the September 2, 2008 priority date of the '134 patent. I understand from counsel for Petitioner that ETSI-157 therefore qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b). ETSI-157 is also related to a standardization of Broadband Satellite Multimedia (BSM) multicast and establishes a framework for specifying quality of service (QoS) requirements for Broadband Satellite (BSM) Networks.

3. Status of ETSI-985

91. *Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP over Satellite*, ETSI TR 101 985 v1.1.2 (“ETSI-985”), was published November 2002, which is more than one year before the assumed September 2, 2008 priority date of the '134 patent. I understand from counsel for Petitioner that ETSI-

985 therefore qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b). ETSI-985 is also related to a standardization of Broadband Satellite Multimedia (BSM) multicast and provides additional details regarding lower level satellite dependent functionality.

4. Overview of the Disclosure of ETSI-156, ETSI-157, and ETSI-985

92. ETSI-156, ETSI-157, and ETSI-985 refer to three related technical specifications published by ETSI relating to a “broadband satellite multimedia” (“BSM”) network.

93. ETSI (the European Telecommunications Standards Institute) is a European Standards Organization (ESO) and promulgates standards related to telecommunications, broadcasting, and other communications networks and services. Each of ETSI-156, ETSI-157, and ETSI-985 were put forth by the Technical Committee Satellite Earth Stations and Systems (SES) which is “responsible for standardization relating to all types of satellite communication systems, services and application” including BSM systems (*i.e.*, the focus of ETSI-156, ETSI-157, and ETSI-985). Ex[1017], p.1; *see* Ex[1004], p.1, 6; Ex[1011], p.1; Ex[1012], p.1, 6. In my opinion, while this document refers to each of the ETSI technical specifications separately, a POSITA would have understood that these specifications are all documents that are part of the same standard.

94. The three specifications generally relate to the use of BSM networks “to transport IP-structured traffic.” Ex[1012], p.7. FIG.2 of ETSI-157 (below) discloses the basic components of the BSM network. As shown, a BSM network is composed of “one or more satellites” connecting various networks. Ex[1011], p.19; *see id.*, p.20, FIG.2. For example, as shown in FIG. 2, the satellites connect three networks: LAN, Internet, and Operating network via the controllers and gateways. *Id.*, p.20. A local area network (LAN) of end users can connect to a satellite terminal (ST) that can manage communications with another wide area network of end users (*e.g.*, the Internet) connected to a satellite gateway. *Id.*, p.20.

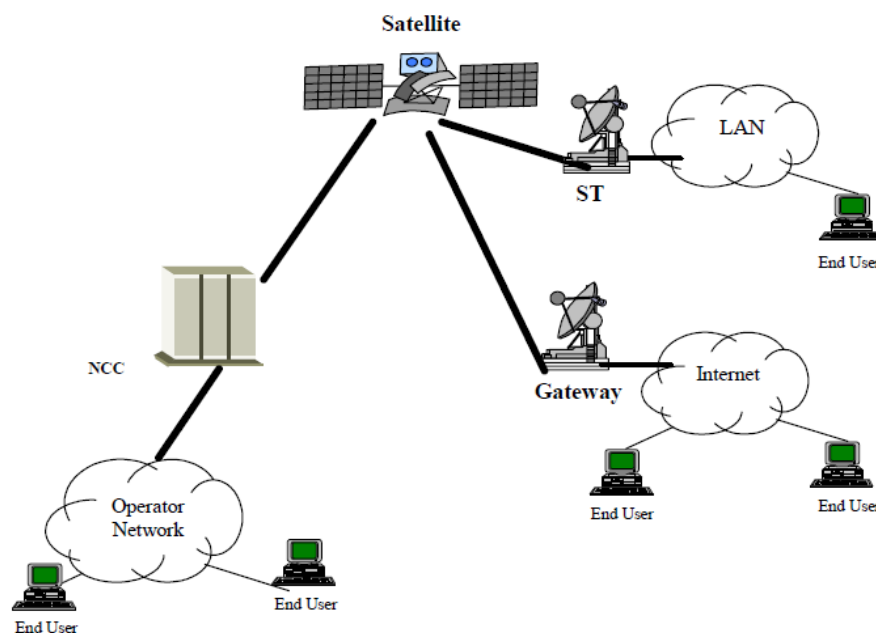


Figure 2: Generic BSM system

95. The different ETSI specifications cross-reference each other and describe different aspects of this system. For example, ETSI-156 specifically focuses

on the use of standards for “delivering IP Multicast over BSM networks.” Ex[1004], p.6. ETSI-156 specifically describes how multicast groups are formed in a BSM network and which protocols can be used to establish links, track group membership, and tear down links. ETSI-985 correspondingly describes additional details regarding lower layer satellite dependent functionality, including medium access control (MAC) layer and physical (PHY) layer components that transform the IP multicast packets into frames compatible with the satellite transmissions, using appropriate modulation and coding. Ex[1012], p.15. These MAC and PHY layer components are used in establishing a satellite link. *Id.*, p.17.

96. ETSI-157 focuses on standardizing IP quality of service (QoS) procedures for BSM networks. Ex[1011], p.8. For example, ETSI-157 describes “QoS parameters and management mechanisms” and how they apply to BSMs “to ensure that their required performance is met.” *Id.*, p.8. ETSI-157 specifically discloses how bandwidth is allocated and adjusted based on various factors. In particular, bandwidth on demand (BoD) is defined as “a bandwidth sharing mechanism that allocates bandwidth to [a] requesting session based on a number of parameters including priorities and other QoS-related mechanisms.” *Id.*, p.31. ETSI-157, for example, discloses that a satellite gateway or terminal can use a Resource ReSerVation Protocol (RSVP) to allocate bandwidth on demand to accommodate applications. *Id.*, pp.34-35.

B. RFC 2205 (Ex[1006])

1. Status of RFC 2205

97. *Resource ReSerVation Protocol (RSVP) – Version 1 Functional Specification* by Braden et. al. (RFC-2205) is a document issued and published by the Network Working Group of the Internet Engineering Task Force (IETF). In my opinion, a POSITA would have considered IETF documentation as reliable and useful sources of information for research, study, development, or design of systems providing a satellite link for multicasting between two domains and allocating and adjusting bandwidth for the link based on various factors. Based on my professional experience, in my opinion IETF is a reliable authority for information regarding the research, study, development, or design of such networking and communication technology.

98. RFC-2205 was published September 1997, which is more than one year before the assumed September 2, 2008 priority date of the '134 patent. I understand from counsel for Petitioner that RFC 2205 therefore qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).

2. Overview of the Disclosure of RFC 2205

99. RFC-2205 is cross-referenced in ETSI-157. RFC-2205 specifically discloses details regarding the RSVP protocol described in the ETSI specifications and how RSVP can be used to allocate and adjust bandwidth of a link. Ex[1006], pp.1-2, 6.

C. Dhesikan (Ex[1007])

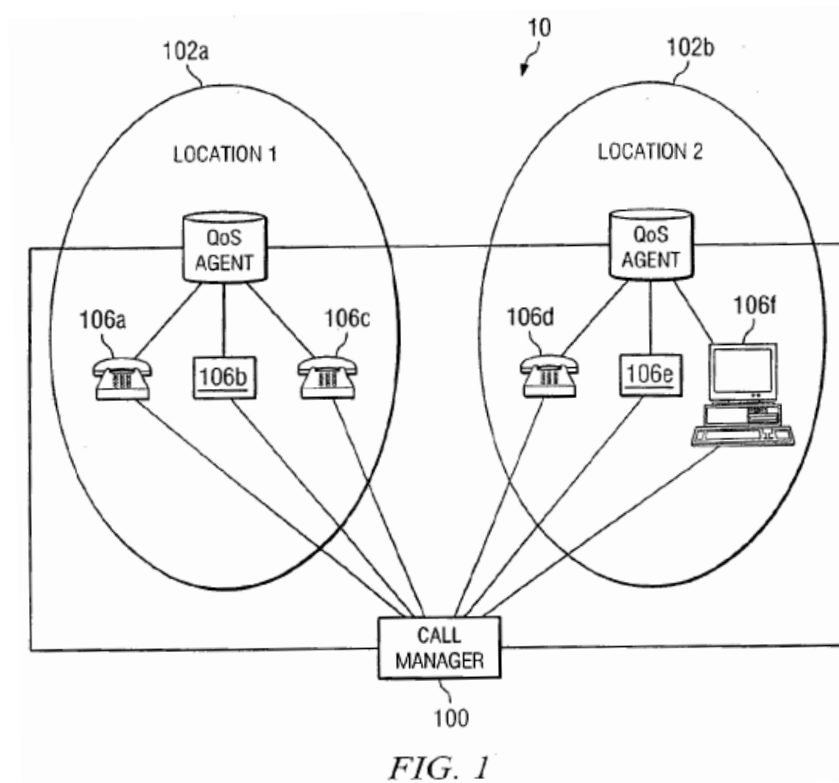
1. Status of Dhesikan

100. U.S. Patent Application Publication No. 2006/0268824 by Subhasri Dhesikan et al., entitled “System and Method for Preserving Bandwidth in a RSVP Environment” (“Dhesikan”) was filed August 31, 2005, and published November 30, 2006, which is more than one year before the assumed September 2, 2008 priority date of the ’134 patent. I understand from counsel for Petitioner that Dhesikan therefore qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).

2. Overview of the Disclosure of Dhesikan

101. Dhesikan discloses a “communication system 10” (FIG. 1 below) for teleconferencing and video conferencing applications. Ex[1007], ¶[0020]. Dhesikan discloses multiple locations (102a and 102b) comprising multiple endpoints (106a, 106c, 106d, and 106f) communicating with each other over network elements (not shown). *Id.*, ¶[0020]. Dhesikan additionally discloses quality of service (QoS) “agents 104” that establish and tear down links between the endpoints, allocate and adjust bandwidth of the links to “accommodate audio and video media streams” and additional conference participants, and select transcoding for the transmitted multimedia. *E.g., Id.*, ¶[0024]; FIGs. 2B, 8. Dhesikan discloses that the locations can be connected via generic network elements, including service providers. *Id.*, ¶[0022].

102. Like the '134 patent, Dhesikan discloses a communication system which has a manager agent that coordinates and supervises communications between endpoints. Ex[1007], ¶¶[0021]-[0022], FIG. 1. For example, QoS agent generates bandwidth reservations for a call in order to provide the call with a guaranteed amount of bandwidth and an established QoS. *Id.*, ¶[0024]. Each endpoint or location associated with an endpoint has a reservation policy that determines how calls are to be handled when a reservation is or is not obtained and when a reservation is lost during a call. *Id.*, ¶[0033].



Id., FIG. 1.

D. BGAN (Ex[1014] and Ex[1015])

1. Status of BGAN

103. BGAN is a technical bulletin that was published by the European Space Agency (ESA) in November 2005, and available on the Internet Archives as of October 9, 2006, which is more than one year before the assumed September 2, 2008 priority date of the '134 patent. I understand from counsel for Petitioner that BGAN therefore qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).

2. Overview of the Disclosure of BGAN

104. BGAN, or Broadband Global Area Network, discloses an on-demand commercial broadband satellite service for the “modern office” provided by Inmarsat. Ex[1014], p.2. BGAN is “[b]ased on IP technology,” and provides “IP-based mobile data communications” for “mobile multimedia” including conference calling. *Id.*, pp.3-5. BGAN can provide “guaranteed bandwidth on demand, enabling live video applications like video conferencing or video streaming,” as well as “multicast service capabilities.” *Id.*, pp.3, 5. The “BGAN Multicast Service” provides “reliable and secure multicast transport protocols ensuring quality of service for individual multicast flows.” *Id.*, p.6.

E. Firestone (Ex[1008])

1. Status of Firestone

105. U.S. Patent Application Publication No. 2005/0248652 by Scott E. Firestone et al., entitled “System and Method for Performing Distributed Video

Conferencing” (“Firestone”) was filed on July 12, 2005, and published November 10, 2005, which is more than one year before the assumed September 2, 2008 priority date of the ’134 patent. I understand from counsel for Petitioner that Firestone therefore qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(a) and 102(b).

2. Overview of the Disclosure of Firestone

106. Firestone, like Dhesikan, was originally assigned to Cisco and discloses a video conferencing system with “appropriate data-routing procedures to achieve optimal data management in a video conferencing environment.” Ex[1008], ¶[0003]. Firestone explains that “[m]edia switches 26” can be used in the communication system to “perform a number of functions” including “audio transcoding” and “video transcoding.” *Id.*, ¶[0034]. Like the ’134 patent, Firestone discloses a conferencing system with “appropriate data-routing procedures to achieve optimal data management in a video conferencing environment.” *Id.*, ¶[0003].

VIII. APPLICATION OF THE PRIOR ART TO THE CHALLENGED CLAIMS

107. I have been asked to provide my opinion as to whether the Challenged Claims of the ’134 patent would have been obvious in view of the prior art. The discussion below provides a detailed analysis of how the prior art references I reviewed disclose, teach, or suggest the limitations of the Challenged Claims of the ’134 patent.

108. As part of my analysis, I have considered the scope and content of the prior art and any potential differences between the claimed subject matter and the prior art. I have conducted my analysis as of the filing date/assumed priority date of the '134 patent: September 2, 2008. I have also considered the level of ordinary skill in the pertinent art as of that date.

109. Below, I describe in detail the scope and content of the prior art, as well as any differences between the subject matter claimed and the prior art, on an element-by-element basis for each challenged claim of the '134 patent. The analysis supports my finding that the differences between the claims of the '134 patent and the prior art discussed herein are such that the subject matter as a whole would have been obvious at the time of the assumed priority date of the '134 patent to a POSITA.

110. In the grounds below, I describe on an element-by-element basis how the prior art discloses or teaches all elements of Claims 1-14 of the '134 patent.

A. Grounds of Unpatentability

111. I have reviewed and analyzed the prior art references and materials listed in Section III above. In my opinion, the Challenged Claims of the '134 patent are rendered obvious based on the following prior art set forth in Grounds 1-2 below:

Ground	'134 Patent Claims	Basis for Challenge
1	1-14	Obvious under §103 based on Dhesikan in view of BGAN and Firestone
2	1-14	Obvious under §103 based on ETSI-156 in view of

		ETSI-157, ETSI-985, and RFC-2205
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B. Ground 1: Claims 1-14 are obvious over ETSI-156 in view of ETSI-157, ETSI-985, and RFC-2205.

1. Motivation to Combine ETSI-156 with ETSI-157, ETSI-985, and RFC-2205.

112. In my opinion, ETSI-156, ETSI-157, ETSI-985, and RFC-2205 are analogous art to the '134 patent because each relates to the field of communications networks, Broadband communication, LAN, IP, network management and satellite communication system. A POSITA would have been motivated to combine ETSI-156, ETSI-157, ETSI-985, and RFC-2205 for several reasons.

113. First, as a general matter, a POSITA would have been motivated to combine these four references, and would have had a reasonable expectation of success in doing so, because they all relate to BSM systems, refer to and cross-reference each other, and are intended to work together. Specifically, as described above, ETSI-156, ETSI-157, and ETSI-985 are all integrated into the same set of specifications relating to BSM networks and are promulgated by the same technical committee at ETSI. Ex[1004], pp.6, 13-14, 72; Ex[1011], pp.8-9; Ex[1012], p.7. ETSI (the European Telecommunications Standards Institute) is a European Standards Organization (ESO) and promulgates standards related to telecommunications, broadcasting, and other communications networks and services. ETSI is an international standard organization attended by many major

communication industries developing and approving standards. Each of ETSI-156, ETSI-157, and ETSI-985 were put forth by the Technical Committee Satellite Earth Stations and Systems (SES) which is “responsible for standardization relating to all types of satellite communication systems, services and application” including BSM systems (the focus of ETSI-156, ETSI-157, and ETSI-985). Ex[1017], p.1; *see* Ex[1004], p.1, 6; Ex[1011], p.1; Ex[1012], p.1, 6. ETSI’s activities in satellite communications include satellite communication services and applications (including mobile and broadcasting), earth stations and earth station equipment, especially the radio frequency interfaces and network and/or user interfaces and protocols implemented in earth stations and satellite systems.

114. In my opinion, each of the specifications describe different aspects of the same BSM network system. ETSI-156 discloses BSM networks for “delivering IP Multicast,” including “service architectures for satellite multicasting,” and the gateways and terminals used in the networks. Ex[1004], pp.6-7. ETSI-157 describes details regarding certain components of the gateways and terminals described in ETSI-156, including a BSM Protocol Manager that maintains Quality of Service (“QoS”). Ex[1011], p.64. ETSI-157 specifically discloses that a gateway or satellite terminal (and its internal BSM Protocol Manager) uses a Resource ReSerVation Protocol (RSVP) to allocate bandwidth on demand to accommodate applications. *Id.*, pp.34-35. ETSI-985 describes details regarding other components of the

gateways and terminals, including the MAC layer and PHY layer components that transform IP multicast packets into frames compatible with the satellite transmissions, using appropriate modulation and coding. Ex[1012], p.15. Finally, RFC-2205, a known Internet Engineering Task Force (IETF) specification describing the RSVP protocol, is described in detail and referenced by ETSI-156, ETSI-157, and ETSI-985 to explain the use of RSVP in a BSM network. Ex[1004], pp.71-72; Ex[1011], pp.34-35; Ex[1012], pp.24-25; *see* Ex[1006], p.4. Thus, in my opinion, a POSITA looking to implement a BSM network that complies with international standards would have sought out, and been motivated to combine, the teachings of ETSI-156, ETSI-157, ETSI-985, and RFC-2205.

115. More specifically, a POSITA would have been motivated to combine ETSI-156 with ETSI-157's description of QoS and use of RSVP to allocate bandwidth, as further supplemented by RFC-2205, because ETSI-157 and RFC-2205 provide detail on how RSVP may be used to reserve bandwidth and manage QoS in a communication session. In fact, here, no modification would be needed to any of the references, because they are specifically designed to be used together and all are intended to provide a multicast communication system with dynamic QoS management. Ex[1004], pp.7, 71-72; Ex[1011], pp.10, 25; Ex[1006], pp.1, 6. Moreover, ETSI-156 explicitly encourages the use of RSVP, disclosed in both ETSI-157 and RFC-2205, to address the QOS requirements of ETSI-156's BSM network.

ETSI-157 and RFC-2205 simply provide a detailed explanation of RSVP and QoS management as referenced in ETSI-156. Accordingly, in my opinion, a POSITA would have understood that implementing ETSI-156 with ETSI-157's description of QoS and use of RSVP as further supplemented by RFC-2205 would have been a predictable combination of known, standardized elements reasonably expected to succeed.

116. Likewise, a POSITA would have been motivated to combine ETSI-156 with ETSI-985's description of MAC layer and PHY layer components because ETSI-985 provides implementation details regarding how the MAC layer and PHY layer components may be used to establish the satellite link discussed in ETSI-156. Ex[1012], p.29. Again, no modification would be needed to the references because they are intended and specifically designed to be used together and both provide a multicast communication system (e.g., a BSM network with dynamic QoS management) and describe systems aimed at providing IP-based services via BSM networks. Ex[1004], pp.7, 13; Ex[1012], p.7. Moreover, ETSI-156 references the MAC and PHY layer on which ETSI-985 provides additional detail. *E.g.*, Ex[1004], p.100; Ex[1012], p.17. Accordingly, in my opinion, a POSITA would have understood that implementing ETSI-156 with ETSI-985's description of MAC layer and PHY layer components would have been a predictable combination of known,

standardized elements according to their established functions, reasonably expected to succeed.

2. Claim 1

a. 1[Pre]: “An apparatus”

117. If the preamble is limiting, ETSI-156 discloses “[a]n apparatus.” For example, ETSI-156 discloses a “Broadband Satellite Multimedia [(BSM)]” network for multicasting content. Ex[1004], pp.13-14.

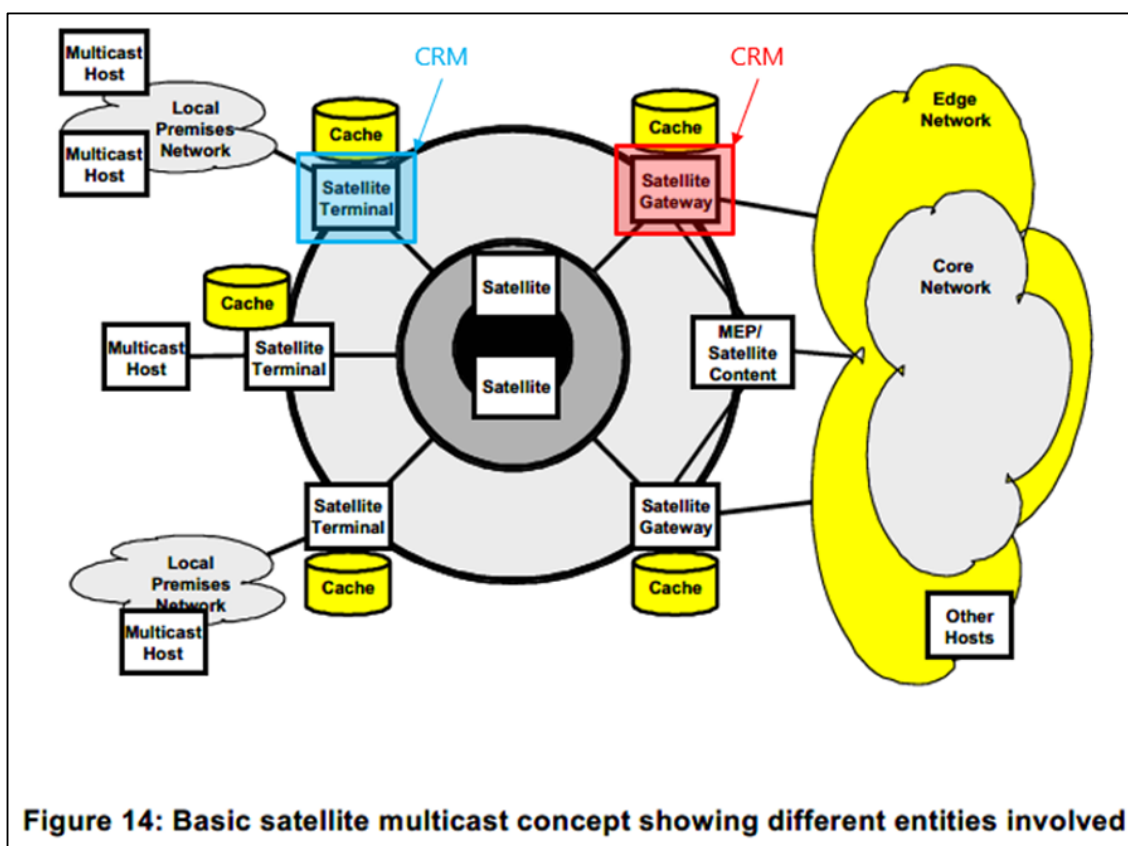
b. 1[a]: “a first communication resource manager located in a first domain and operable to interact with a second communication resource manager located in a second domain”

118. ETSI-156 discloses limitation 1[a]. Each network in a BSM is a domain that interact with other networks (*domains*) via its gateway or satellite terminal (*communication resource manager*) that manages resources, including satellite links.⁴

119. In particular, as shown in FIG. 14 below, ETSI-156 teaches that a BSM system includes a satellite that connects at least two domains, *e.g.*, (1) a core network (Internet); and (2) a local premises (LAN) network. Ex[1004], p.42. In my opinion, both domains have a *communication resource manager* (CRM)—in one domain, the

⁴ As I explain for this limitation and limitation 1[b], each CRM also constitutes software and/or hardware that controls a satellite link for multicasting and tracks presence data. Ex[1036].

first CRM is a gateway or satellite terminal (ST) connected to the core network (red), and, in the other domain, the second CRM is the gateway or satellite terminal connected to the local network (blue). *Id.* Gateways and satellite terminals have similar components and either one constitutes a CRM; the former is used to connect to a core network, whereas the latter is used to connect to a local area network. *Id.*, pp.42-43.



Id., p.42 (annotated).

120. For example, ETSI-156 expressly discloses using the above BSM architecture for multicast applications. *Id.*, pp.13, 32. In general, ETSI-156 discloses several multicast applications including one-to-many services, such as “Internet TV”

or “streaming media” such as a “web concert,” as well as “many-to-many” services, such as “teleconferencing.” *Id.*, pp.13, 35. In FIG. 14 (above), the BSM “satellite multicast” architecture includes a core network (a domain also with its own CRM, in red), and several local premises networks (each a domain with its own CRM, in blue). *Id.*, p.41.

121. The two CRMs are *operable to interact* with each other. For example, FIG. 18 of ETSI-156 (annotated below) shows the interaction of the two CRMs and depicts a “star network” satellite system connecting two domains (IP networks), each with a CRM. *Id.*, p.49. Here, the first CRM (gateway, referred to as “[h]ub terminal”⁵) creates a satellite link to the second CRM (ST, referred to as “[r]emote terminal”), so that users connected to the gateway (*e.g.*, participants in a teleconference) can stream media to users connected to the satellite terminal (*e.g.*, other participants in a teleconference) via the satellite link. *Id.*, p.49; *see also id.*, pp.32, 35. All multicast data to any host connected to any terminal on the satellite network would have to enter the satellite network through the gateway or hub (contact point). *Id.*, p.49-50. Notably, a satellite can connect multiple satellite

⁵ In a “star network,” a gateway acts as a “[h]ub terminal” for “[r]emote terminal[s]” (STs). Ex[1004], pp.48-49; *see* Ex[1012], p.13. This hub terminal is analogous to the Gateway shown above in FIG. 14. Ex[1004], p.42.

terminals in other configurations including, for example, a “mesh” formation. *Id.*, pp.8, 53, FIG. 25.

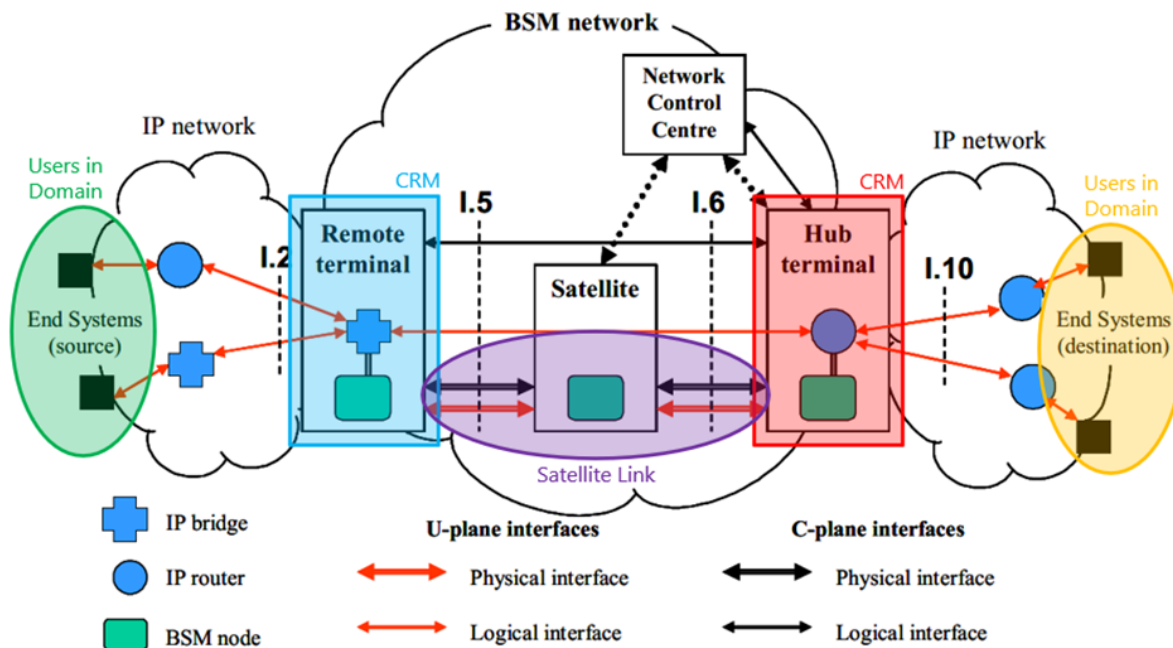


Figure 18: Star network architecture from TR 101 984

122. In my opinion, each CRM also controls and manages resources, including a satellite link for multicasting. ETSI-156, for example, describes that the satellite terminals and gateways (CRMs) include “[s]atellite [i]ndependent” (SI) components, which implement non-satellite protocols, and “satellite dependent” components, which create physical satellite links. *Id.*, pp.90-93. The CRMs, for example, “maintain a set of[] tables” tracking presence data and identifying which receiver terminals needs to receive which multicast messages, which routes the messages should take, and “which coding/modulation/power should be used in each beam.” *Id.*, pp.51, 44 (describing use of satellite links in IP multicast routing trees).

The CRMs also include a BSM Multicast Proxy (BSM-MP), which “will act as a multicast manager” and is designed to “optimize the use of” satellite resources by controlling, for example, “session management.” Ex[1004], pp.16 (acronym list), 90-91, 93.

123. ETSI-157 provides further details regarding the CRM’s management and control functions. For example, ETSI-157 explains that each CRM also includes a BSM Protocol Manager that adjusts the bandwidth or other parameters to maintain Quality of Service (“QoS”). Ex[1011], p.64 (describing that the BSM Protocol Manager is implemented in a “ST” (satellite terminal)). ETSI-157 explains that “[a] network with QoS support provides certain priorities and guarantees to specific network traffic” including but not limited to “dedicated bandwidth controlled or managed jitter and latency for some real-time and interactive traffic, and predictable end-to-end loss characteristics.” *Id.*, p.18. As illustrated in FIG. 19 (below), the BSM Protocol Manager, for example, “defines how IP protocols and packet markings are interpreted and transmitted through the BSM, which satellite independent (SI) protocols are used and how they in turn trigger Satellite Dependent (SD) functions.” *Id.*, p.64. In my opinion, the BSM Protocol Manager is an “intelligent” traffic manager; it “receives information from various interfaces and decides on the BSM protocol to trigger.” *Id.*, pp.64, 66, FIG. 20.

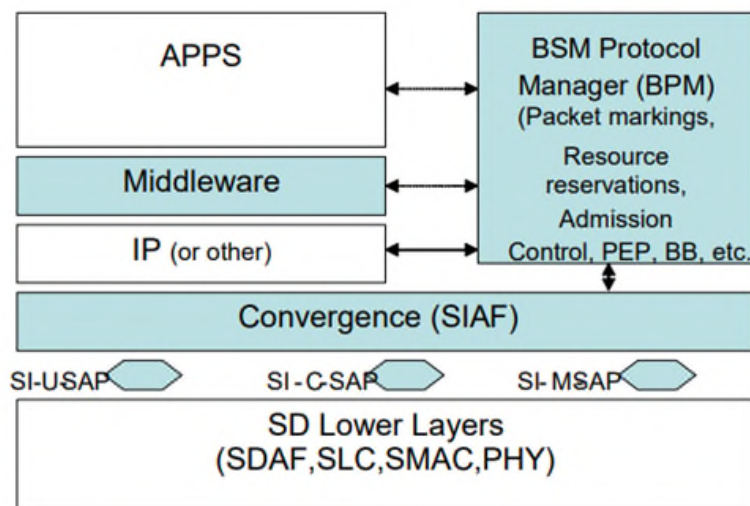


Figure 19: Protocol manager - System architecture

Id., p.65.

- c. 1[b]: “determine[s] to establish a link for multicasting between users in the first domain and users in the second domain based on presence data of at least one user in the first domain and at least one user in the second domain”

124. ETSI-156 in view of ETSI-985 discloses limitation 1[b]. The gateway or satellite terminal (CRM) in the first network (domain) establishes a satellite link for multicasting between users in the first domain and a second domain if it detects that at least one user is active in each domain (presence data).⁶

⁶ As I describe for this limitation, the satellite link simultaneously delivers information between a group of users in the first domain and a group of users in the second domain using the most efficient strategy, Ex[1036], and the link is established based on presence data, *e.g.*, a “status indicator that conveys an ability and/or willingness of a potential communication partner to communicate.” *Id.*

125. First, in my opinion, ETSI-156 discloses that the first CRM (gateway or satellite terminal) establishes a satellite link for multicasting. The first CRM establishes a satellite link for multicasting by “mapping” multicast IP addresses into “satellite layer 2 addresses,” which creates a satellite link to a receiver. Ex[1004], p.67. In particular, the first CRM specifies: the address for the recipients; the modulation and coding scheme needed for the type of transmission; and whether the transmission requires reliable multicast (*e.g.*, file transfers) or semi-reliable multicast (*e.g.*, audio- and video-conferencing). *Id.*, pp.62, 64. The link simultaneously delivers information between a group of users in the first domain and a group of users in a second domain using the most efficient strategy,⁷ for example, during audio and video conferencing. *Id.*, p.35 (“satellite IP multicast should support existing multicast applications such as reliable file transfer, data distribution and multimedia streaming including video, voice and data); *id.* (describing many-to-many multicast including “[t]eleconferencing” and “[w]hiteboard”); *id.* p.14 (describing that “[r]eal-time applications may include interactive video-conferencing to many parties...”); *id.* p.66 (“Multicasting routing within BSM network may be static or dynamic. It should be dynamic to allow efficient use of bandwidth.”); *id.* p.43 (“Efficiency is here considered to be with the minimum use

⁷ In general, IP multicasting uses a unique address to “transport data to multiple destination stations using a single IP packet.” Ex[1004], 67.

of spectrum resources while fulfilling the multicast requirements that are given for that group (i.e., time delay, etc.).”).⁸

126. ETSI-985 provides additional details as to how the first CRM establishes a satellite link. For example, as shown in Figure 5.3.3.4 from ETSI-985 (below, annotated), each CRM in each domain (satellite terminal (ST) #1 and #2, blue and red below) includes, as part of its satellite dependent functionality, MAC layer and PHY layer components that transform the IP multicast packets into frames compatible with the satellite transmissions, using appropriate modulation and coding. Ex[1012], p.15.

⁸ ETSI-156 recognizes that multi-party video conferencing is “possible” but “complex.” Ex[1004], p.46. In my opinion, a POSITA could have readily achieved multi-party video conferencing over satellite from the disclosures in the ETSI Specifications. Indeed, BGAN, which I describe for Ground 2, disclosed a commercial service for video conferencing over satellite well before the assumed priority date for the ’134 patent. Ex[1014], p.66 (“The Streaming IP data service, available on selected BGAN terminals, will offer guaranteed bandwidth on demand, enabling live video applications like video conferencing or video streaming.”).

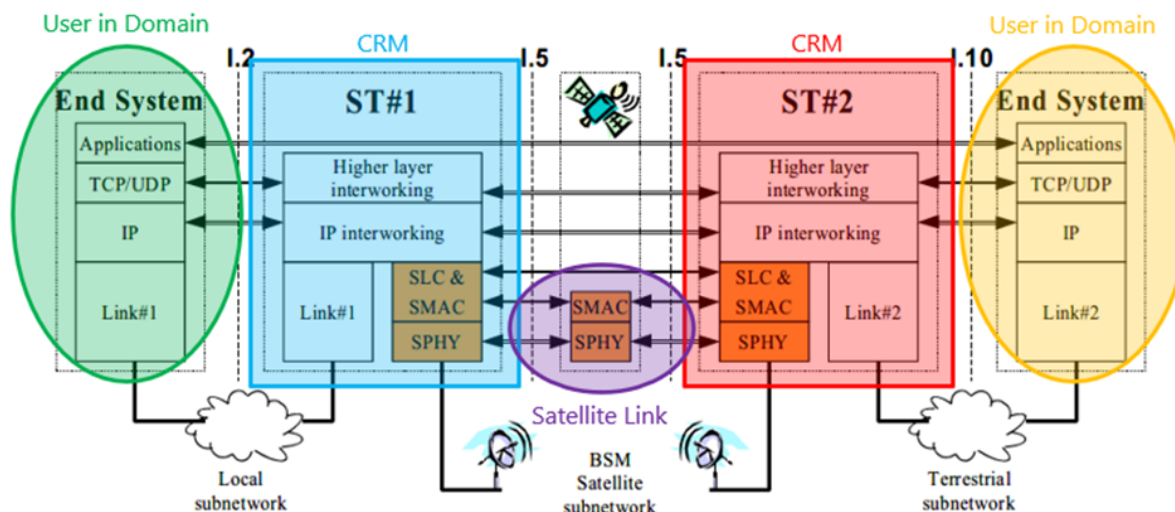


Figure 5.3.3.4: Higher layer interworking functions

Id., p.17 (annotated).

127. Second, the link for multicasting can be between *users* in the first domain and *users* in the second domain. In a BSM network, for example, the satellite link for multicasting can be used for “multi-party video conferen[ces],” that connect participants in a call located in the two domains. Ex[1004], p.46. ETSI-156 also describes “[s]atellite systems” that “can support mobile and/or nomadic users” and support multicasting on a “*user* basis.” *Id.*, p.67. For example, Figure 5.3.3.4 from ETSI-985 (above) shows a satellite link connecting “[e]nd [s]ystem[s]” in each domain (green and yellow), each of which communicate via TCP/UDP and IP protocols. Ex[1012], p.17. Each end system is operated by an “end user,” and the BSM network is designed to ensure a reliable QoS “experienced by the end user.” *Id.*, p.20 (describing “user” satisfaction as measured by multiple parameters).

128. Third, to establish the link, the first CRM determines presence data of at least one user in the first domain and one user in the second domain. In general, in a BSM network, “the spectrum resources need to be used wisely.” Ex[1004], p.58. “[R]esources are limited and should be used carefully,” and it is important to monitor presence information using a “satellite group management system.” *Id.*, pp.68-69, 55 (“[e]fficient satellite multicast” should send not send data where “no target receivers are known), 95 (“multicast data should only require capacity in those beams that have subscribers to the content”).

129. Accordingly, each CRM includes tables of available “hosts and multicast groups” (*presence data*) that “[i]dentify where these receivers are (at the moment).” *Id.*, pp.58, 62. “A multicast session can be terminated either by reaching the end of a scheduled duration, by signalling from the session owner that the multicast session has ended, or, for sessions that have no duration, when no data has been sent for a configurable amount of time.” *Id.*, p.109. A CRM thus knows the “availability of a multicast source” (in the first domain) and “which down-links need to receive this multicast transmission” to address multicast receivers (in the second domain). *Id.*, p.95. To build the tables of presence data, ETSI-156 discloses that CRMs implement multicast protocols, such as Internet Group Management Protocol (IGMP) and Protocol Independent Multicast - Sparse Mode (PIM-SM). *Id.*, p.86. IGMP is a “group membership protocol,” and PIM-SM is an “IP multicast routing

protocol.” Ex[1012], pp.34-35. “IP multicast requires destination hosts wanting to receive a multicast to subscribe, using [IGMP] (which supports other related functions, such as leaving a multicast group).” Ex[1004], p.18. In my opinion, these protocols are adapted for a BSM network to take into account that “bandwidth on BSM network needs to be efficiently used by services.” Ex[1012], p.35.

130. For example, IGMP “is an Internet protocol that provides a way for an Internet computer to report its multicast group membership to adjacent routers” and “verify whether known group members are still active.” Ex[1004], p.22. In a BSM network, IGMP is implemented at a “satellite terminal” to determine if hosts are present and available and to convey a status indicator of ability and/or willingness if the host can communicate. *Id.*, pp.66, 69, 87 (describing use of IGMP version 2 at terminals); Ex[1001], 6:41-44 (describing presence information). Specifically, using IGMP, each host in a satellite multicast group periodically sends a report to notify the group of its presence. Ex[1004], p.68. In several applications, such as teleconferencing, each host can represent a “user,” such as a participant in the teleconference, that can join and leave the multicast teleconference group. *Id.*, p.69; *see also id.*, p.102 (“The initiative to subscribe to a multicast group would come from the end user...”). The user’s report is received at the terminal (CRM), which collects presence information about all hosts in the group. *Id.*, p.66; *id.*, p.69

(describing “simple IGMP router functionality in the terminal, that ‘looks and feels’ as an IGMP router to the host computer.”).⁹

131. Finally, ETSI-156 explains that a first CRM manages the presence data of users in two domains in determining to establish the satellite link. For example, the below annotated flow diagram illustrates the process of establishing a link when a new user at a host in one domain sends an IGMP message to its connected terminal announcing that it would like to join a multicast group in another domain (“IGMP message” below). *Id.*, p.94. Here, the first CRM is a gateway already participating in the multicast group, and the second CRM is the satellite terminal that seeks to join the group.

132. If the user’s terminal had not previously subscribed to the group (the group is not “here” at the terminal, below), the terminal relays the request to the gateway in the source domain (first CRM in a first domain) (“Request new group message” below). If the group is available on the gateway (“Yes,” below), then the gateway (first CRM) determines presence information about both the (a) host (“source”) of the user in the first domain, and (b) new recipient host in the second domain. *Id.*, p.94, FIG. 38; *see also id.* p.102. “At this point [the gateway, CRM] can

⁹ Similarly, ETSI-985 describes that PIM-SM is used at gateways (other CRMs) to set timers to determine if a host is still active, or if the host should be “pruned” from the CRM’s routing table. Ex[1012], p.36; *see also* Ex[1004], p.66.

consider the requirements for the source and terminals (QoS setting, reliable multicast, capabilities of the terminal, subscription perhaps, and so on).” *Id.*, p.102. If appropriate, the gateway then establishes a satellite link to the terminal by passing the “Group ID” and “related params,” after which the terminal can start receiving from the group over the link. *Id.*, p.94, FIG. 38. The first CRM also modifies its tables so future payloads from the source are sent to the new user. *Id.*, pp.104, 108. This ensures that “[d]ata is forwarded only to those satellite terminals (ST) that have multicast members connected to them.” *Id.*, p.104.

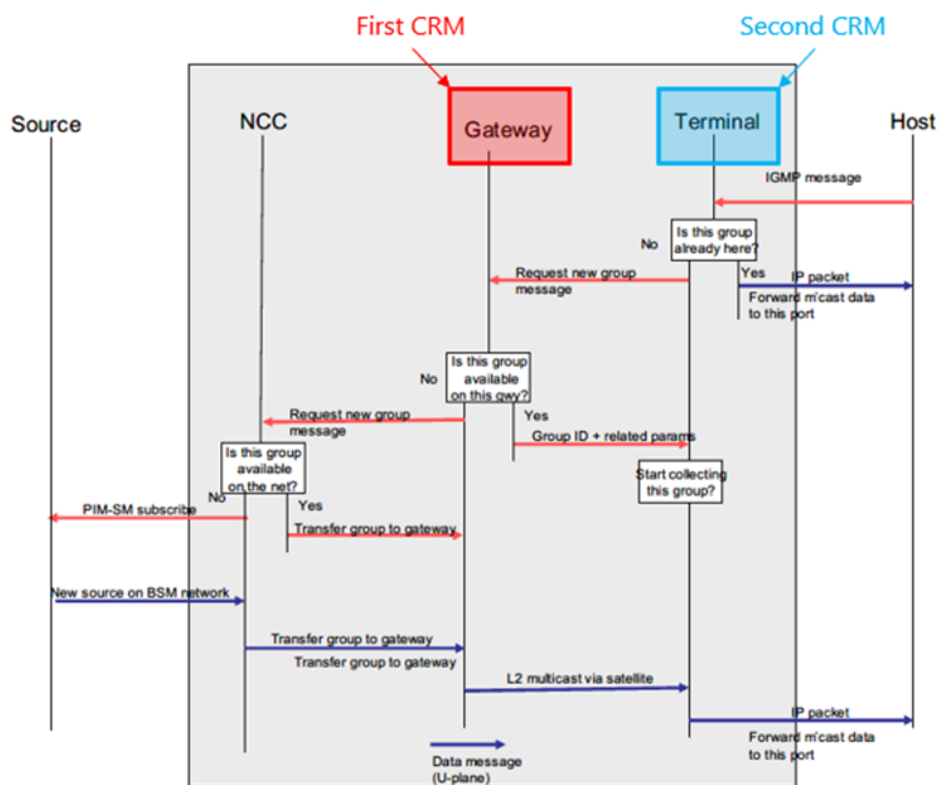


Figure 38: Interworking example

Id., p.94 (annotated).

d. 1[c]: “determine[s] an application to be used in a communication session over the link”

133. ETSI-156 in view of ETSI-157 discloses limitation 1[c]. ETSI-156 discloses that the first CRM can determine a variety of applications to be used over the multicast link in a communication session. *Id.*, pp.34-35. For example, applications may include “[c]onversational services” such as “video telephony” and “video-conferences,” “[m]essage services” such as “video mail and document mail,” and “[r]etrieval services” such as “video” and “high-resolution imag[ing].” *Id.*, p.34. Further, “satellite IP multicast should support existing multicast applications such as reliable file transfer, data distribution and multimedia streaming including video, voice and data.” *Id.*, p.35.

134. After determining to establish a link, the first CRM determines the application as part of its resource reservation process. Each application “may have different QoS requirements.” *Id.* A CRM’s QoS management therefore determines the application to be transmitted in the session, which in turn determines “guaranteed bandwidth and delay” for the session. *Id.*, p.72. Such QoS management occurs in the CRMs (gateways and terminals), using the CRM’s BSM Protocol Manager and BSM-MP. *Id.*, p.100 (figure); §VIII.B.2.c.

135. ETSI-157 provides additional details of a CRM’s determination of an application. ETSI-157 specifically discloses that QoS management and performance monitoring are “located in the gateway and the terminals” (CRMs). Ex[1011], p.23.

ETSI-157 defines QoS to mean “the collective effect of service performances which determine the degree of satisfaction of a user of a service,” and specifies that QoS requires the “ability to segment traffic between service types or streams” so that certain services can be prioritized. *Id.*, pp.26-27. ETSI-157, for example, describes different QoS classes based on application, including VoIP and video streaming, which a CRM determines so that the CRM can determine the QoS to implement. *Id.*, pp.28, 42; *see also id.*, p.27 (disclosing a functional model for a CRM’s implementation of QoS, including satellite independent access functions (SIAF) and satellite dependent access functions (SDAF)). ETSI-157 maps QoS classes to applications such that choosing a QoS class determines the application. *Id.*, p.28 (describing different QoS classes based on application). Additionally, a bandwidth reservation request “generally includes a ‘service class’” “that specifies the desired QoS.” *Id.*, p.35. For example, a “QoS class” of “High” indicates VoIP, interactive application, and a “QoS class” of “Medium” with a “Low delay” indicates “Streaming Audio/Video.” *Id.*, p.46. ETSI-157 also describes different performance targets for audio and video applications. *Id.* p.57.

- e. 1[d]: “allocate[s] a bandwidth level to be used for the link to accommodate the application”

136. ETSI-156 in view of ETSI-157 discloses limitation 1[d]. ETSI-157 discloses that a first CRM (gateway or satellite) can use an RSVP protocol for allocating bandwidth on demand to accommodate an application.

137. ETSI-157, for example, discloses “bandwidth on demand” for allocating bandwidth to a particular satellite link transporting a specific application. In general, ETSI-157 describes that satellite spectrum resources “are very limited,” and “hence tight bandwidth management is central to BSM QoS.”¹⁰ *Id.*, p.25. Bandwidth-on-demand (BoD) “defines a bandwidth sharing mechanism that allocates bandwidth to requesting session based on a number of parameters including priorities and other QoS-related mechanisms.” *Id.*, p.31. Moreover, the parameters for determining bandwidth include the *application* to be sent over the link: “[a]ny QoS mechanism must ensure that bandwidth is available for high priority (or high revenue generating) services even if it means dropping lower level sessions in times of high load or high noise.” *Id.*, p.25.

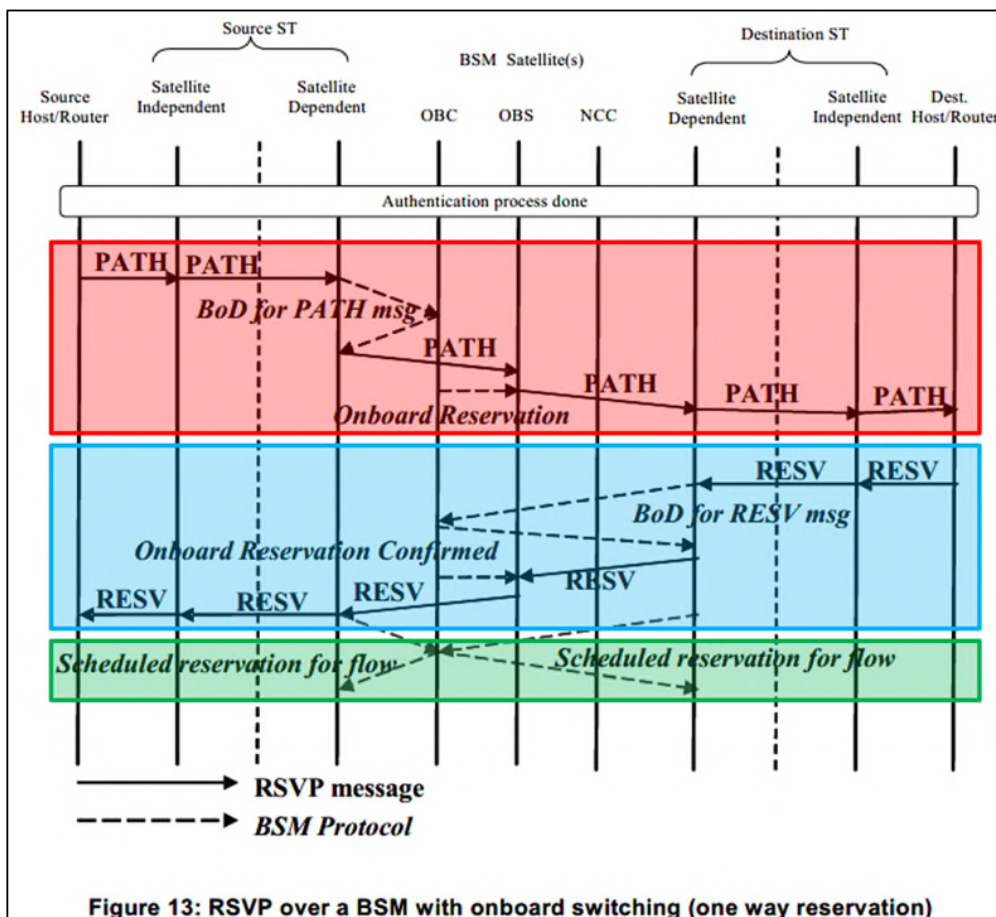
138. ETSI-157 specifically discloses that a first CRM (gateway or satellite terminal) uses a Resource ReSerVation Protocol (RSVP) to allocate bandwidth on demand to accommodate applications. *Id.*, pp.34-35. RSVP is a “signalling protocol designed to request a specific Quality of Service (QoS) from the network for a data stream.” *Id.*, p.35. Using RSVP, “bandwidth is reserved” for a flow from a source to

¹⁰For example, “[g]enerally, replication should be done close to the IP multicast group member, as this saves bandwidth.” *Id.*, p.60. “Multicast routing within BSM network may be static or dynamic.” *Id.*, p.65. “It should be dynamic to allow efficient use of bandwidth.” *Id.*

a destination, where the flow is associated with a “desired QoS” for the specific “service class” and performance target associated with an application. *Id.*, pp.34-35. Indeed, “BSM offers an advantage over terrestrial wired networks: because of the coverage of most BSM there will be a lesser number of routers on the reservation path of the BSM...” which “helps alleviate some of the scalability issues of RSVP.” *Id.*, p.39.

139. ETSI-157 describes how to implement RSVP in a BSM network. For example, FIG. 13 (annotated below) illustrates an example of how a first CRM (“Source ST”) allocates bandwidth using RSVP and how “RSVP leads to scheduled requests for bandwidth to ensure that the reservation is met when the traffic flow traverses the BSM.” *Id.*, p.39. As shown, a user first issues a PATH message (red) to the first CRM (“[s]ource ST”) to “initiate[] the communication session” and to “bid[]” the “data path of a flow.” *Id.*, p.34. The first CRM sends the PATH message (red) to the satellite to request initial bandwidth to communicate with a second CRM (“[d]estination ST”). The satellite responds with bandwidth-on-demand, which the first CRM uses to establish a link to the second CRM. *Id.*, p.39. On this link, second CRM then responds with a “RESV” message (blue), which includes “specific QoS resource requirements of the destination.” *Id.*, p.34. Based on this response, the first CRM allocates a bandwidth for the application flow and “establishes a scheduled or permanent uplink bandwidth reservation to support the RSVP flow with the accepted

bandwidth and delay” (green). *Id.*, p.39; *see also id.*, p.27 (The control plane functions in the CRM include “signalling reservation and bandwidth allocation.”).

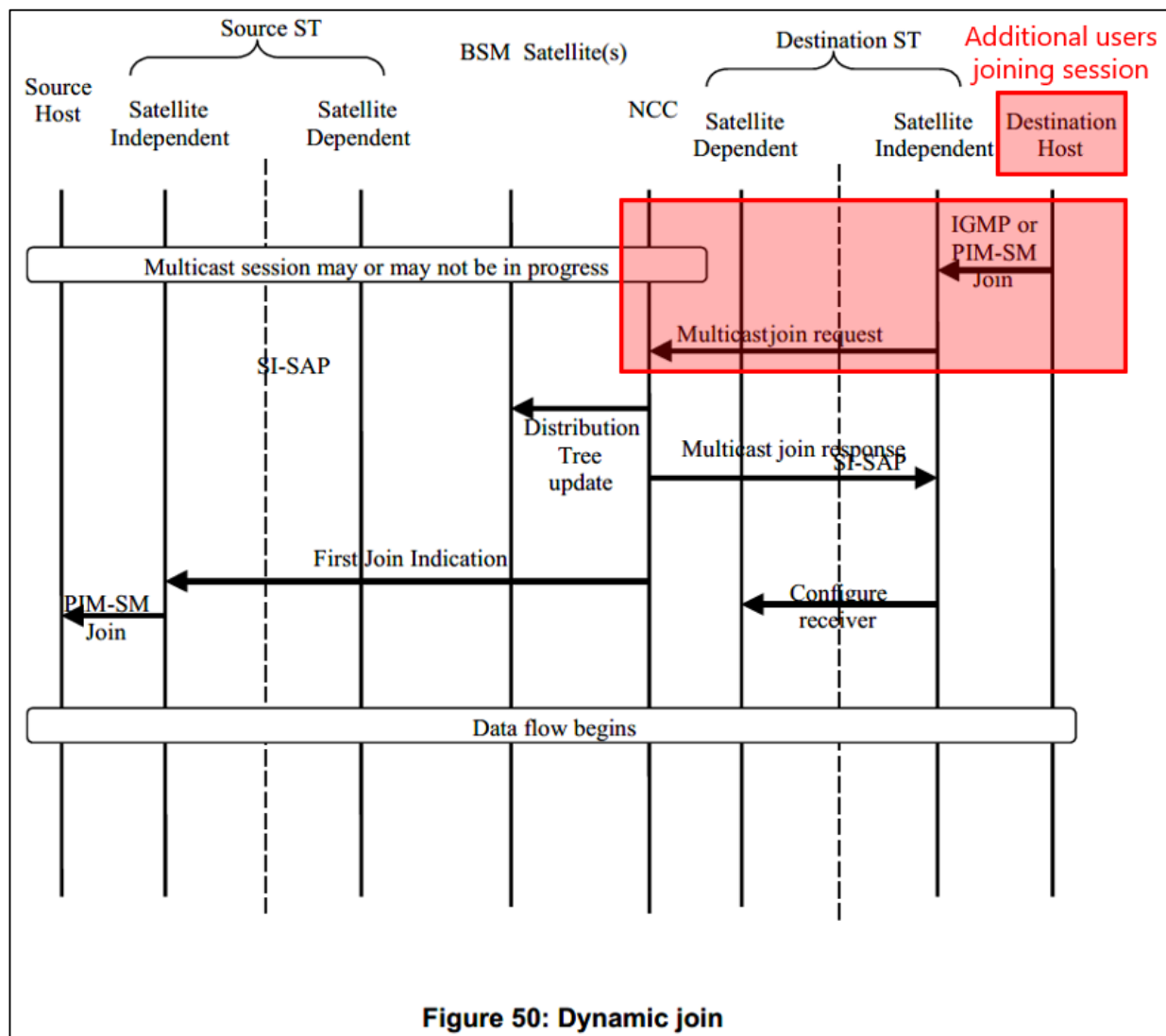


- f. 1[e]: “increase[s] the bandwidth level for the link based on a change in the application and based on an identification of additional presence data for additional users that have joined the communication session”

140. ETSI-156 in view of ETSI-157 and RFC-2205 discloses limitation 1[e].

The first CRM uses the RSVP protocol to increase bandwidth when either the application is changed or based on presence data for additional users in the session.

141. ETSI-156 discloses that a multicast session may dynamically change. For example, FIG. 50 (below) shows how users can be added to the session, and, as described for limitation 1[b], the first CRM will monitor the presence of these users using a table of available “hosts and multicast groups” that is built and updated using IGMP or PIM-SM. Ex[1004], pp.58, 62; Ex[1012], pp.34-35; *see also* §VIII.B.2.c; Ex[1004], p.104. (“An on-demand session may have participants that are preconfigured or may allow potential participants to join dynamically after the session has been set up.”).



Ex[1004], p.107 (annotated).

142. In addition, an application can change during a session. For example, ETSI-156 describes that a user can request “supplemental text content” during a television broadcast. *Id.*, p.38. In this case, a user initially receiving audio and video streaming (one set of applications) changes an application by adding text (another

type of application).¹¹ Similarly, ETSI-157 describes different applications (*e.g.*, conversational voice, high quality streaming audio, and videophone) with different performance targets. Ex[1011], p.57. It would have been obvious to a POSITA that conferencing programs could allow a user in a conference to change an application from audio-video to audio-only during a session. As described for limitation 1[c], the CRM's QoS manager will also determine the application change to determine "guaranteed bandwidth and delay" for the session, as a POSITA would have recognized. Ex[1004], p.72; §VIII.B.2.d.

143. In my opinion, ETSI-157, in combination with RFC-2205, teaches that the CRM can allocate additional bandwidth for additional users or different applications. ETSI-157 reserves bandwidth for a particular flow involving a particular application and a particular set of users. Ex[1011], p.34 (describing that each user destination has "specific QoS resource requirements"); §VIII.B.2.e. For example, a particular user added to the session may subscribe to a guaranteed quality tier of service that imposes additional QoS requirements on the transmission. Ex[1011], p.45 (users can subscribe to a "reliable delivery" service to receive a higher QoS). A change in application also may require a different QoS parameter. *Id.*, pp.57-58. The specific QoS requirements and parameters determine the

¹¹ The '134 patent describes voice, video and text as different applications. Ex[1001], 4:16-24.

“bandwidth” reserved for a flow from source to destination. *Id.*, pp.34-35; *see id.*, p.27 (describing BSM QoS as responsible for “reservation and bandwidth allocation”).

144. RFC-2205, which is specifically referenced in ETSI-157, discloses how additional bandwidth can be reserved during a session. *Id.*, pp.34-35. For example, RFC-2205 explains that “RSVP makes receivers responsible for requesting a specific QoS” so as “to efficiently accommodate large groups, dynamic group membership, and heterogenous receiver requirements.” Ex[1006], p.4. For example, RSVP can accommodate QoS changes based on a new user with a higher QoS joining a call, or a changing application during a session to one with a higher QoS requirement. To accommodate such changes, “[t]he state maintained by RSVP is dynamic” and “to change any QoS request, a host simply starts sending revised Path and/or Resv messages.” *Id.*, p.23. RFC-2205 refers to this as “a ‘soft state’ approach to managing the reservation state in routers and hosts.” *Id.*, p.22. “RSVP soft state is created and periodically refreshed by Path and Resv messages,” *id.*, p.22, and provides “graceful support for dynamic membership changes and automatic adaptation to routing changes.” *Id.*, p.6. If a new PATH message is sent, then, as described for limitation 1[d], the first CRM will establish a link with an additional allocation of bandwidth in the same way as with the initial PATH message.

- g. 1[f]: “the communication resource managers each includes respective trunking element that is automatically

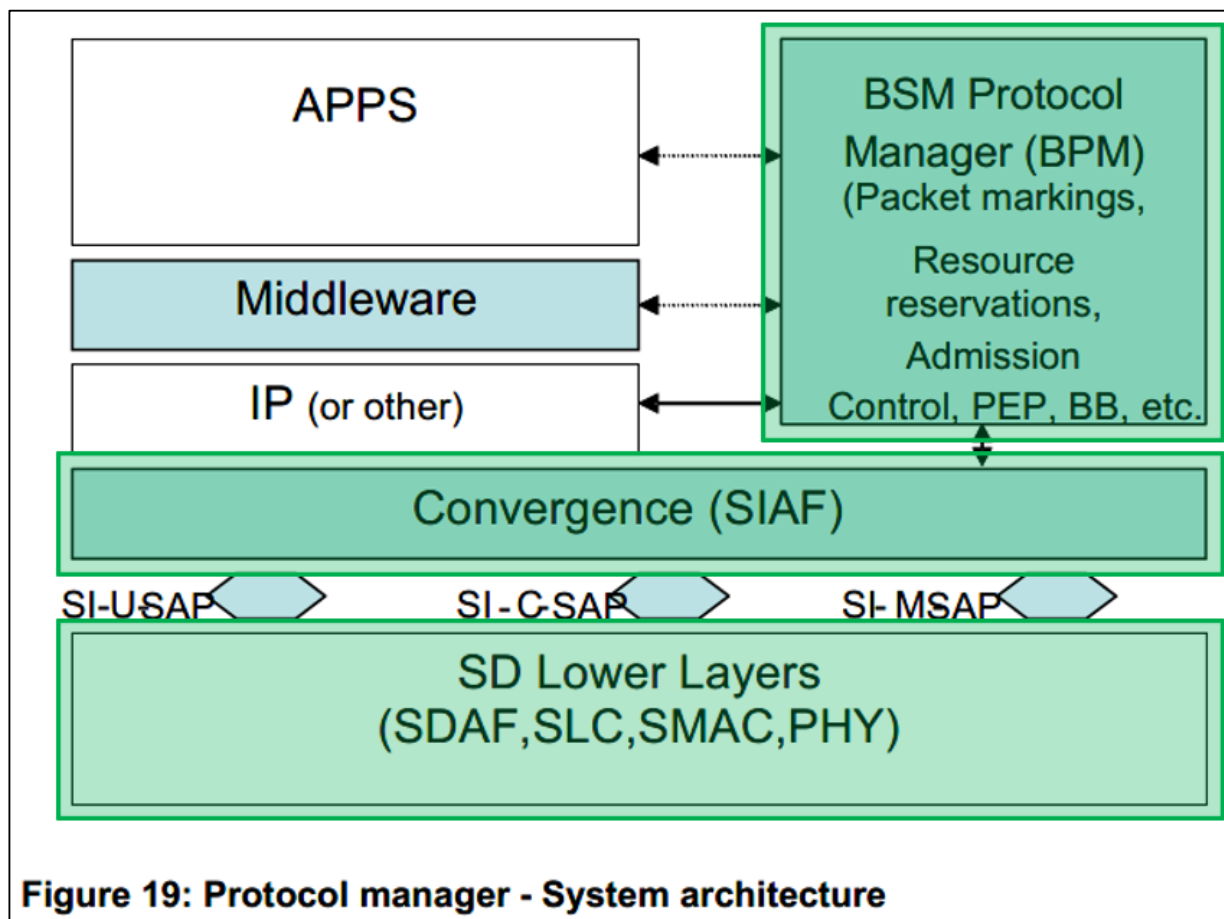
configured to select a transcoding based on available bandwidth

145. ETSI-156 in view of ETSI-157 discloses limitation 1[f]. The trunking element in each CRM includes functionality in the BSM Protocol Manager, BSM Multicast Proxy, “[s]atellite [i]ndependent,” and “satellite dependent” functionality in each gateway or satellite terminal.¹² §VIII.B.2.c. As I describe below, that trunking element is automatically configured to select a transcoding based on bandwidth.

146. In particular, ETSI-156 in view of ETSI-157 discloses the same type of trunking elements as described in the ’134 patent. Ex[1001], 2:54-62, 3:11-19, 4:33-49 (describing “dynamic trunking elements 50 and 52” that “bring up the SatCom link,” “increase the bandwidth of the link,” and “bring[] down the SatCom link” dynamically rather than using a “pre-configured static” link). As described for limitation 1[a], in the ETSI Specifications, each CRM’s trunking element (green below, except BSM Multicast Proxy which is not shown) creates and tears down physical satellite links. See §VIII.B.2.c (describing establishing a link). For example, these components “maintain a set of tables” for establishing and tearing down a satellite link, including to identify which receiver terminal needs to receive which

¹² As I describe for this limitation, the trunking element constitutes software and/or hardware in the communication resource manager that establishes, tears down, and controls the bandwidth of the satellite link.” Ex[1036].

multicast messages, which route the messages should take, and “which coding/modulation/power should be used in each beam.” Ex[1004], pp.51, 44 (describing use of satellite links in IP multicast routing trees), 58, 62 (choice of coding depends on multicast data). As described for limitation 1[d], these components also allocate bandwidth for the link. §VIII.B.2.e.



Ex[1011], p.65 (annotated).

147. In addition, ETSI-157 describes that each CRM’s trunking element is configured to automatically select a transcoding based on available bandwidth. As a general matter, BSM networks are susceptible to changes in available bandwidth due

to external conditions. For example, “wind that can move [satellite terminal] antennas, rain that induces large fades and scintillation that causes interference” can cause “error bursts (or reduced bandwidth) that will lead to packet loss.” *Id.*, p.25. In these scenarios, “[t]he BSM cannot allocate bandwidth that does not exist...” *Id.*

148. To address these problems, ETSI-157 discloses that “bandwidth and delay should be used as metrics for QoS routing.” *Id.*, p.43. For example, to address changes in bandwidth, ETSI-157 discloses a “Codec Type” field included in the “QoS metadata.” *Id.*, p.68. A POSITA would have understood that this field would only change if necessary and that the codec with the highest compatible fidelity would generally be selected. *Id.*

149. In addition, the CRM can “reduce the rate” of transmissions to accommodate lower bandwidth circumstances so that “service can continue with degraded performance for all services (if the service agreements allow it) or at nominal performance for high QoS classes by shutting down some low priority services.” *Id.*, p.32; *see also id.* (describing that “[l]ink layer methods” can “maintain the link budget”). For example, the CRM’s BSM Protocol Manager can request “link layer services such as compression” to reduce the bit rate for a transmission. *Id.*, p.67.

150. Modifying bit rate using compression or changing the codec type are methods of *transcoding* because, for example, they are coding techniques applied to

previously encoded data. For example, ETSI-157 describes numerous applications, including VoIP, RTSP (for streaming audio/video) and SMTP (for email), in which the data content received by the CRM for transmission is previously encoded based on various protocols and standards. *Id.*, pp.46 (describing various BSM services and protocols), 12 (describing data transfer units as including ATM cells and MPEG digital packets). For example, a stream of video received by the CRM from a host may be encoded in an MPEG format at a certain bit rate; however, if the available bandwidth of the satellite link cannot accommodate this bit rate, the QoS functionality in ETSI-157 would allow the CRM to choose a different codec (*e.g.*, a lower bit rate MPEG transmission) to transmit the video over the satellite network to the receiving domain.

- h. 1[g]: “adjust[s] the bandwidth level based on a determination which of the additional users and the users in the first and second domains can transmit data simultaneously during the communication session”

151. ETSI-156 in view of RFC-2205 discloses limitation 1[g]. As described for limitation 1[e], ETSI-156 in view of ETSI-157 and RFC-2205 discloses that the first CRM reserves and increases bandwidth based on the presence of users that have joined the communication session. *See* §VIII.B.2.f. The first CRM can further adjust bandwidth based on whether the additional users and the users in the first and second domains can transmit data simultaneously during the session.

152. For example, ETSI-156 describes that the BSM supports various service classes, including (a) applications in which multiple users transmit simultaneously, such as “[c]onversational services,” “video telephony” and “video-conferences;” and (b) applications with only a single transmitter, such as retrieval of video, documents, and data. Ex[1004], p.34. For the different applications, ETSI-157 describes different performance targets, including based on whether the transmission is “one-way” (one transmitter) or “[t]wo-way” (simultaneous transmitters). Ex[1011], p.57 (web-browsing is “[p]rimarily one-way” and “[c]onversational voice” is “[t]wo-way”).

153. As described for limitation 1[e], ETSI-157 further discloses that the first CRM considers these performance targets and service class information for a new user (*e.g.*, whether the new user will participate in a video conference as a potential transmitter in a two-way communication session) in determining whether to adjust the QoS for a session, and, correspondingly, whether to adjust the bandwidth for a session. *See, e.g.*, Ex[1011], pp.35 (“The flowspec in a reservation request generally includes a service class...”), 57; §VIII.B.2.e (QoS determines bandwidth allocation). It would at least have been obvious to consider whether each of the users can transmit data simultaneously in adjusting bandwidth after a user joins a session, as a POSITA would have recognized that users can change their role from receiver to transmitter, *e.g.*, during a conference call, and with more

simultaneous transmitters in a session, a link with a higher bandwidth may be required.

- i. 1[h]: “detect[s] an absence of active users in the first domain and the second domain”

154. ETSI-156 discloses limitation 1[h]. As described for limitation 1[b], ETSI-156 discloses that a gateway or satellite terminal (first CRM) monitors presence of users in a multicast session, such as a video conferencing session. See §VIII.B.2.c. ETSI-156, for example, describes that “[f]or sessions that allow dynamic membership, any participant may leave the session while it is active” by sending an IGMP leave request to its connected satellite terminal in a first domain (first CRM). Ex[1004], pp.108-09.

155. A first CRM will also receive indication of users of hosts in the same multicast group that leave a remote domain. For example, a message may be sent to the first CRM that there are no other remaining active hosts in the BSM so that the first CRM will “teardown the multicast tree.” *Id.*, p.109 (“If this is the last ST in the BSM system to leave the multicast,” the source ST receives a message “to prompt the ST to generate a PIM-SM prune message upstream out its terrestrial port to teardown the multicast tree.”). In this regard, the first CRM detects an absence of users in both domains.

j. 1[i]: “tear[s] down the link based on the absence”

156. ETSI-156 in view of RFC-2205 discloses or at least renders obvious limitation 1[i]. As described for limitation 1[h], a first CRM will detect the absence of users in its own domain and in other domains. In addition, ETSI-156 also describes that the first CRM will receive a teardown message when the last satellite terminal leaves the multicast group so that the first CRM will tear down the link. *Id.*, pp.108-09.

157. In my opinion, it would have been obvious in view of ETSI-156 that the teardown message would be sent if there is an absence of active users in both domains. If either domain had active users in a multicast videoconference, for example, the link should remain active (not torn down) in case a user in another domain chooses to join that conference. *Id.*, p.107 (explaining that “where there are no [satellite terminal] receivers who have yet joined a dynamic on-demand session,” a timer is used to wait for receivers to join), pp.108-109 (explaining “[i]f other [satellite terminals] in the multicast session are still active...multicast packets are still down-linked to that beam”). “A multicast session can be terminated either by reaching the end of a scheduled duration, by signalling from the session owner that the multicast session has ended, or, for sessions that have no duration, when no data has been sent for a configurable amount of time.” *Id.*, p.109.

k. 1[j]: “the link is a satellite communication link”

158. ETSI-156 discloses limitation 1[j]. As described for limitations [1a] through [1h], the link in ETSI-156 is a satellite link in the BSM network. Ex[1004], p.41-42; *see* §§VIII.B.2.b-i.

3. Claim 2

159. ETSI-156 discloses claim 2—“*the users of the first domain comprise a virtual talking group (VTG).*”

160. In my opinion, ETSI-156 discloses a “virtual talking group” as that term is used in the examples of the ’134 patent.¹³ *See* Ex[1001], FIGs. 3-4 (illustrating users in different groups in each domain). ETSI-156, for example, describes a BSM network for multicasting in which users (hosts) form a “host group,” in which an “IP datagram” is transmitted “to a set of zero or more hosts identified by a single IP destination address.” Ex[1004], pp.14-15. There can be multiple users (hosts) in each domain, as shown below.

¹³ As I describe for this limitation, ETSI-156 discloses a talk group that communicates using an IP address. Ex[1036].

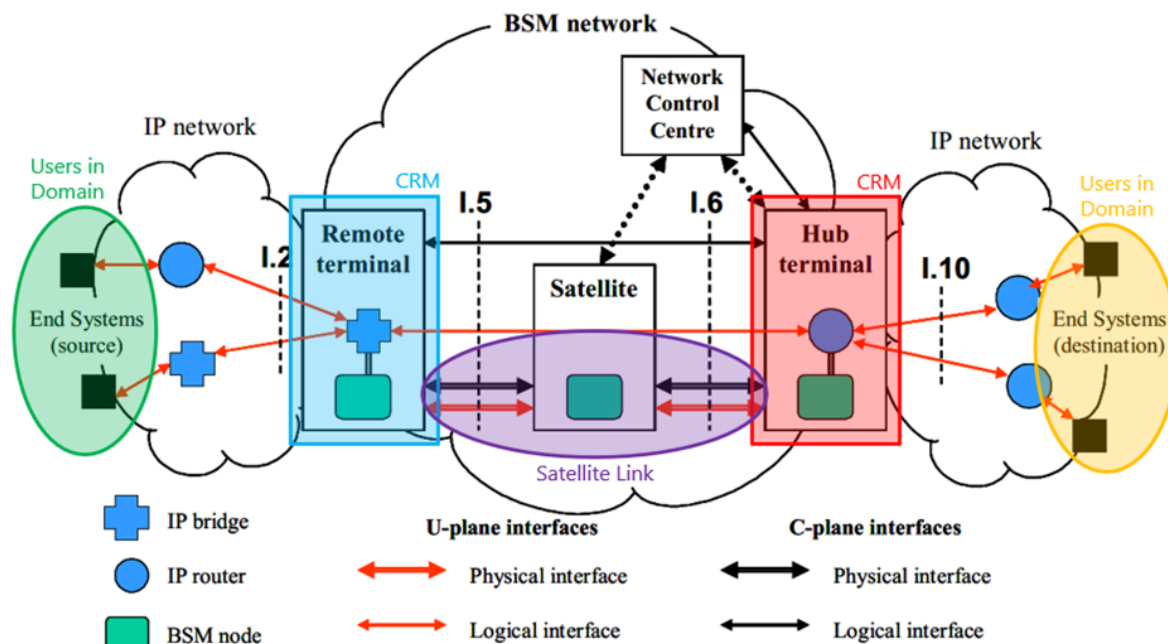


Figure 18: Star network architecture from TR 101 984

Id., pp.8, 53, FIG. 18 (annotated). The users (hosts) can be a “talk” group, for example when the IP multicast group is formed for voice or “[t]eleconferencing.” *Id.*, p.35.

161. Additionally, “[a] BSM network may additionally offer restricted/private groups, i.e. for corporate multicasts and Virtual Private Networks (VPN).” *Id.*, p.13. “Satellite service providers may also offer limited sources and groups just for the BSM subscribers, and such local sources may take particular advantage of BSM network capabilities as one in this case could have all receivers on the same subnetwork.” *Id.*

4. Claim 3

162. ETSI-156 in view of ETSI-157 discloses claim 3—“*the additional presence data relates to whether a given end user has logged into their respective system.*”

163. ETSI-156 explains that the BSM network may support “conditional access, including authentication, and key distribution.” Ex[1004], pp.43, 72 (explaining multicast applications require “user authentication”). A POSITA would have understood that the process of authentication determines whether a given end user has “logged into” their respective system.

164. Moreover, “[t]he authentication and key distribution center may be located at a service provider gateway” (e.g., the first CRM). *Id.*, p.43. It would have been obvious to a POSITA to require a user’s authentication *before* monitoring a user’s presence with IGMP and PIM-SM, otherwise satellite links could be established for fraudulent users. *Id.*, pp.58, 62; §VIII.B.2.f. In this circumstance, the subsequent transmission of IGMP and PIM-SM presence data (which I described for limitation 1[b]) relates to the user’s authentication (logging in).

5. Claim 4

165. ETSI-156 in view of ETSI-157 discloses claim 4—“*the communication resource managers each includes respective virtual talk group (VTG) presence managers (VPMs), each of which is operable to monitor their users who are present*

in their respective domains.” The VPM is included in the BSM Multicast Proxy and BSM Protocol Manager.

166. For example, ETSI-156 describes that a CRM’s BSM Multicast Proxy (BSM-MP) acts as a multicast manager to track presence of users in its domain. Ex[1004], pp.91-92, 94, FIGs. 35 (annotated below), 38. Additionally, ETSI-157 discloses a CRM’s BSM Protocol Manager is “an ‘intelligent’ traffic manager” and “defines how IP protocols” such as IGMP and PIM-SM (which track presence data in a domain, §VIII.B.2.c) “are interpreted and transmitted through the BSM.” Ex[1011], pp.64-65. Accordingly, the BSM-MP and BSM Protocol Manager are operable to monitor users who are present in their domain.

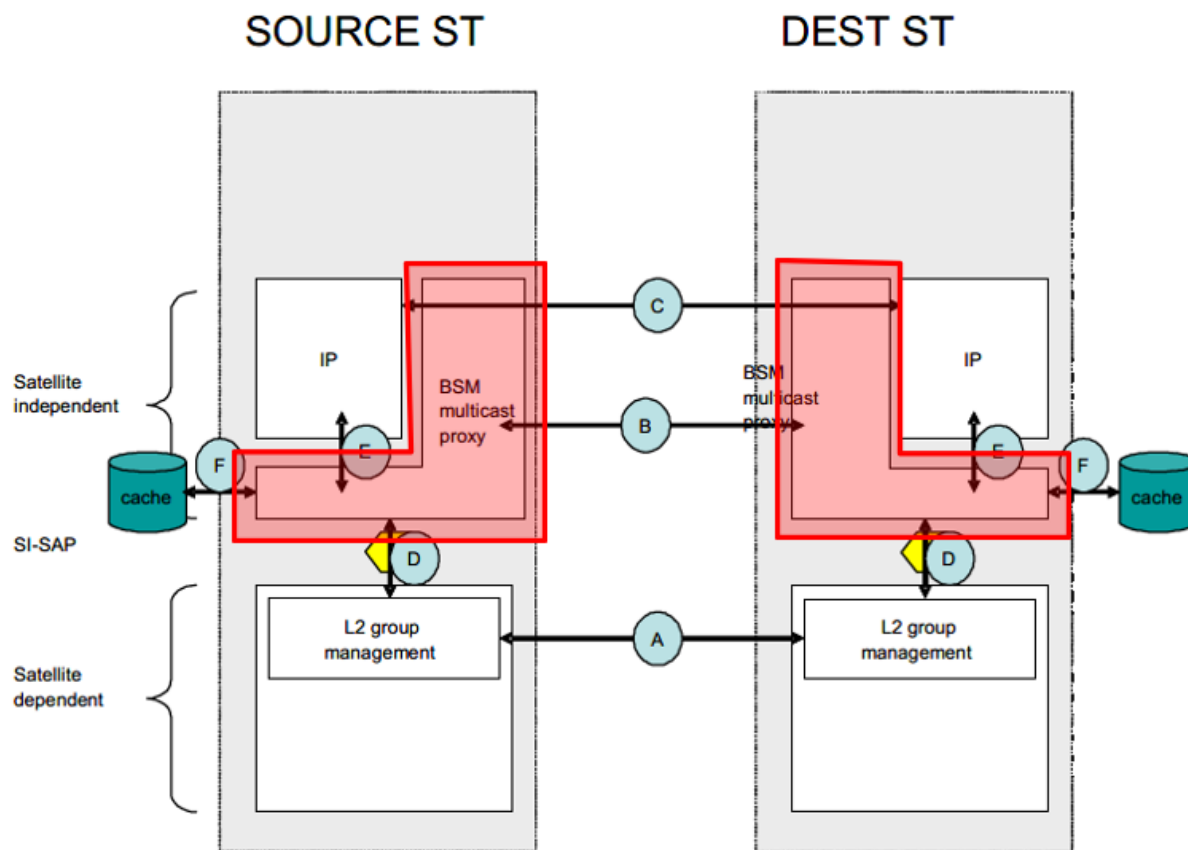


Figure 35: BSM proxy concept

Ex[1004], p.92 (annotated).

6. Claim 5

167. ETSI-156 in view of ETSI-157 and RFC-2205 discloses claim 5—*“information received from the VPMs is used to maintain a designated link bandwidth allocation.”* As described for limitation 1[d] (§VIII.B.2.e), the portion of the CRM responsible for allocating bandwidth based on presence information is in the BSM Protocol Manager, which, together with the BSM Multicast Proxy (BSM-MP), disclose the VPM as discussed above for claim 4. §VIII.B.5. In particular, QoS

management occurs in the CRM's BSM Protocol Manager and BSM-MP. Ex[1004], p.100 (figure); §VIII.B.2.e. Lower level satellite dependent components of the CRM subsequently receive information from the VPM to create and maintain a satellite link at a particular bandwidth. Ex[1011], p.65, FIG. 19 (annotated below); §VIII.B.2.c (describing lower level satellite dependent functionality using "QoS setting" to establish a link); §VIII.B.2.e (describing RSVP for determining QoS settings and bandwidth).

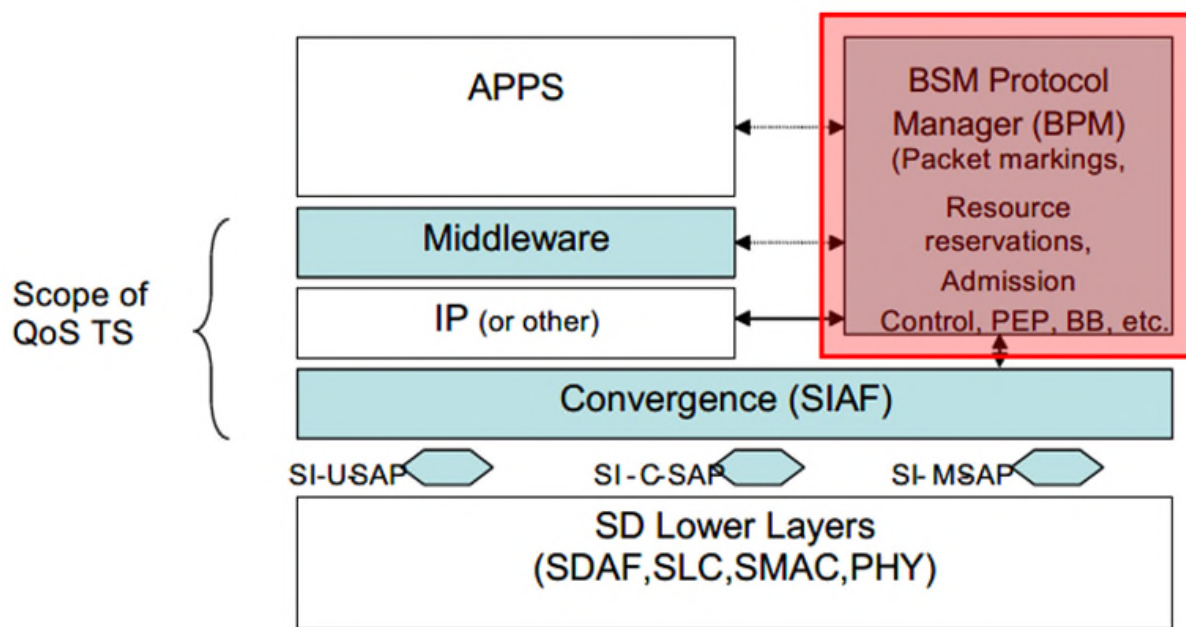


Figure 19: Protocol manager - System architecture

Ex[1011], p.65 (annotated).

168. Moreover, ETSI-157 explains that the CRM's BSM Protocol Manager and BSM-MP use the RSVP protocol to reserve *and* maintain the state of resources. Ex[1011], p.34 (RSVP reservation states are "soft states"); §VIII.B.2.e. Thus, even

if there is no change to the number of users or application, the VPMs use RSVP to maintain the link at the specified bandwidth. §VIII.B.2.e; Ex[1011], p.34; Ex[1006], p.6 (explaining that “RSVP sends periodic refresh messages to maintain the state along the reserved path(s)”).

7. Claim 6

169. ETSI-156 in view of ETSI-157 and RFC-2205 discloses claim 6—“*if either one of the VPMs determine that there are no active users logged into their respective systems, then the VPMs tear down the link.*”

170. As described for claims 3 and 4, ETSI-156 describes or renders obvious determining presence at the BSM-MP and BSM Protocol Manager, including relating to if a user is logged into their system through “authentication.” §VIII.B.4-5. Additionally, as described for limitation 1[i], each CRM (including the VPM) looks for active users in at least one domain, and the CRM (including the VPM) receives a teardown message when the last satellite terminal leaves the multicast group. §VIII.B.2.j; Ex[1004], pp.91-92, 108-09. The VPM then communicates with the other portions of the CRM to tear down the link. Ex[1004], pp. 91-92 (showing interaction between BSM-MP and other portions of CRM); §VIII.B.2.g (describing trunking element for establishing and tear down links).

8. Claim 7

171. ETSI-156 in view of ETSI-157 discloses claim 7—“*a router that establishes the link based on direction from the communication resource manager.*”

172. The router includes functionality in the BSM Multicast Proxy, “[s]atellite [i]ndependent,” and “satellite dependent” components, which route a transmission to the host and multicast group from the CRM. Ex[1004], pp.90-93; *see also id.*, p.90 (“In general, BSM-MP will thus act as a multicast enabled router seen from the core network side. External multicast sources will find the BSM-MP router, as any other multicast enabled router, and forward the multicast content to it. The BSM-MP will in turn deliver it to the terminals that shall have it.”). These elements also receive direction from other portions of the CRM, including the BSM Protocol Manager, *e.g.*, for route discovery and authentication. Ex[1011], p.65.

9. Claim 8

a. 8[Pre]

173. If the preamble is limiting, ETSI-156 discloses it. For example, ETSI-156 discloses “standards for delivering IP Multicast over BSM networks.” Ex[1004], p.6.

b. 8[a]

174. For the reasons disclosed for limitation 1[a], ETSI-156 discloses limitation 8[a].

c. 8[b]

175. For the reasons disclosed for limitation 1[b], ETSI-156 in view of ETSI-985 discloses limitation 8[b].

d. 8[c]

176. For the reasons disclosed for limitation 1[c], ETSI-156 in view of ETSI-157 discloses limitation 8[c].

e. 8[d]

177. For the reasons disclosed for limitation 1[d], ETSI-156 in view of ETSI-157 discloses limitation 8[d].

f. 8[e]

178. For the reasons disclosed for limitation 1[e], ETSI-156 in view of ETSI-157 and RFC-2205 discloses limitation 8[e].

g. 8[f]

179. For the reasons disclosed for limitation 1[f], ETSI-156 in view of ETSI-157 discloses limitation 8[f].

h. 8[g]

180. For the reasons disclosed for limitation 1[g], ETSI-156 in view of RFC-2205 discloses limitation 8[g].

i. 8[h]

181. For the reasons disclosed for limitation 1[h], ETSI-156 discloses limitation 8[h].

j. 8[i]

182. For the reasons disclosed for limitation 1[i], ETSI-156 in view of RFC-2205 discloses limitation 8[i].

k. 8[j]

183. For the reasons disclosed for limitation 1[j], ETSI-156 discloses limitation 8[j].

10. Claim 9

184. For the reasons disclosed for claim 2, ETSI-156 discloses claim 9.

11. Claim 10

185. For the reasons disclosed for claim 3, ETSI-156 in view of ETSI-157 discloses claim 10.

12. Claim 11

186. For the reasons disclosed for claim 5, ETSI-156 in view of ETSI-157 and RFC-2205 discloses claim 11.

13. Claim 12

a. 12[Pre]

187. If the preamble is limiting, ETSI-156 discloses it. For example, ETSI-156 discloses “standards for delivering IP Multicast over BSM networks.” Ex[1004], p.6.

b. 12[a]

188. For the reasons disclosed for limitation 1[a], ETSI-156 discloses limitation 12[a].

c. 12[b]

189. For the reasons disclosed for limitation 1[b], ETSI-156 in view of ETSI-985 discloses limitation 12[b].

d. 12[c]

190. For the reasons disclosed for limitation 1[c], ETSI-156 in view of ETSI-157 discloses limitation 12[c].

e. 12[d]

191. For the reasons disclosed for limitation 1[d], ETSI-156 in view of ETSI-157 discloses limitation 12[d].

f. 12[e]

192. For the reasons disclosed for limitation 1[e], ETSI-156 in view of ETSI-157 and RFC-2205 discloses limitation 12[e].

g. 12[f]

193. For the reasons disclosed for limitation 1[f], ETSI-156 in view of ETSI-157 discloses limitation 12[f].

h. 12[g]

194. For the reasons disclosed for element 1[g], ETSI-156 in view of RFC-2205 discloses element 12[g].

i. 12[h]

195. For the reasons disclosed for limitation 1[h], ETSI-156 discloses limitation 12[h].

j. 12[i]

196. For the reasons disclosed for limitation 1[i], ETSI-156 in view of RFC-2205 discloses limitation 12[i].

k. 12[j]

197. For the reasons disclosed for limitation 1[j], ETSI-156 discloses limitation 12[j].

14. Claim 13

198. For the reasons disclosed for claim 3, ETSI-156 in view of ETSI-157 discloses claim 13.

15. Claim 14

199. For the reasons disclosed for claim 5, ETSI-156 in view of ETSI-157 and RFC-2205 discloses claim 14.

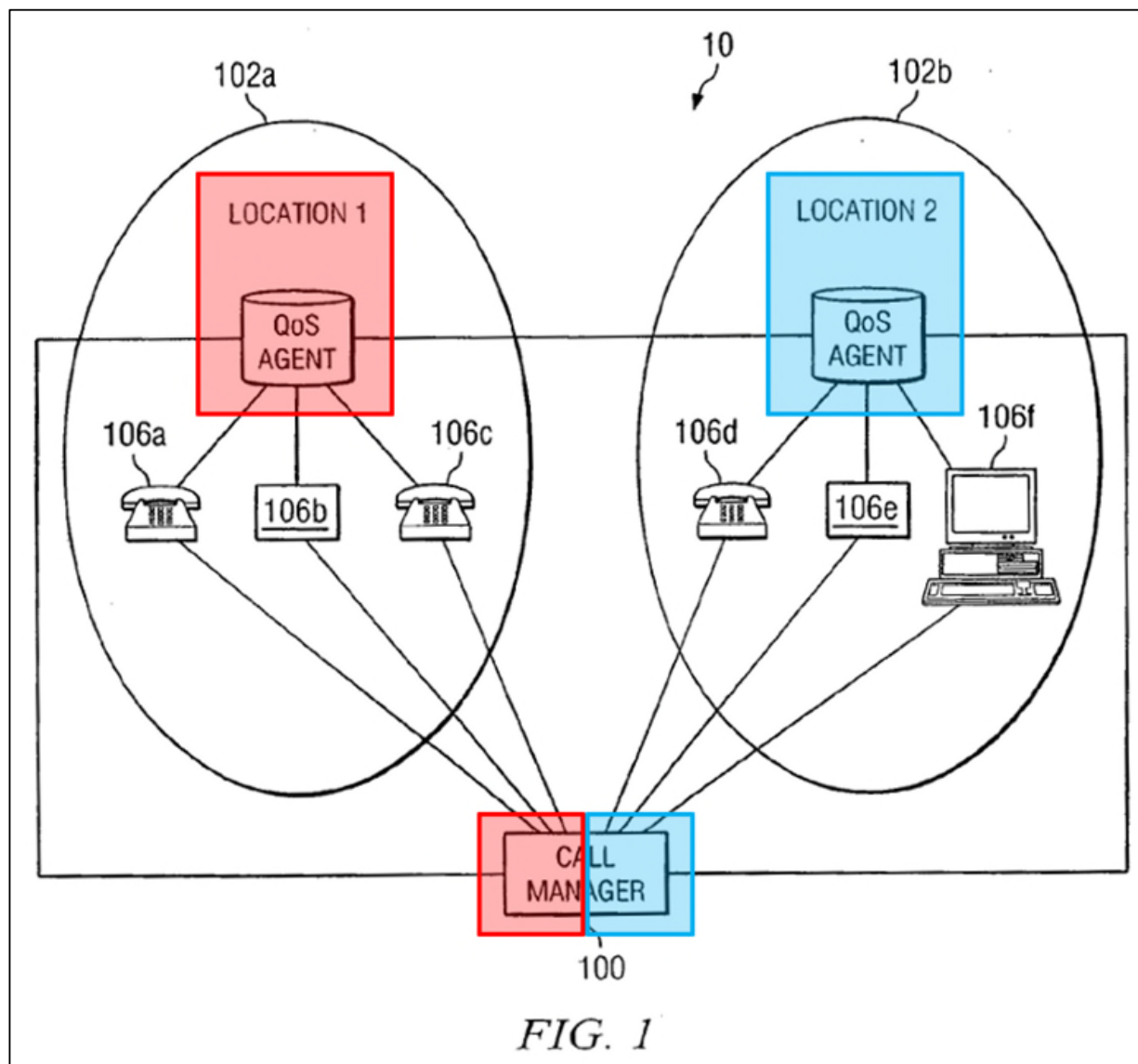
C. Ground 2: Claims 1-14 are obvious over Dhesikan in view of BGAN and Firestone.

1. Motivation to Combine Dhesikan with BGAN and Firestone.

200. In my opinion, a POSITA would have combined, and could have combined, Dhesikan with BGAN and Firestone with an expectation of success to arrive at the Challenged Claims.

i. *A POSITA Would Have Modified Dhesikan to Use the Satellite Network Described in BGAN*

201. FIG. 1 of Dhesikan discloses a system 10 (below) for setting up an audio and video conference call between two or more groups of different types of endpoints, 106a, 106c, 106d, 106f, in different networks at different locations, 102a and 102b. Ex[1007], ¶¶[0005], [0020], [0022], [0023], FIG. 1. Although shown as a centralized call manager below, Dhesikan describes that call agents may be “distributed” and located in each domain; for example, a “separate call agent 100 may be associated with each location 102,” as indicated by the red and blue highlighting below. *Id.*, ¶[0031].



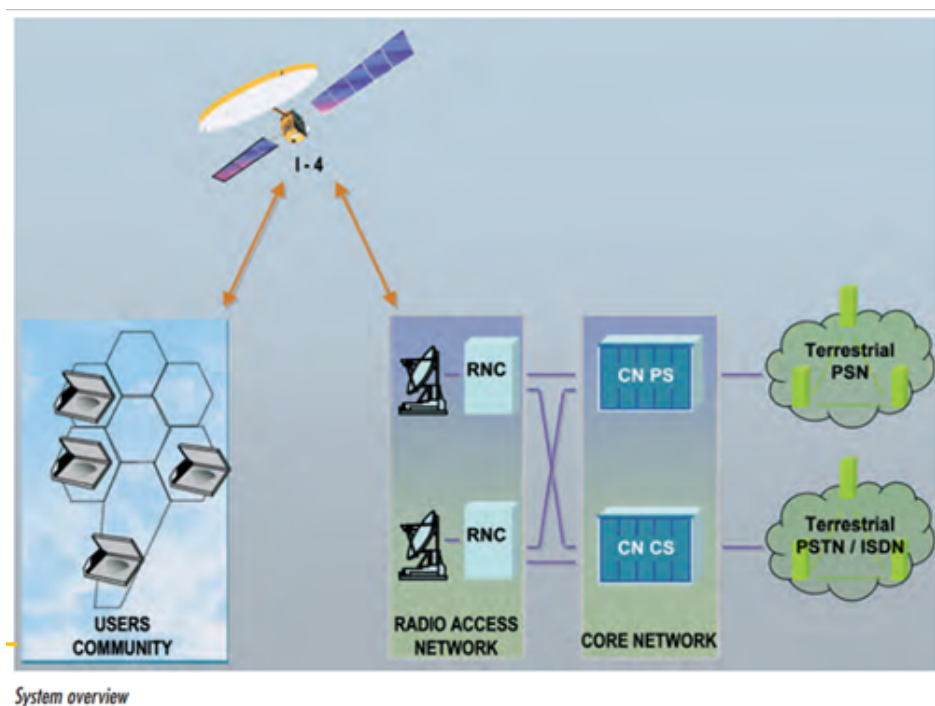
Id., FIG. 1 (annotated).

Dhesikan further discloses that the locations “communicate with each other” via known “network elements.” *Id.*, ¶[0022]. These network elements can transmit audio and video streams (data) using an IP-based signaling protocol, including a “multicast” protocol, that maintains a certain Quality of Service level. *Id.*, ¶¶[0024], [0027]. Notably, Dhesikan does not describe or limit the type of network elements

that can exist between domains and teaches that the domains may be connected to “a service provider network” and “may be any suitable architecture,” such as any “appropriate architecture or system that facilitates communications.” *Id.*, ¶[0022]. Although Dhesikan contemplates that its system may be used with any “appropriate architecture or system that facilitates communications,” Dhesikan does not expressly disclose use of a satellite communication link.

202. In my opinion, the BGAN system (below) discloses this aspect of the claims. BGAN, or Broadband Global Area Network, discloses an on-demand broadband satellite service for the “modern office” provided by Inmarsat. Ex[1014], p.2. “BGAN is designed to provide a portfolio of packet-mode and circuit-mode-based services.” *Id.*, p.3. BGAN is “[b]ased on IP technology,” and provides “IP-based mobile data communications” for “mobile multimedia” including data and voice. *Id.*, p.3-5. BGAN delivers “broadband data and voice simultaneously through one device, to almost anywhere on the planet.” *Id.*, p.3. The “voice service” provides “conference calling” services.” *Id.*, pp.4-5. “The Streaming IP service” provides “guaranteed bandwidth on demand, enabling live video applications like video conferencing or video streaming.” *Id.*, p.5. BGAN also provides “multicast service capabilities,” “exploiting the natural strength of satellites for delivering multicast services at the global level.” *Id.*, p.3. The “BGAN Multicast Service” relies on “IP-based standard protocols for interfacing to the end users and content providers, who

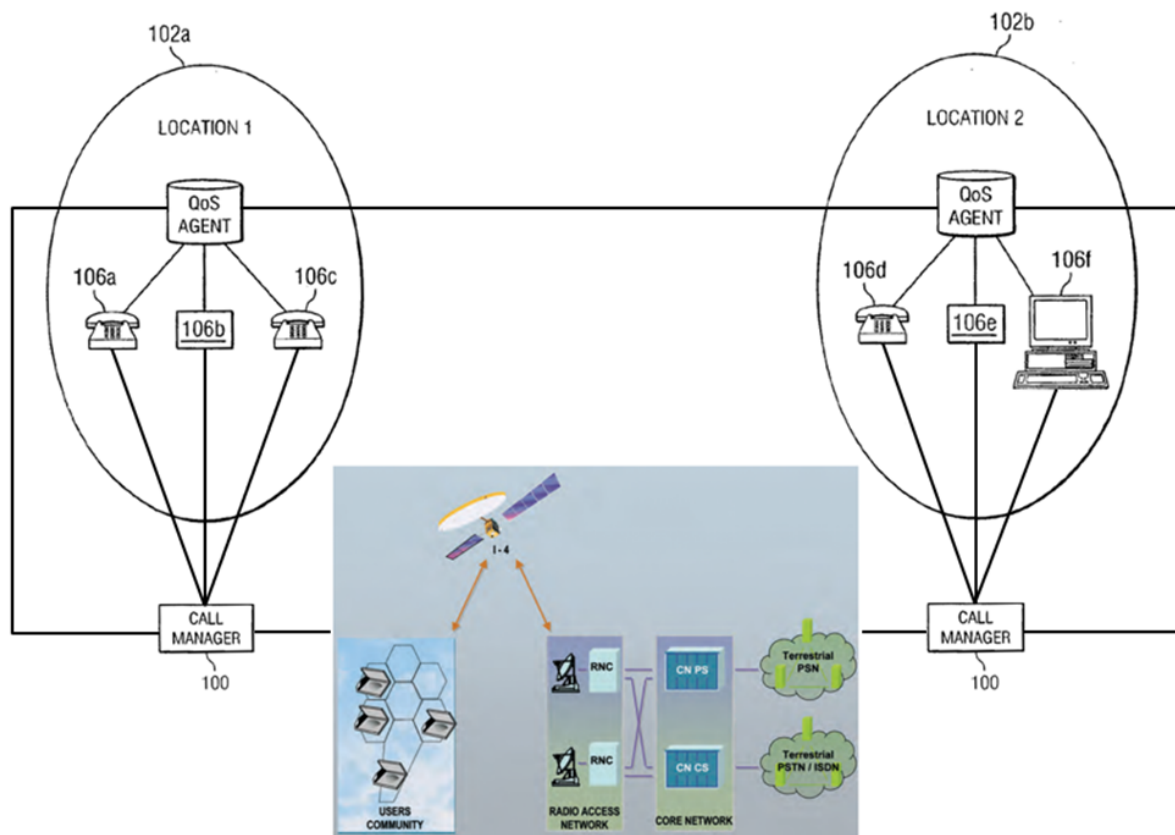
can be connected to the BGAN system through the Internet” and provides “reliable and secure multicast transport protocols ensuring quality of service for individual multicast flows.” *Id.*, p.6.



Id., p.4.

203. In my opinion, it would have been obvious to a POSITA to modify Dhesikan’s system 10 to operate with the satellite network in BGAN, as shown below in a modified version of FIG. 1 of Dhesikan combined with BGAN. A POSITA would have understood that incorporating the satellite system of BGAN would improve Dhesikan’s system by “enabl[ing] broadband connection on the move, delivering all the key tools of the modern office” “to almost anywhere on the planet.” *Id.*, pp.2-3. For instance, BGAN explains that its system “combine[s] large

bandwidth with ubiquitous coverage, reliability, and portability.” *Id.*, p.2. The satellite telecommunication system of BGAN “deliver[s] broadband data and voice simultaneously through one device, to almost anywhere on the planet.” *Id.*, p.3. A POSITA would have found BGAN’s “large bandwidth” and “ubiquitous coverage, reliability, and portability” (*id.*, p.2) desirable, especially in circumstances where endpoints are operating in remote locations in which an Internet or cellular connection is not available. Incorporating BGAN’s satellite telecommunications network with Dhesikan to connect two locations via a satellite link would enhance the ability of Dhesikan’s system “to quickly and effectively interact with an individual through any suitable communications media” and further Dhesikan’s goal of providing a system that can use “any other appropriate architecture or system that facilitates communications.” See Ex[1007], ¶¶[0003], [0022].



204. In my opinion, a POSITA would have had a reasonable expectation of success in combining these known individual elements in Dhesikan and BGAN to connect locations 102a and 102b in Dhesikan using a satellite communications link in the manner recited in the Challenged Claims. *Id.*, ¶[0022]. In addition to BGAN, the use of satellite communications links in other systems was well-known, which suggests that a POSITA would have been able to implement the combination. As one example, Shaffer discloses a similar system to Dhesikan for setting up a call between two or more groups of different types of endpoints (*e.g.*, radios, IP phones) in different networks at different locations (*e.g.*, 24a-24d). Ex[1009], ¶[0021], FIG.1. In Shaffer, the different networks can communicate with each other via a

communicating IP network 24e, which can be any “global distributed network” such as cellular networks or a “satellite network.” *Id.*, ¶¶[0025], [0027], [0030]-[0031] (emphasis added).

205. Further, Dhesikan already contemplates that its techniques are applicable to “any suitable architecture,” including “any other appropriate architecture or system that facilitates communications.” Ex[1007], ¶[0022]. A POSITA would have understood the satellite telecommunications network in BGAN to be one such “architecture or system that facilitates communications.” Moreover, a POSITA would have recognized that the BGAN satellite telecommunication network would be compatible with Dhesikan’s system. *See id.* As discussed below, Dhesikan discloses an IP link, including over multicast, with a guaranteed quality of service protocol. *See* §§VIII.C.2.b-i. BGAN discloses that the same type of IP link—using multicast with a guaranteed quality of service protocol—can be implemented as the claimed satellite communications link over a commercial satellite service. Ex[1014], p.6. It would have been within the abilities of a POSITA to incorporate BGAN’s commercial satellite service (including satellite terminals connected to a satellite) that implements IP protocols, as designed, between the CRMs in each domain in Dhesikan. For example, a POSITA would have reasonably expected to be able to interface Dhesikan’s CRM with the satellite provider’s terminal, which would take IP communications from each domain, and repackage and send them

over satellite to the other domain, which would also interface with a Dhesikan CRM. Each element would merely perform the same function as it did separately.

206. In my opinion, the combination would have relied on known methods and a POSTA would have understood it to be predictable, routine, and reasonably expected to succeed before the September 2008 assumed priority date of the '134 patent. For example, the combination would have merely required purchasing well-known services to implement IP over satellite that had been commercially available for years before the priority date of the '134 patent, and using that commercial service to connect Dhesikan's locations 102a and 102b. Indeed, Dhesikan already teaches to connect the locations using such a "service provider network" such as that disclosed as BGAN. Ex[1007], ¶[0022].

ii. *A POSITA Would Have Been Motivated to Modify Dhesikan's QoS Agents to Implement the Transcoding Functionality Described in Firestone*

207. Each of the domains in Dhesikan's system 10 (above) includes a QoS agent (104a or 104b) comprising "[s]oftware, hardware, or a combination" thereof that can be implemented on "switches, gateways, bridges, voice-mail servers, routers, and load balancers." Ex[1007], ¶¶[0023]-[0024], [0032]; *see id.* FIG. 1. Dhesikan's QoS agents are "involved in the signaling and media exchange between endpoints" and perform various operations, including bandwidth reservations to "accommodate audio and video media streams" along with "appropriate transcoding

operations.” *Id.*, ¶[0024]. Although Dhesikan provides extensive detail about how the QoS agents reserve bandwidth, Dhesikan does not provide details about the transcoding operations. Thus, in my opinion, a POSITA would have looked to other prior art references for further details regarding how Dhesikan’s QoS agents could implement transcoding.

208. In my opinion, Firestone is one such reference. Firestone discloses a similar communication system as Dhesikan with “media switches” that also are involved in signaling and media exchange. Ex[1008], ¶¶[0015], [0025]. In Firestone, “audio and video streams may be transmitted between end points 12 and their associated media switch 26.” *Id.*, ¶[0022]; *see id.* ¶[0034]. As in the QoS agents of Dhesikan, Firestone’s media switches can be implemented as “software” using “existing network devices such as routers, switches, and wireless access points.” *Id.*, ¶[0036]. Additionally, like Dhesikan’s QoS agents, Firestone’s media switches perform “transcoding” operations. *Id.*, ¶[0034]. Firestone expressly discloses that the media switch transcoding is selected to accommodate available bandwidth. For example, Firestone describes that endpoints may require “a video transrater” or a “video transcoder” to accommodate “[b]andwidth constraints” (i.e., available bandwidth). *Id.*, ¶[0029].

209. It would have been obvious to implement Firestone’s transcoding functionality in Dhesikan’s QoS agents and a POSITA would have had a reasonable

expectation of success in doing so. Firestone discloses that its media switch transcoding can be implemented in software on a switch or router (*Id.*, ¶[0036]), and Dhesikan already discloses that its QoS agents perform transcoding, and can be implemented in software on a switch and router (Ex[1007], ¶¶[0023]-[0024], [0032]). The combination would merely involve a straightforward modification to the existing software in Dhesikan to implement the disclosed functionality in Firestone to require that the QoS agents select the appropriate transcoding based on available bandwidth that the QoS agents are also responsible for calculating. No additional components would be required other than those already implemented by the QoS agents, and the combination would have been simple, predictable, and reasonably expected to succeed.

210. Moreover, a POSITA would have been motivated to make the combination. Dhesikan already teaches that QoS agents perform transcoding, but fails to provide details regarding how transcoding should be performed. Firestone provides those details. Both references are in the same field of art, originally assigned to the same entity, and aimed at solving similar problems associated with resource allocation and management to make conferencing more efficient. Ex[1007], ¶¶[0020], [0024]; Ex[1008], ¶¶[0015]-[0016], [0034], [0109].

2. Claim 1

a. 1[Pre]: “An apparatus”

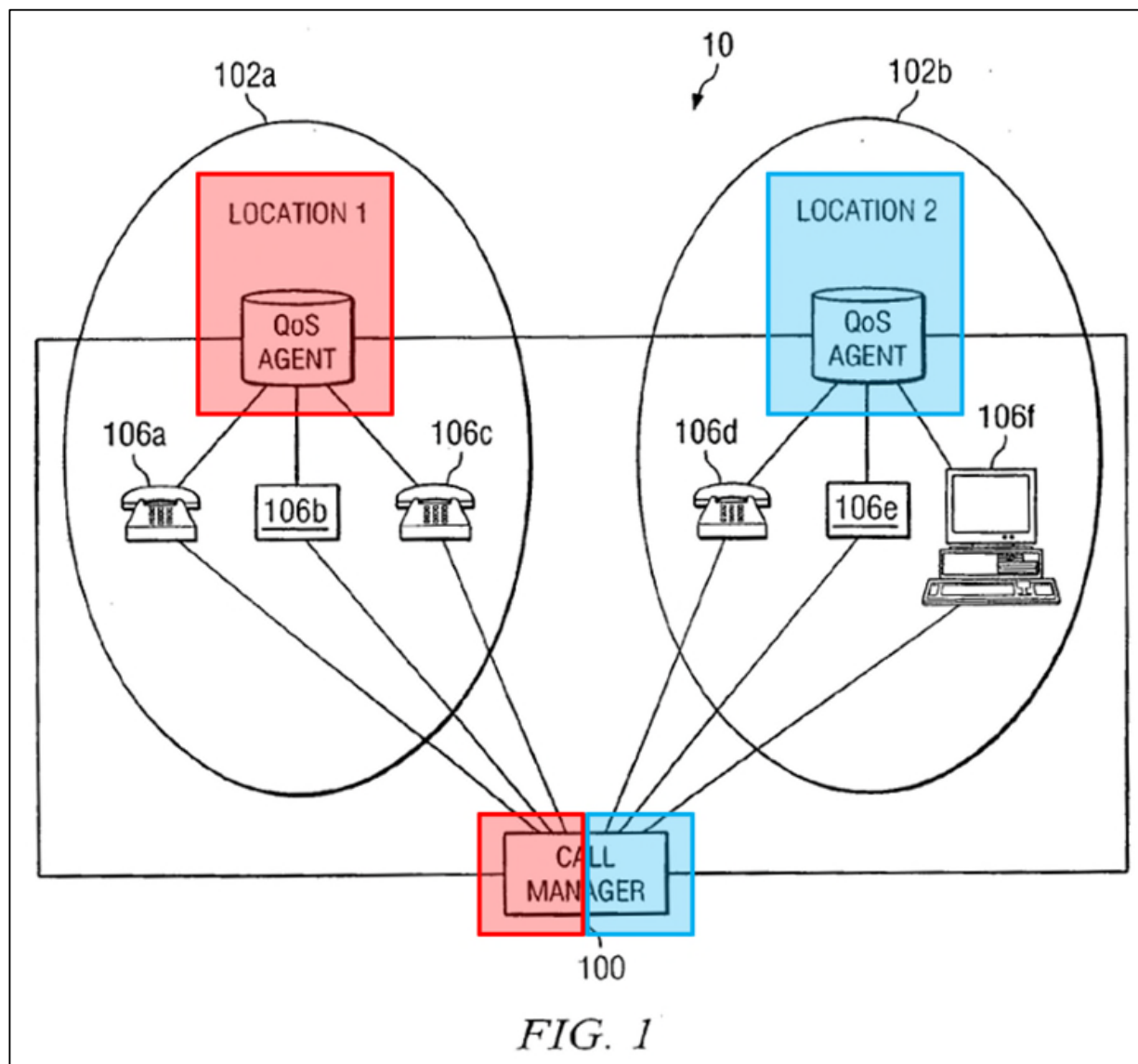
211. If the preamble is limiting, Dhesikan+BGAN discloses “[a]n apparatus.” Ex[1007], ¶[0005] (“a communication system is provided”); *see also id.* ¶¶[0002], [0020].

b. 1[a]: “a first communication resource manager located in a first domain and operable to interact with a second communication resource manager located in a second domain”

212. Dhesikan+BGAN discloses limitation 1[a]. Dhesikan+BGAN discloses a first CRM (first QoS agent and first portion of call agent 100¹⁴ in location 1, shown in red below), and a second CRM (second QoS agent and second portion of call agent 100 in location 2, shown in blue below).¹⁵ Although shown as a centralized call manager in FIG.1, call agents also may also be “distributed” and located in each domain; for example, a “separate call agent 100 may be associated with each location 102,” as indicated by the red and blue highlighting below. Ex[1007], ¶[0031].

¹⁴ FIG.1 refers to element 100 as “call manager,” but Dhesikan uses the term “call agent” for element 100 throughout the specification. Ex[1007], ¶¶[0020]-[0022], [0024], [0026]-[0028].

¹⁵ As I explain for this limitation and limitation 1[b], each CRM also constitutes software and/or hardware that controls a satellite link for multicasting and tracks presence data. Ex[1036].



Id., FIG. 1 (annotated).

213. In my opinion, in Dhesikan+BGAN, each of Dhesikan's CRMs manage resources, including controlling a satellite link between domains and tracking presence data in each domain. For example, the call agents "control[] the setup of a call between two or more endpoints" operated by users (users of telephones and computer 106a-106d in FIG. 1), which includes establishing a call over a satellite

link, as I described above in §VIII.C.1.i (motivation to combine analysis). *Id.*, ¶[0005]. Moreover, QoS agents “establish[] reservations between endpoints in order to guarantee a certain amount of bandwidth for the call.” *Id.*, ¶¶[0005], [0020]. Specifically, each QoS agent “reserve[s] bandwidth on behalf of endpoints 106, and are involved in the signaling and media exchange between endpoints 106 as determined by call agent 100.” *Id.*, ¶[0024].

214. Further, the CRMs in each domain are operable to interact with each other via satellite network equipment. *Id.*, ¶[0031]; §VIII.C.1.i (motivation to combine analysis). For example, as shown in FIG. 1, the CRM controls the exchange of media between locations 102a and 102b and the individual endpoints 106 within locations 102a and 102b. The groups 102a and 102b are logical groupings and can be physically anywhere and represents interconnected communication nodes for receiving and transmitting packets of information via IP. For example, the locations 102 may be a local area network (LAN), a virtual private network (VPN) or a wide area network (WAN) or any other appropriate network.

215. Furthermore, endpoints 106 can include Skinny Client Control Protocol (SCCP) telephones, Session Initiation Protocol (SIP) telephones, a computer, a personal digital assistant, a laptop, videoconferencing devices, gateways, or any other suitable endpoint. Ex[1007], ¶[0023]. Endpoints 106 may be enabled by any protocol such as SCCP, SIP, H.323, Media Gateway Control Protocol (MGCP), or

an Internet protocol telephone. *Id.*, ¶[0023]. SIP is an IP-based protocol to provide a signaling and call setup protocol for IP-based communications in the public switched telephone network (PSTN) and also supports multimedia applications. SCCP is also an IP-based protocol for session signaling with Cisco Unified Communications Manager.

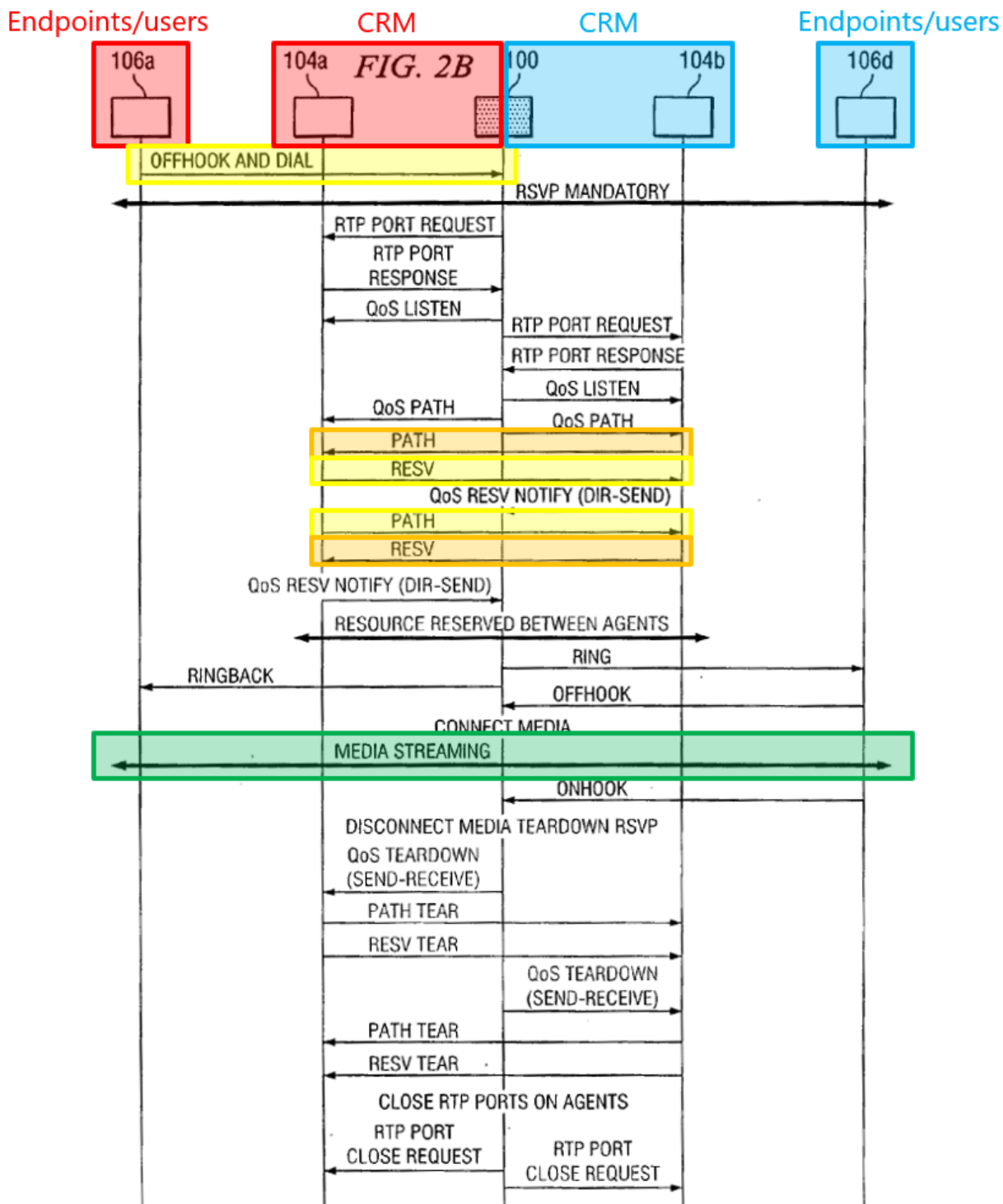
216. Accordingly, a POSITA would have understood that the end points within the groups 102 communicate via IP protocols. A POSITA would also have understood that the communication between these networks can be via IP over satellite. *Id.*, ¶[0022]; §VIII.C.1.i (motivation to combine analysis).

- c. 1[b]: “determine to establish a link for multicasting between users in the first domain and users in the second domain based on presence data of at least one user in the first domain and at least one user in the second domain”

217. Dhesikan+BGAN discloses limitation 1[b]. QoS and call agent in the first domain (first CRM) establishes a link for multicasting between users in two domains based on presence data of users in both domains.¹⁶

¹⁶ As I describe for this limitation, the satellite link in Dhesikan+BGAN simultaneously delivers information between a group of users in the first domain and a group of users in the second domain using the most efficient strategy, Ex[1036], and the link is established based on presence data, *e.g.*, a “status indicator that conveys an ability and/or willingness of a potential communication partner to communicate.” *Id.*

218. First, Dhesikan+BGAN describes that the first CRM (in location 1 in FIG. 1 above) determines to establish a satellite link between users in two domains. When a first user (*e.g.*, at endpoint 106a in FIG. 2B, below, annotated) establishes a communication session with a second user (*e.g.*, at endpoint 106d in FIG. 2B, below, annotated), the first CRM in the first user's domain (first QoS and call agent in location 1 of FIG. 1 above) determines to establish a link between the users by "secur[ing] a reservation for each media stream" in the session. Ex[1007], ¶¶[0027]-[0028], [0054]. For example, the first CRM establishes the link using the RSVP protocol, which reserves IP resources in BGAN's satellite system for a communication session between users. *Id.*, ¶¶[0020], [0027]; §VIII.C.1.i (motivation to combine analysis). For example, as shown in FIG. 2B, the first CRM allocates bandwidth for user 106a to transmit to user 106d using the "PATH" messages (bottom yellow) and bandwidth for 106a to receive from user 106d using the "RESV" message (middle yellow), which results in a link ("MEDIA STREAMING," green) between the users. *Id.*, ¶¶[0038]-[0039].



Id., FIG. 2B (annotated).

219. Second, the satellite link can be a multicast link. *Id.*, ¶[0027] (explaining that RSVP is used to reserve bandwidth and that “RSVP supports unicast and multicast environments”). The link simultaneously delivers information between a group of users in the first domain and a group of users in a second domain using the most efficient strategy,¹⁷ for example, during “audio and video conferences,” which are enabled by QoS agents 104. *Id.*, ¶[0024]. In particular, using RSVP is efficient and helps “move away from a hub and spoke network topology.” *Id.*, ¶[0027]; *see also id.* ¶[0006] (“Yet another technical advantage of an embodiment may be that calls may gain a reservation during a call, which improves the QoS, or may restore a reservation that fails mid-call, which also improves a call’s QoS”).

220. Finally, Dhesikan+BGAN discloses that the satellite link is established based on presence data of at least one user in the first domain and one user in the second domain. The ’134 patent describes “presence information” as covering an indicator that “conveys an ability and/or willingness of a potential communication partner to communicate.” Ex[1001], 6:41-44. Dhesikan discloses that the first CRM (QoS and Call agent in first domain) receives the same type of presence information relating to the first user (106a) and the second user (106d). For example, as shown

¹⁷ In general, IP multicasting uses a unique address to “transport data to multiple destination stations using a single IP packet.” Ex[1004], p.67.

in FIG. 2B (above), for first user 106a, the first CRM receives an “inbound call request from endpoint 106a” indicating the willingness of user 106a to communicate (“OFFHOOK AND DIAL,” top yellow). Ex[1007], ¶[0038]. In addition, for the second user 106d, the first CRM receives a PATH message (top orange) and a RESV message (bottom orange) from the user 106d’s CRM, indicating the ability of the second user to transmit and receive.¹⁸ *Id.*, ¶[0038]. And the first CRM establishes the communication link (green) *based on* and only after the first CRM detects all of this presence data. *Id.*, FIG. 2B.

221. To the extent Patent Owner argues Dhesikan does not disclose a link for *multicasting*, it would have been obvious to implement Dhesikan such that the link implements teleconferencing and video conferencing using multicast services and delivers information between a group of users in the first domain and a group of users in a second domain using the most efficient strategy, such as the system described in BGAN. *See, e.g.*, Ex[1014], p.3 (describing BGAN’s “multicast service capabilities”). As described, a POSITA implementing the disclosed link in Dhesikan using the known multicast services in BGAN would have a reasonable expectation of success, and the result of the combination would have been predictable, because

¹⁸ The first CRM also receives an indication that the endpoint 106d also goes “off hook,” further indicating the *willingness* of the second user to communicate. Ex[1007], ¶[0040].

multicast protocols were well-known and frequently used before Dhesikan's publication date, and Dhesikan itself expressly discloses that the link can be a link for multicasting. Ex[1007], ¶[0027] (explaining that RSVP is used to reserve bandwidth and that "RSVP supports unicast and multicast environments."); §VIII.C.1.i. In my opinion, a POSITA would also have understood that the multicast services in BGAN are particularly well-suited for use for the teleconferencing and video conferencing applications in Dhesikan, which can involve more than one user, because multicasting efficiently delivers a stream of information to numerous recipients simultaneously. Ex[1007], FIG. 8 (illustrating "a conference call situation" with multiple users), ¶[0063] (describing same).

222. In my opinion, a POSITA also could have combined Dhesikan's link with BGAN's multicast services using known methods and a reasonable expectation of success, for the reasons I described above. §VIII.C.1.i. When multicast is used with Dhesikan, a POSITA would simply have implemented the messages illustrated in FIG. 2B, for example, with multicast addresses and off-the-shelf routers programmed to recognize those address to route the messages to the relevant recipients. Ex[1007], ¶[0027]. Dhesikan further describes establishing calls using real-time protocol (RTP), which a POSITA would have known to be a network protocol suite for delivering audio and video that can implement multicasting. *Id.*, ¶[0024]; Ex[1013], p.1 (explaining that "RTP provides end-to-end network transport

functions suitable for applications transmitting real-time data, such as audio, video or simulation data, over multicast or unicast network services”), p.7 (describing using RTP to support audio and video conferencing using multicast). In my opinion, a POSITA would easily have been able to implement Dhesikan using these known methods and protocols.

d. 1[c]: “determine[s] an application to be used in a communication session over the link”

223. Dhesikan+BGAN discloses limitation 1[c]. The first CRM (QoS and call agent in first domain) determines an application (*e.g.*, video or audio) to be used over the link in a communication session.

224. First, Dhesikan describes users communicating over the established link in a *communication session*. For example, “[e]ndpoints 106 establish a communication tunnel, link, or session in communication system 10 via locations 102.” Ex[1007], ¶[0023]. Dhesikan makes “a reservation of bandwidth for a particular session” allowing users to talk (communicate) in that session. *Id.*, ¶[0027].

225. Second, after determining to establish the link for an audio call, the first CRM (QoS and call agent in the first domain) determines if another application (such as video) will be used in the session over the link. *Id.*, ¶[0039]. For example, Dhesikan discloses that “[f]or an *audio* call, call agent 100 may use any estimated bandwidth between endpoints 106a and 106d determined in any manner” while “[f]or a *video* call, call agent 100 may use a desired minimum value default video

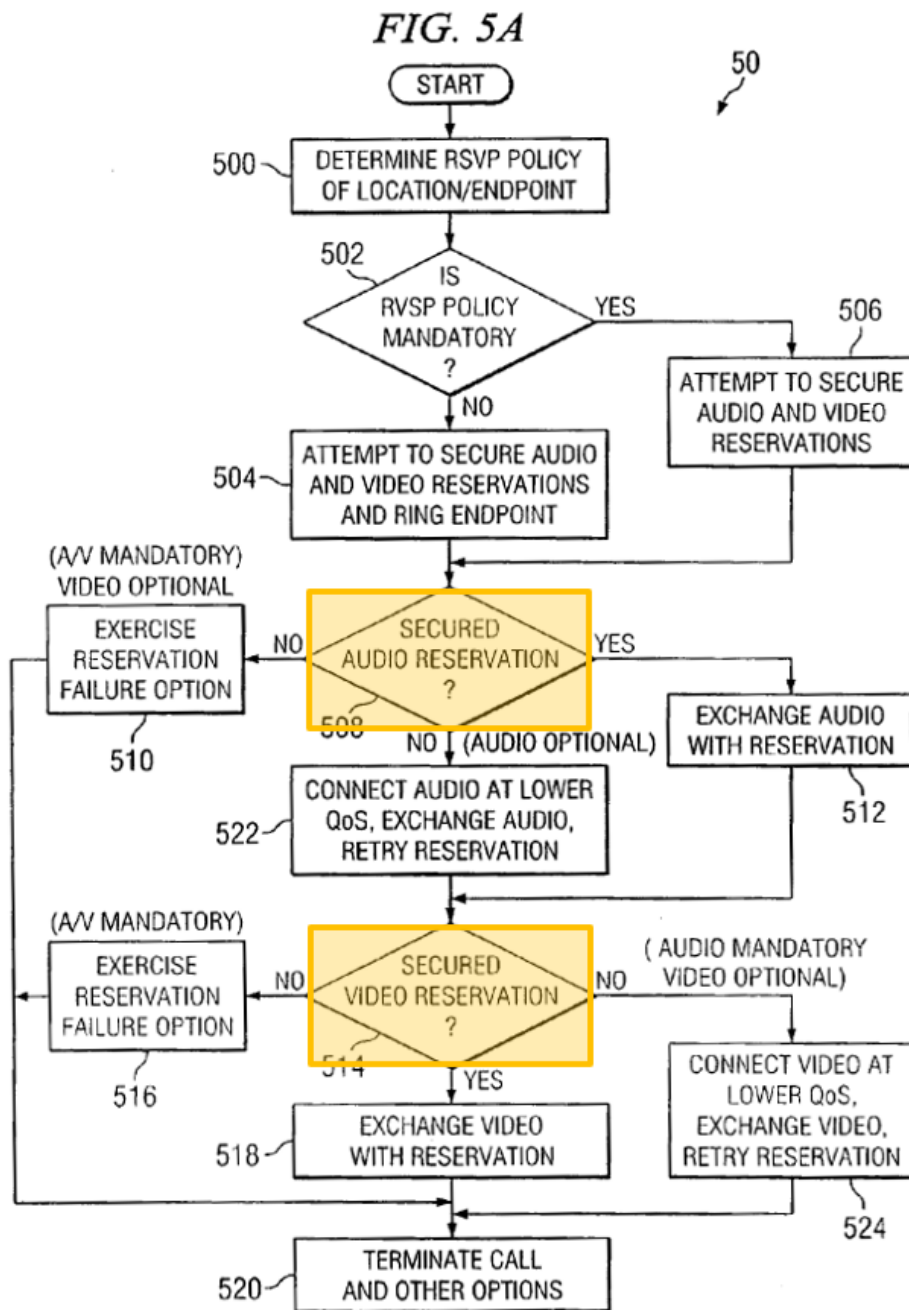
bandwidth.” *Id.*, ¶[0044] (emphases added). Likewise, the QoS agent in each domain determines an application because the QoS agent reserves appropriate resources for a communication session based on whether the session “accommodate[s] audio and video media streams” and “audio and video conferences,” and whether calls may exchange “both audio and video streams.” *Id.*, ¶¶[0024], [0053] (describing exchanging “both audio and video streams”).

- e. 1[d]: “allocate[s] a bandwidth level to be used for the link to accommodate the application”

226. Dhesikan+BGAN discloses limitation 1[d]. The first CRM (QoS and call agent in the first domain) allocates bandwidth for the link based on the determined application.

227. For example, Dhesikan discloses that the QoS agent in the first CRM allocates different bandwidth levels for the link based on whether the link will also include video transmissions. *Id.*, ¶[0024]. FIG. 5A (below), for example, “expand[s] on the concepts” of FIG. 2B for calls “exchanging both audio and video streams” for which the QoS and call agents attempt “to secure a reservation for each media stream” (*e.g.*, audio and video). *Id.*, ¶¶[0053]-[0054]. As shown below, first, “[a]t block 508, a decision is made whether a reservation for the audio stream has been secured,” including whether bandwidth for the audio stream has been allocated. *Id.*, ¶¶[0054], [0027] (“By having a reservation, a call can utilize reserved bandwidth and experience improved QoS.”). Then, “[a]t decision block 514, it is determined

whether the video stream has secured a reservation,” including whether bandwidth for the video stream has been separately allocated. *Id.*, ¶¶[0055], [0027].



Id., FIG. 5A (annotated).

228. Dhesikan expressly describes that the CRM determines bandwidth and may change it based on QoS:

From block 220, call agent 100 determines at block 222 whether the connected call has experienced a failing event. A failing event may include a call being preempted by another call that has a higher priority, a call that has insufficient bandwidth to continue, or any suitable failing event. Instead of the call being released because the failing event has occurred, the call continues with degraded service. For example, the degraded service may involve using a lower DSCP marking value, which lowers the QoS of the call. To continue the call with degraded service and support another call, the bandwidth originally supporting the call is reallocated based on the availability of the QoS.

Id., ¶[0035] (describing FIG. 2A).

FIG. 2C shows a message flow when call agent 100 is connecting the media upon successful reservation of each audio stream. When obtaining the reservations for each stream, call agent 100 will not know the exact bandwidth to use for the call before connecting the media. At this time, call agent 100 provides estimated bandwidth information in the QoSPath message. For an audio call, call agent 100 may use any estimated bandwidth between endpoints 106a and 106d determined in any manner. For a video call, call agent 100 may use a desired minimum value default video band width. Upon connecting the media, call agent 100 can instruct QoS agents 104a and 104b to adjust RSVP bandwidth reservation for the call via a QoSModifyTSpec message. After each one-way media stream is established, call agent 100 can instruct QoS agents 104a and 104b to adjust bandwidth specifications if it is different from the one used in the QoSPath and QoSResV messages.

Id., ¶[0044] (describing FIG. 2C); *see also id.*, ¶[0024] (“QoS agents 104a and 104b, respectively, are coupled to an associated call agent 100 and to associated endpoints 106. QoS agents 104 represent endpoints 106, reserve bandwidth on behalf of endpoints 106, and are involved in the signaling and media exchange between

endpoints 106 as determined by call agent 100. QoS agents 104 control the implementation of RSVP by determining the available bandwidth and making reservations on behalf of endpoints 106. A call leg and a signaling path may be created by any one of QoS agents 104.”).

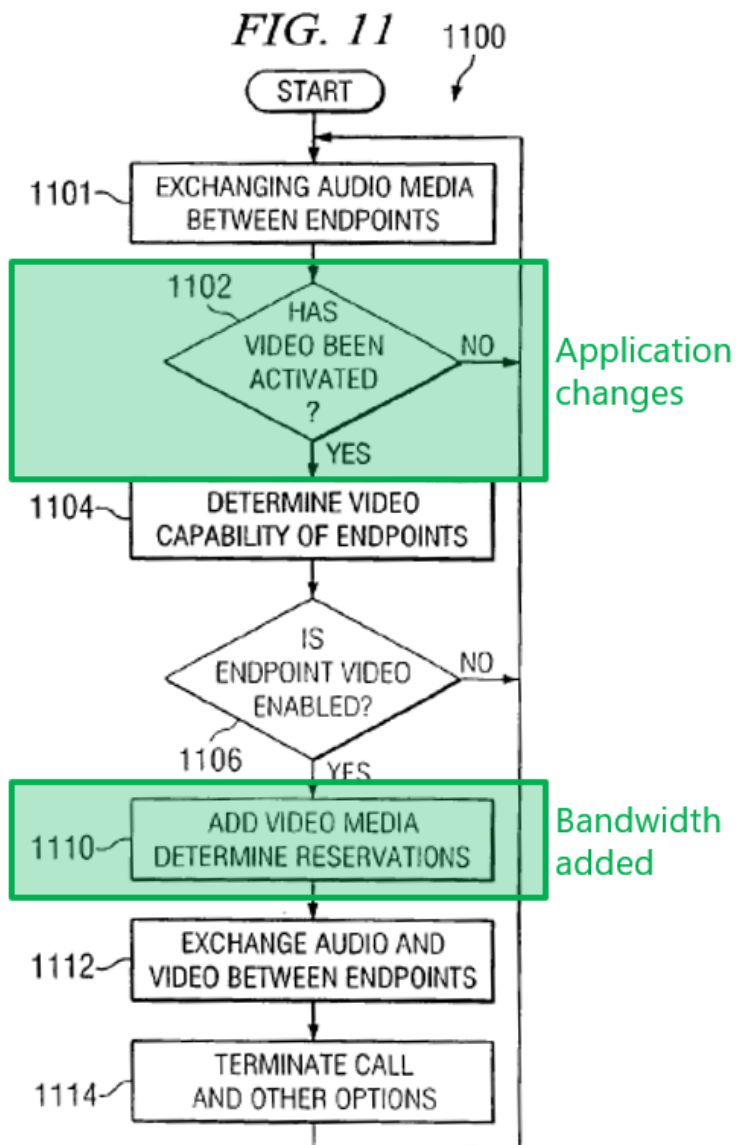
- f. 1[e]: “increase[s] the bandwidth level for the link based on a change in the application and based on an identification of additional presence data for additional users that have joined the communication session”

229. Dhesikan+BGAN discloses limitation 1[e]. The first CRM (QoS and call agent in the first domain) increases bandwidth based on changes in application and presence data for additional users joining the communication session.

230. Dhesikan’s CRM “establishes reservations between endpoints in order to guarantee a certain amount of bandwidth for [a] call.” *Id.*, ¶[0005]. RSVP controls and preserves the bandwidth between the two endpoints. If an additional endpoint is added, or a new application with higher bandwidth is implemented, the CRM allocates new RSVP reservations and new bandwidth for the new endpoint or application while preserving the bandwidth for the first two endpoints. *Id.*, ¶[0024]. The QoS agent “control the implementation of RSVP by determining the available bandwidth and making reservations on behalf of [the] endpoints.” *Id.*

231. As I described for limitation 1[d], the CRM increases the bandwidth in various scenarios. For example, Dhesikan describes that an application can change during a conference call (*e.g.*, video can be added to an audio call) and, based on

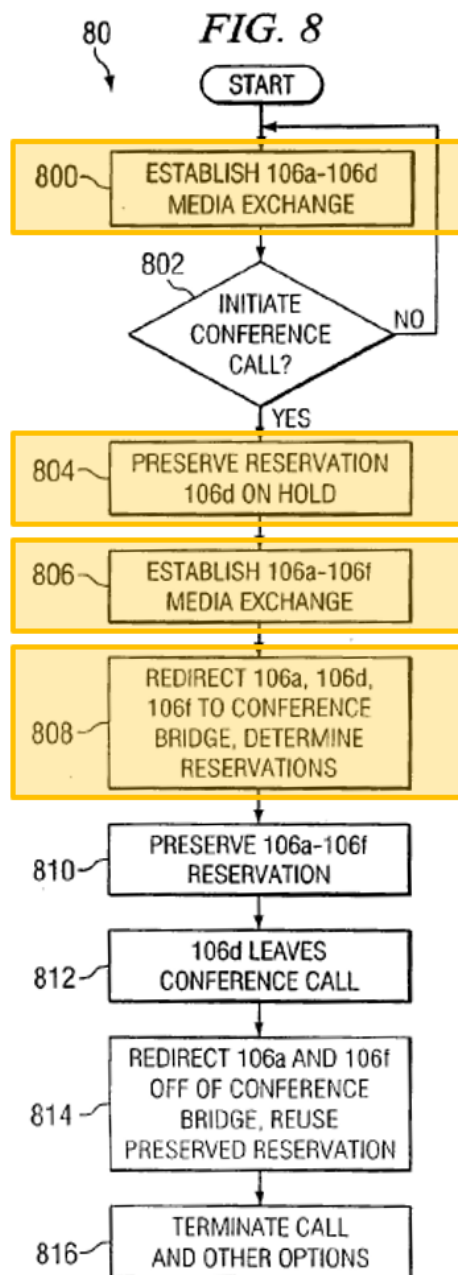
that change of application, the first CRM can increase the bandwidth allocated to the link. The process is shown in FIG. 11 (below). For example, at block 102, during a call between users 106a and 106d, the “[c]all agent 100” may “dynamically determine[] whether video has been activated.” *Id.*, ¶[0068]. If video is activated, and if both devices are “video enabled,” then “[v]ideo media is added to the call with a RSVP reservation at block 1110.” *Id.* The additional RSVP reservation increases the bandwidth level for the link. *Id.*, ¶[0027] (“By having a reservation, a call can utilize reserved bandwidth and experience improved QoS.”).



Id., FIG. 11 (annotated).

232. Further, Dhesikan also discloses that the first CRM increases the bandwidth level based on an identification of additional presence data for additional users joining a call (communication session). FIG. 8 (below), for example, illustrates the process. As shown, at block 800, original users 106a and 106d are already exchanging media in a communication session. *Id.*, ¶[0063]. Then, at step 802, user

106a indicates it would like to initiate a conference call including both user 106d and new user 106f. *Id.*, ¶[0063]. Accordingly, at step 806, user 106a attempts to connect with user 106f by checking 106f's "reservation" requirements as needed (*e.g.*, whether 106f requires bandwidth for video). *Id.* As described above for the process of establishing a link in FIG. 2B (which also applies to a new user), the process of reserving bandwidth for user 106f also involves identifying presence data for user 106f, including its willingness to communicate, via a PATH or RESV message sent by user 106f's CRM to the first CRM to reserve bandwidth with which user 106f can transmit and receive. §VIII.C.2.e; Ex[1007], ¶¶[0038]-[0039], [0063] (noting that the reservation process for reserving bandwidth for user 106f is the same "as discussed above").



Ex[1007], FIG. 8 (annotated).

233. Moreover, Dhesikan discloses that the new user 106f can join the original communication session using the established link between 106a and 106d. For example, Dhesikan describes that new user 106f can be co-located with original

user 106d, such that 106f uses the same link as 106d and the same bandwidth reservation for the call between 106a and 106d can be “reused” to accommodate (at least in part) user 106f’s reservation requirements. *Id.*, ¶[0063].

234. Finally, Dhesikan also discloses that the first CRM can increase the bandwidth allocated to the link based on the additional presence data for user 106f. More specifically, according to Dhesikan, the conference bridge for the call between the three users can be located in the same domain as user 106a. *Id.*, ¶[0064]. In that scenario, each of the individual bandwidths for each of the individual reservations (106a-106d) and (106a-106f) “can be reused” for the conference call using the conference bridge. *Id.* Accordingly, the bandwidth allocated to the individual call between 106a and 106d *and* the bandwidth allocated to the individual call between 106a and 106f can be combined and used for the three-way conference call. *Id.* In my opinion, it would at least have been obvious to a POSITA that reusing *both* individual bandwidth reservations would result in an *increase* in overall bandwidth for the link to accommodate both reservations and both QoS requirements. *Id.*

- g. 1[f]: “the communication resource managers each includes respective trunking element that is automatically configured to select a transcoding based on available bandwidth”

235. Dhesikan+BGAN in view of Firestone discloses limitation 1[f].

236. First, Dhesikan’s CRMs (QoS and call agents in each domain), in combination with BGAN’s satellite service, each include a trunking element (at least

QoS and a portion of call agent), which performs the same trunking functionality as described in the '134 patent (*e.g.*, bringing up and tearing down the satellite link and controlling bandwidth for the link).¹⁹ Ex[1001], 2:54-62, 4:33-49. For example, the QoS agent and call agent in the CRM establish the link using the RSVP protocol, which reserves IP resources in BGAN's satellite system for a communication session between users. Ex[1007], ¶¶[0020], [0027]; §VIII.C.1.i (motivation to combine analysis). Further, the QoS agent allocates different bandwidth levels for the link based on whether the link will accommodate audio or video transmissions. Ex[1007], ¶[0024]. And QoS agent and call agent also tear down a link when a communication session ends. *Id.*, ¶[0040].

237. In my opinion, it would also have been obvious for the QoS agents to incorporate Firestone's media switch functionality in this system to automatically select a transcoding based on available bandwidth. *Id.*, ¶[0024]; §VIII.C.1.ii. For example, Dhesikan discloses that the QoS agents may "perform appropriate transcoding." Ex[1007], ¶[0024]. Firestone's media switch functionality incorporated in Dhesikan's QoS agent results in the first CRM in Dhesikan automatically selecting a transcoding based on available bandwidth. As Firestone

¹⁹ As I describe for this limitation, the trunking element constitutes software and/or hardware in the communication resource manager that establishes, tears down, and controls the bandwidth of the satellite link." Ex[1036].

describes, certain users (end points) may have limitations on “how much bandwidth reservation” they can request, and therefore may require “a video transrater” or a “video transcoder” to accommodate “bandwidth constraints,” to select a transcoding based on available bandwidth. Ex[1008], ¶¶[0029], [0032]. For instance, Firestone’s “media switches” “can perform a number of functions” including “audio transcoding,” “video transcoding,” and “video transrating.” *Id.*, ¶¶[0034], [0108]-[0109]. “[V]ideo transrating and transcoding” “allow end points using different rates or codecs to natively join the same conference without needing external transraters or transcoders.” *Id.*, ¶[0034]. Video “transrating,” for example, provides “bandwidth reduction by changing video quantization parameters.”²⁰ *Id.*, ¶[0034].

238. Accordingly, Dhesikan+BGAN in view of Firestone discloses that each CRM in each domain includes a trunking element (QoS agent) that is automatically configured to select a transcoding based on available bandwidth.

- h. 1[g]: “adjust[s] the bandwidth level based on a determination which of the additional users and the users in the first and second domains can transmit data simultaneously during the communication session”

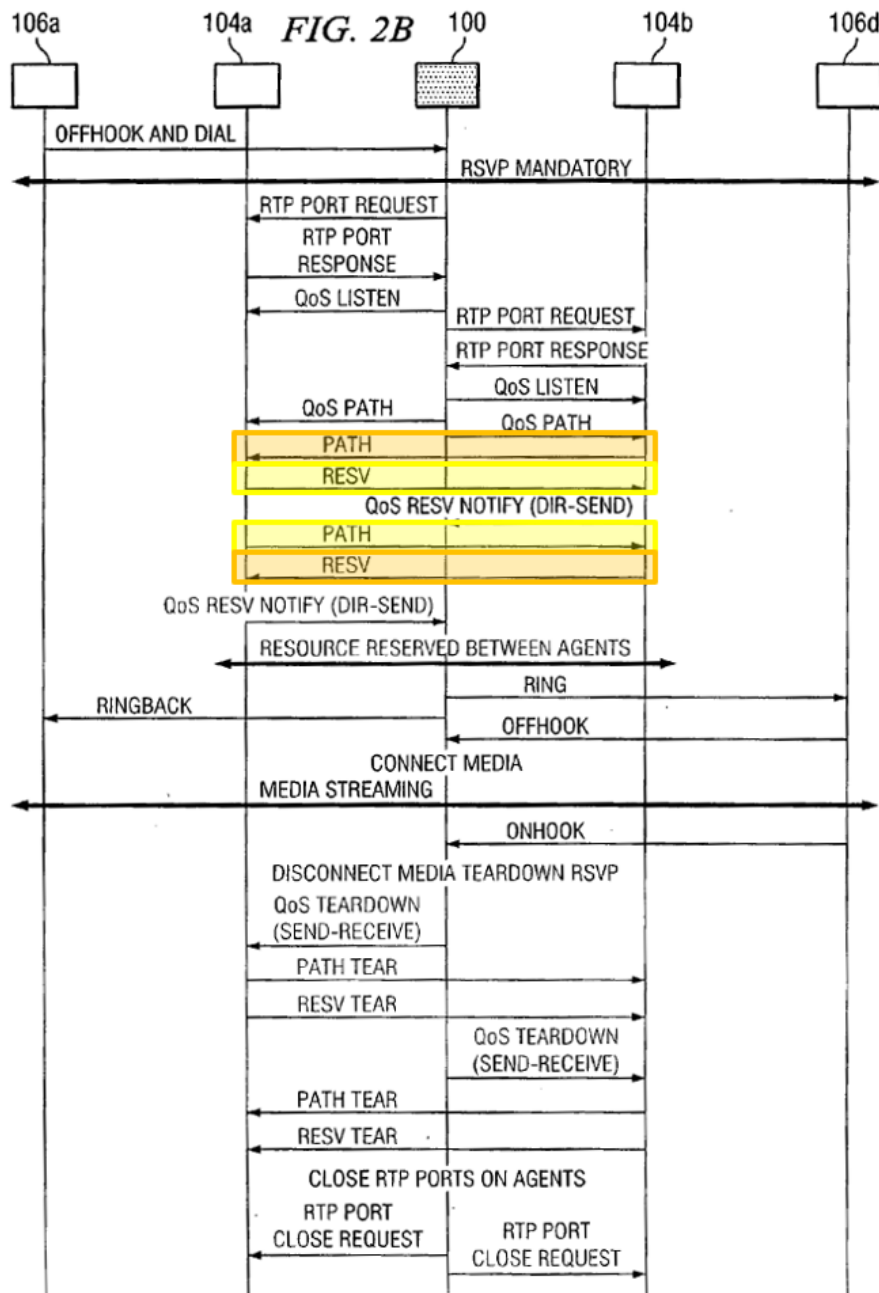
239. Dhesikan+BGAN discloses limitation 1[g]. The first CRM (QoS and Call agent in the first domain) adjusts bandwidth based on determining which of the

²⁰ As described in Firestone, video transrating is therefore a special case of video transcoding that alters bandwidth of a video signal.

additional users and the users in the first and second domains can transmit data simultaneously in the session.

240. As described for limitation 1[e], Dhesikan discloses increasing (adjusting) the bandwidth level based on determining that additional users have joined a communication session. See §VIII.C.2.e-f.

241. Dhesikan also describes that the first CRM then adjusts bandwidth level based on a determination of which of the additional users and the existing users in the first and second domains can transmit data simultaneously during a communication session. For example, in Dhesikan, a CRM (QoS and call agent) separately allocates bandwidth for each user that wishes to transmit simultaneously on the link. Ex[1007], ¶[0039]. Indeed, in FIG. 2B below, for the communication session between users 106a and 106d, the first “PATH” message from QoS agent 104b reserves bandwidth on the link so user 106d can *transmit* to user 106a. *Id.* Then, the second “PATH” message from QoS agent 104a reserves additional bandwidth on the link for user 106a to *transmit* to user 106d. *Id.* Together the reservations increase (*adjust*) bandwidth to allow for transmission by both users.



Id., FIG. 2B (annotated).

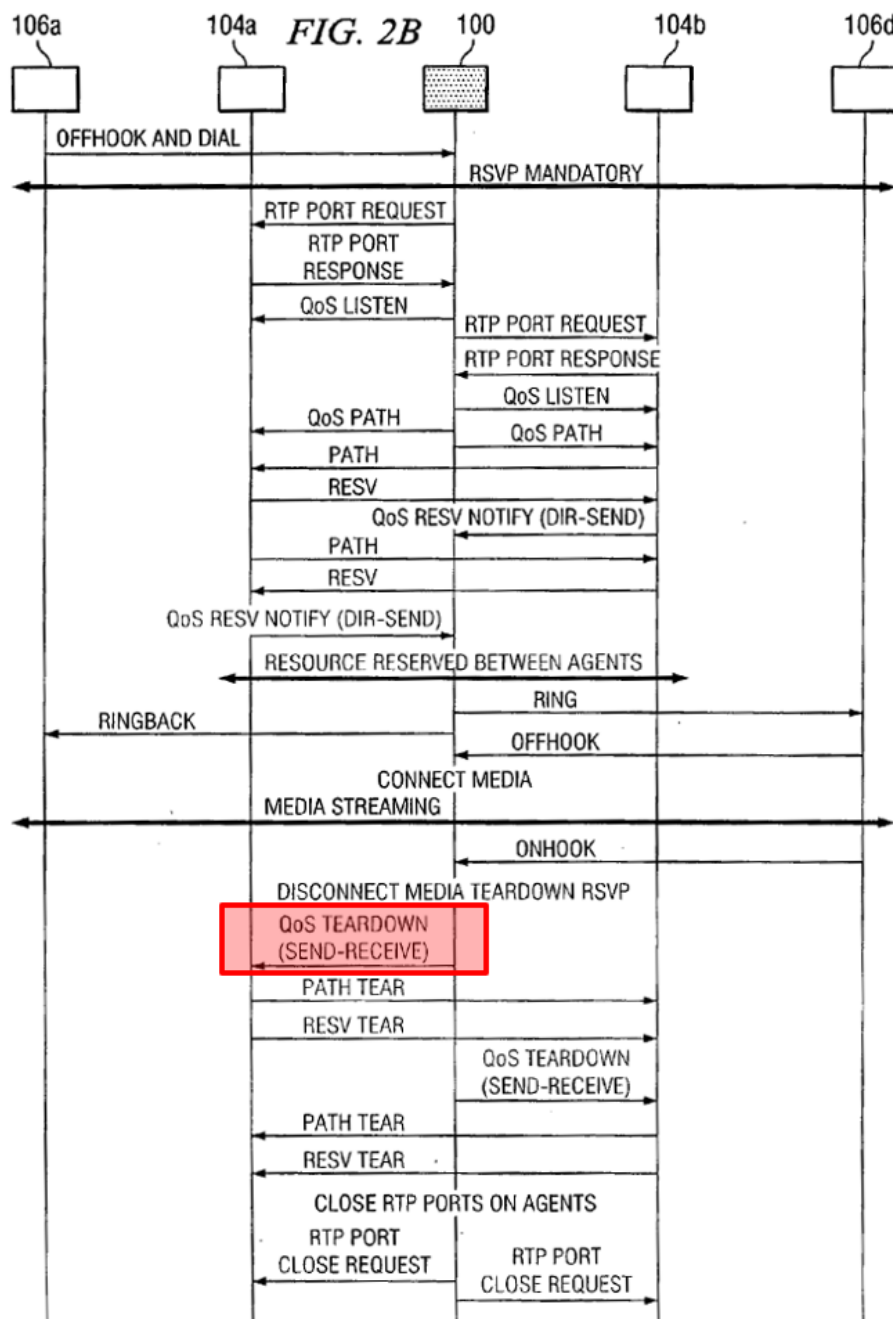
242. Based on this disclosure, a POSITA would have understood, and it would have at least been obvious that the transmissions in Dhesikan occur *simultaneously*. Moreover, a key application for both Dhesikan and BGAN is

videoconferencing and teleconferencing, which typically involve full duplex communications in which users can transmit simultaneously in a communication session. *Id.*, ¶[0024]; Ex[1014], p.66. A POSITA would also have understood that the protocols described in Dhesikan, including H.323, are used in full duplex teleconferencing and videoconferencing. *See, e.g.*, Ex[1007], ¶[0024] (describing use of the H.323 protocol).

- i. 1[h]:“detect[s] an absence of active users in the first domain and the second domain”

243. Dhesikan+BGAN discloses limitation 1[h]. In Dhesikan, the first CRM (QoS and call agent in the first domain) detects an absence of active users in both domains.

244. For example, as shown in FIG. 2B (below), endpoint 106d can go “on hook” and terminate a call. *Id.*, ¶[0040]. At that time, the users in the session may remain active (for example, may remain on “hold” until a call resumes), *or* the users can go inactive and indicate their intent to leave the session. *Id.* In the latter case, the first CRM (including QoS agent 104a) can detect the absence of activity of both users via a “QoS TearDown” message (red below) indicating both (a) that user 106d has left the session (is inactive); and (b) that user 106a will leave the session and become inactive (such that the reservation should be torn down, rather than preserved). *Id.*



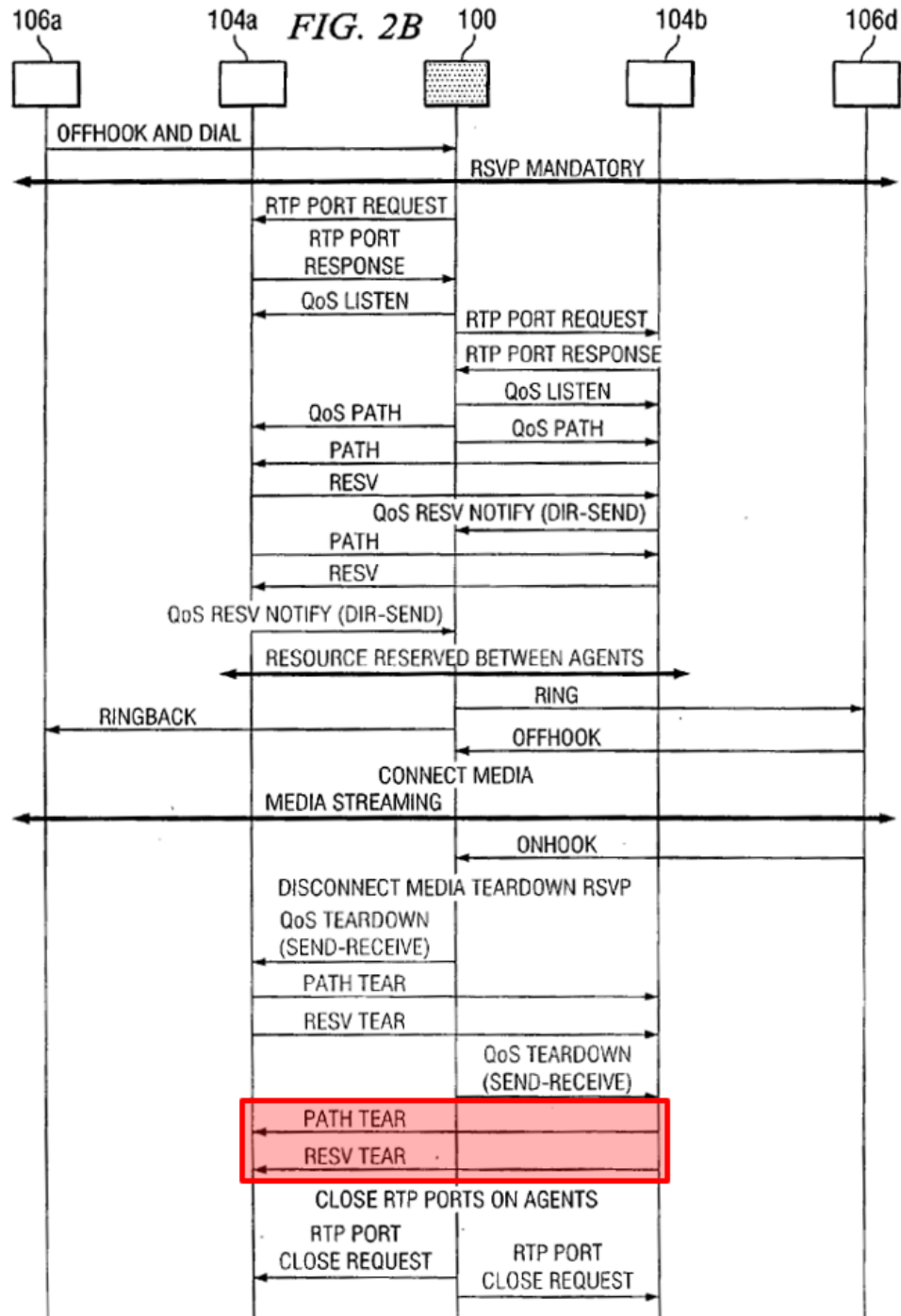
Id., FIG. 2B (annotated).

j. 1[i]: “tear[s] down the link based on the absence”

245. Dhesikan+BGAN discloses limitation 1[i]. As described for limitation 1[h], Dhesikan discloses that the first CRM can detect an absence of active users in

the two domains. See §VIII.C.2.i. In addition, based on the absence of detected activity, the first CRM (QoS agent 104a and call agent) tears down the link.

246. Specifically, as shown in FIG. 2B, QoS agent 104a sends a “PATHTear message” and a “RESVTear message” to tear down the link for user 106a to both transmit and receive information. Ex[1007], ¶[0040].



Id., FIG. 2B (annotated).

k. 1[j]: “the link is a satellite communication link”

247. Dhesikan+BGAN discloses limitation 1[j]. BGAN discloses providing “multicast service capabilities” using an on-demand broadband satellite service. Ex[1014], pp.2-3. In my opinion, for the reasons set forth above, §VIII.C.1.i, it would have been obvious to implement the network link described in Dhesikan using the satellite-based IP network disclosed in BGAN.

3. Claim 2

248. Dhesikan+BGAN discloses claim 2—“*the users of the first domain comprise a virtual talking group (VTG).*”²¹

249. Dhesikan discloses a “virtual talking group” as that term is used in the exemplary embodiment of the ’134 patent. See Ex[1001], FIGs. 3-4 (illustrating users in different groups in each domain). FIG. 1 of Dhesikan (below), for example, illustrates that “[l]ocations 102a and 102b” can include “logical groupings of endpoints.” Ex[1007], ¶[0022].

²¹ As I describe for this limitation, Dhesikan discloses a talk group that communicates using an IP address. Ex[1036].

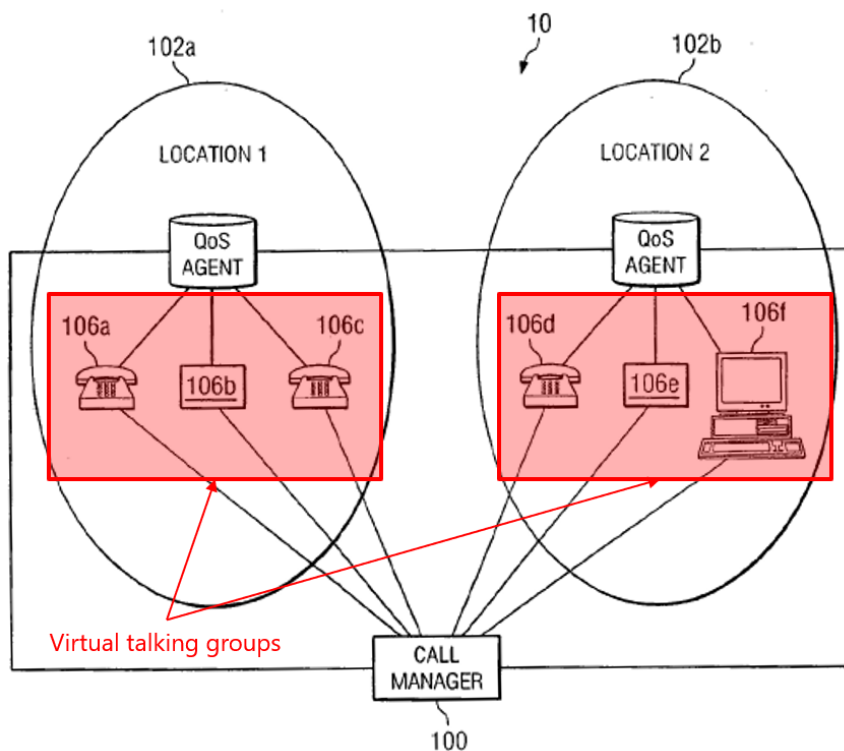


FIG. 1

Id., FIG. 1 (annotated). Multiple users (a group) in each domain (connected to a single QoS agent) can join a telephone conference or video conference to talk to each other. *Id.*, FIGs. 8, 10A, ¶¶[0063] (describing users 106d and 106f at the same “location” such that they can use the same “preserved reservations”), [0066] (describing endpoints 106d and 106f in the same location can use “a single QoS agent”). Moreover, as I described above for limitation 1[a], the users can communicate using an IP protocol, and hence an IP address. §VIII.C.2.b,

4. Claim 3

250. Dhesikan+BGAN discloses claim 3—“*the additional presence data relates to whether a given end user has logged into their respective system.*”

251. As described for limitation 1[e], Dhesikan's disclosure of a PATH message or a RESV message for a new user 106f constitutes additional presence data for a user that joins a session. §VIII.C.2.f. BGAN further discloses that a new user must also be authenticated "prior to authorising the reception of the multicast content, based on such criteria as membership status, geographical location, user status, mobile capabilities, and network resources." Ex[1014], p.6. In my opinion, user authentication constitutes log-on information for a system and further relates to Dhesikan's presence data (PATH or RESV message) because a PATH or RESV message would only be sent if a user is determined to have the privileges necessary to transmit or receive information in the session.

252. It would have been obvious to a POSITA to implement the user authentication of BGAN in the call agent of Dhesikan and doing so would have enhanced the security of Dhesikan's communication system which is a common goal in networking. Dhesikan's call agent, for example, already stores caller precedent information and passes that information to the QoS agent, to indicate if a caller (user) has a high or low priority designation. Ex[1007], ¶[0043]. In my opinion, it would have been a simple software design change for the call agent to store information about the user's successful authentication and login to the system.

5. Claim 4

253. Dhesikan+BGAN discloses claim 4—“*the communication resource managers each includes respective virtual talk group (VTG) presence managers (VPMs), each of which is operable to monitor their users who are present in their respective domains.*”

254. In my opinion, the QoS agent in each CRM discloses the claimed virtual presence manager. As explained for limitations 1[a] and 1[b], Dhesikan discloses that each CRM in a domain includes a QoS agent that monitors user presence in that domain and, if a user is present, issues a PATH or RESV message for that user to reserve bandwidth. See §§VIII.C.2.b-c.

6. Claim 5

255. Dhesikan+BGAN discloses claim 5—“*information received from the VPMs is used to maintain a designated link bandwidth allocation.*”

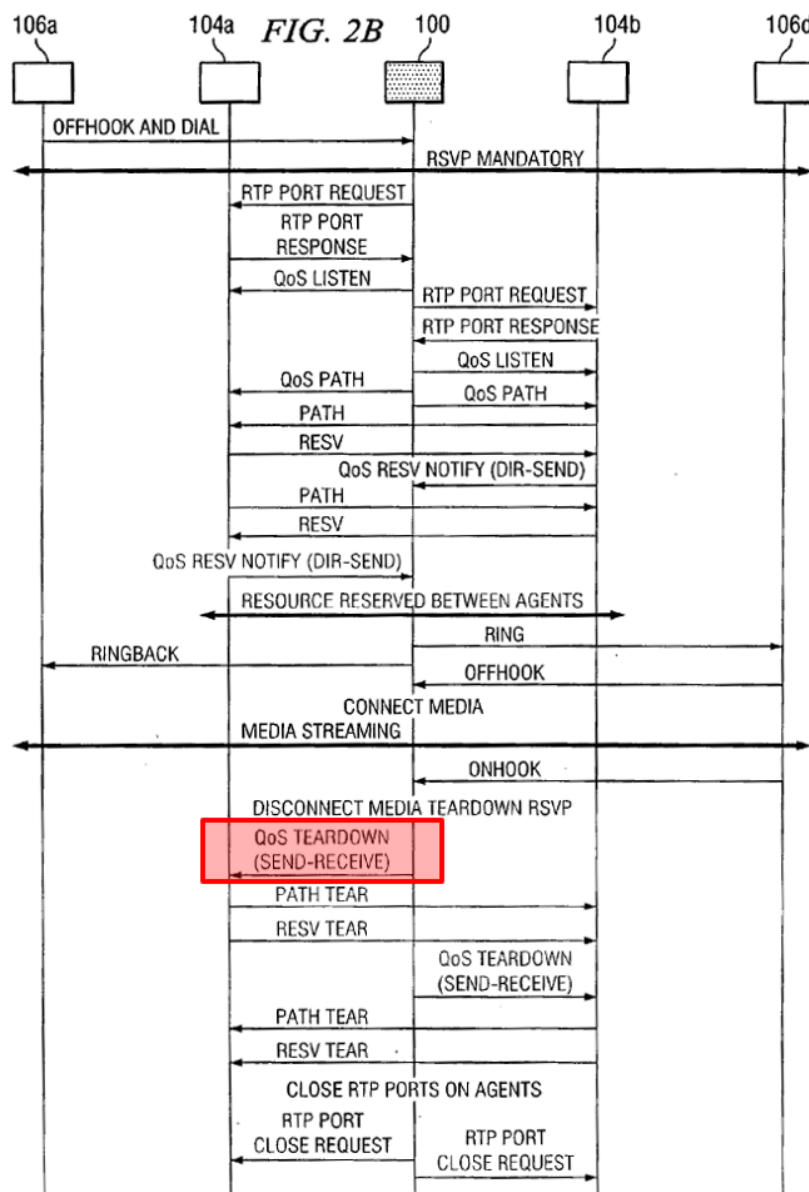
256. As disclosed for limitations 1[d] and 1[e], a call agent in a domain receives information from the QoS agent (which corresponds to the claimed VPM) in that domain to maintain a designated link bandwidth allocation. §§VIII.C.2.e-f. For example, Dhesikan’s FIGs. 3Ba and 3Bb illustrate a scenario where a reservation has been lost. Ex[1007], ¶[0052]. In that situation, the QoS agent (VPM) retries the reservation and sends a QoS RESV NOTIFY message to the call agent to notify the

call agent that the original bandwidth allocation has been maintained so that call agent can reestablish a “higher class of service.” *Id.*, ¶[0052], FIGs.3Ba-3Bb.

7. Claim 6

257. Dhesikan+BGAN discloses claim 6—“*if either one of the VPMs determine that there are no active users logged into their respective systems, then the VPMs tear down the link.*”

258. In my opinion, as described for limitations 1[h] and 1[i] and claim 3, Dhesikan discloses that *each* QoS agent (VPM) in each of two connected domains can determine if no active users are logged onto their respective systems. §VIII.C.2.i-j. For example, as shown in FIG. 2B (below) each QoS agent in each domain can receive a “QoS TearDown” message from a call agent indicating that a session should be torn down because no remaining active users are in the session that requires a call to be placed on “hold.” Ex[1007], ¶[0040]; §§VIII.C.2.i-j. When the QoS agent (VPM) receives that message, it then takes steps to tear down the link by sending RESVTear and PATHTear messages. Ex[1007], ¶[0040].



Id., FIG. 2B (annotated).

8. Claim 7

259. Dhesikan+BGAN discloses claim 7—“a router that establishes the link based on direction from the communication resource manager.”

260. As described for limitation 1[b], Dhesikan discloses that QoS agents receive direction from other components of the CRM (call agents) to establish the link. See §VIII.C.2.c; Ex[1007], FIG. 2B (showing transmissions from call agent to QoS agents). Additionally, Dhesikan discloses that QoS agents 104 may be “routers.” Ex[1007], ¶[0024].

9. Claim 8

a. 8[Pre]

261. If the preamble is limiting, Dhesikan+BGAN discloses it. For example, Dhesikan discloses “a method for securing a reservation in communication system 10.” *Id.*, ¶[0033].

b. 8[a]

262. For the reasons disclosed for limitation 1[a], Dhesikan+BGAN discloses limitation 8[a].

c. 8[b]

263. For the reasons disclosed for limitation 1[b], Dhesikan+BGAN discloses limitation 8[b].

d. 8[c]

264. For the reasons disclosed for limitation 1[c], Dhesikan+BGAN discloses limitation 8[c].

e. 8[d]

265. For the reasons disclosed for limitation 1[d], Dhesikan+BGAN discloses limitation 8[d].

f. 8[e]

266. For the reasons disclosed for limitation 1[e], Dhesikan+BGAN discloses limitation 8[e].

g. 8[f]

267. For the reasons disclosed for limitation 1[f], Dhesikan+BGAN in view of Firestone discloses limitation 8[f].

h. 8[g]

268. For the reasons disclosed for limitation 1[g], Dhesikan+BGAN discloses limitation 8[g].

i. 8[h]

269. For the reasons disclosed for limitation 1[h], Dhesikan+BGAN discloses limitation 8[h].

j. 8[i]

270. For the reasons disclosed for limitation 1[i], Dhesikan+BGAN discloses limitation 8[i].

k. 8[j]

271. For the reasons disclosed for limitation 1[j], Dhesikan+BGAN discloses limitation 8[j].

10. Claim 9

272. For the reasons disclosed for claim 2, Dhesikan+BGAN discloses claim 9.

11. Claim 10

273. For the reasons disclosed for claim 3, Dhesikan+BGAN discloses claim 10.

12. Claim 11

274. For the reasons disclosed for claim 5, Dhesikan+BGAN discloses claim 11.

13. Claim 12

a. 12[Pre]

275. If the preamble is limiting, Dhesikan+BGAN discloses it. For example, Dhesikan discloses “a method for securing a reservation in communication system 10.” *Id.*, ¶[0033].

b. 12[a]

276. For the reasons disclosed for limitation 1[a], Dhesikan+BGAN discloses limitation 12[a].

c. 12[b]

277. For the reasons disclosed for limitation 1[b], Dhesikan+BGAN discloses limitation 12[b].

d. 12[c]

278. For the reasons disclosed for limitation 1[c], Dhesikan+BGAN discloses limitation 12[c].

e. 12[d]

279. For the reasons disclosed for limitation 1[d], Dhesikan+BGAN discloses limitation 12[d].

f. 12[e]

280. For the reasons disclosed for limitation 1[e], Dhesikan+BGAN discloses limitation 12[e].

g. 12[f]

281. For the reasons disclosed for limitation 1[f], Dhesikan+BGAN in view of Firestone discloses limitation 12[f].

h. 12[g]

282. For the reasons disclosed for limitation 1[g], Dhesikan+BGAN discloses limitation 12[g].

i. 12[h]

283. For the reasons disclosed for limitation 1[h], Dhesikan+BGAN discloses limitation 12[h].

j. 12[i]

284. For the reasons disclosed for limitation 1[i], Dhesikan+BGAN discloses limitation 12[i].

k. 12[j]

285. For the reasons disclosed for limitation 1[j], Dhesikan+BGAN discloses limitation 8[j].

14. Claim 13

286. For the reasons disclosed for claim 3, Dhesikan+BGAN discloses claim 13.

15. Claim 14

287. For the reasons disclosed for claim 5, Dhesikan+BGAN discloses claim 14.

IX. SECONDARY CONSIDERATIONS

288. During prosecution of the '134 patent, the applicant did not identify any evidence of secondary considerations of non-obviousness tied to the claimed invention of the '134 patent. I understand from counsel for Petitioner that Patent Owner in the co-pending district court litigation has not identified any evidence with respect to secondary considerations of non-obviousness. I am aware of no evidence of secondary considerations that would meaningfully rebut a finding of obviousness.

289. Accordingly, there is no objective evidence of non-obviousness that might warrant a finding that Claims 1-14 are patentable. To the extent Patent Owner at a later date cites or provides any other evidence regarding secondary considerations, including any expert opinions, I reserve the right to supplement my analysis and opinions to address it.

X. CONCLUSION

290. For at least the above-described reasons, in my opinion Claims 1-14 of the '134 patent would have been obvious to a POSITA based on the prior art references that I have cited and analyzed above.

291. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross examination within the United States during the time allotted for cross-examination.

292. I reserve the right to supplement my opinions in the future to respond to any arguments raised by Patent Owner and to consider any new information that becomes available to me.

293. 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 were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on August 21, 2023.

Respectfully submitted,

Petition for *Inter Partes* Review of U.S. Patent No. 8,489,134

Aug 21-2023

Dr. Sayfe Kiaei

A handwritten signature in cursive script, reading "Sayfe Kiaei". The signature is written in dark ink on a white background.

Appendix A

Dr. Sayfe Kiaei
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Arizona State University, Tempe, AZ 85287
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Sayfe Kiaei

Professor, Motorola Endowed Chair Professor

School of Electrical, Computer and Energy Engineering, Arizona State University, Tempe, AZ

FIELDS OF SPECIALIZATION

- **Integrated Circuits (IC):** Analog & Digital IC, Mixed-Signal IC, VLSI, Processor, ASIC, RFIC
- **Radio Frequency:** RF, Receiver, Transmitter, Synthesizer, Antenna, MIMO, RF system
- **Power Management:** Power Management IC, Battery Management, Energy System, Energy Management
- **Sensors:** RFID, ZIGBEE, BT, Custom Sensors, MICS, IOT, Bio-Electronics, Bio-sensors, Hearing Aid sensors, Implanted devices electronics
- **Bio-Electronics:** Bio-Sensors, Hearing Aid, Implanted Bio-Electronics, Medical Implanted Communication System (MICS)
- **Signal Processing:** Digital Signal Processing, Adaptive Signal Processing, Video & Audio Signal Processing, Adaptive Audio Array processing, Audio and Acoustic & Speech processing
- **Wireless Communication Systems:** 1G-5G, 2-way radio, BT, WIFI, Sensors, ZIGBEE, wireless sensors
- **Wireline Communication System:** CABLE, DSL, Optical
- **Digital System:** VLSI, Processor, DSP processor

DEGREES

- **Ph.D.,** Electrical and Computer Engineering, Washington State University, 1987
- **M.S.,** Electrical and Computer Engineering, Washington State University, 1984
- **B.S.E.E.,** Electrical Engineering, Northeastern University, Washington State University, 1982

ACADEMIC POSITIONS

Fall 2001-Present: Professor, Motorola Endowed Chair Professor in Analog and RFIC School of Electrical, Computer and Energy Engineering, Arizona State University, Tempe, AZ

- **Professor:** Research and teaching in integrated circuits, RF circuits and systems, Communications, Wireless and Wireline transceiver, mixed-signal and Analog IC, Sensors, Power management IC, Signal processing, Bio-electronics, Signal Processing, Audio processing, GPS, wireless system
- **Research Projects:**
 - Analog and digital IC, Radio Frequency IC, RF transceiver
 - VLSI, Processor System Architecture, ASIC
 - Power Management IC, Battery Management & Sensing, Integrated Power Electronics
 - Digital Signal Processing, Audio processing, adaptive signal processing, Array processing, AI
 - Wireless communication system, wireless modems, 1G, 2G GSM, 3G CDMA, 4G LTE, 5G wireless mobile system, LTE, WiFi, Bluetooth, Wireless system standards
 - Wireline Communication system and transceivers, MODEM standards, CABLE MODEM DOCIS, DSL

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- Signal Processing, Digital Signal Processing, Adaptive Signal Processing
- Adaptive Audio Array processing, Audio and Acoustic & Speech processing,
- Sensors, Bio-electronics, Bio-sensors, Hearing Aid Electronics, Implanted devices electronics
- Research Funded by NSF, USAID, DARPA, JPL, NASA, Motorola Inc., Intel Inc., Broadcom, Qualcomm, Raytheon, General Dynamics, Texas Instruments, and over 10 other industries. List of Current significant research awards:
 - Center of Excellence for Energy (COE) in Egypt , Funding \$22.5M
 - Partnership Center for Energy systems, USAID, 2015-2020, \$18M. Principle Investigator
 - Solar Energy Development in ME, Private funds and World Bank, \$2M
 - Connection One NSF Center, Director, 2004-Present, Total funding \$5M, average annual funding over \$750K.

2021-Present, Director, USAID, Center of Excellence for Energy (COE) in Egypt , Funding \$22.5M

- Director and PI: COE - Energy Center funded by the USAID.
 - USIAD Centers of Excellence for Energy (COE) - established the Center of Excellence for Energy (COE/E) in Egypt with funding and support from the United States Agency for International Development (USAID/Egypt) in November 2021. COE/E is a partnership between ASU-US and three Egyptian partner universities (EPUs): Ain Shams University (ASU-EG), Aswan University (AU), and Mansoura University (MU).

2004-Present, Director and founder of NSF IUCRC Center Connection One, School of Electrical, Computer, and Energy Engineering, Arizona State University, Tempe, AZ; <https://connectionone.org>

- The NSF Connection One Industry/University Cooperative Research Center was established the center in 2002 with focus on communication system, integrated Circuits and Systems, wireless system, RF, sensors, and related areas. The center has five university member with over 30 industrial members. Total funding over \$10M.

2014-2020, Director, USAID, US-PCASE: Center for Advance Studies in Energy, Funding \$18M.

<https://uspcase.asu.edu/>

- **Director and PI:** PCASE - Partnership Center for Energy systems, Energy Center funded by the USAID.
- USIAD Centers for Advanced Studies in Energy program (USPCAS-E) is a partnership between Arizona State University and two leading Pakistani universities: the National University of Science and Technology (NUST) Islamabad and the University of Engineering and Technology in Peshawar (UET).
- PCASE has developed two new Graduate schools of Energy. Within 5 years, the center has over 1000 MS and PHD Students, with 14 new energy degrees in MS and PhD, two new building with 20+ energy labs in the power system, grid, power electronics, renewable energy, PV, Wind, Hydro, bio-fuel, fuel cell, batteries and storage, and thermal areas.

2008-2012: Associate Dean of Research, Ira A. Fulton Schools of Engineering, Arizona State University

Responsible for leading the research infrastructure, promoting and developing research programs with industry and federal agencies, leading large multi-university proposals, investing and providing seed funding to foster new

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research areas, and promoting graduate program in the college of engineering. Research Enterprise support included:

- Increase College of Engineering research funding from \$50M to over \$80M.
- Working with Vice President for Research, Dean's, and directors on University-wide research initiatives.
- Established the first NSF Engineering Research Center (ERC) at the ASU on Solar Energy QESST. Managed, organized and planned the ERC proposal process. ASU is the lead school partnering with MIT, Georgia Tech, U of Delaware, Cal-Tech, U of New Mexico, and UA.
- Lead several trans-disciplinary 4M research projects (4M: multi-million, multi-investigator, multi-disciplinary, multi-university grants) in energy, security, and related initiatives.
- Oversight of over 20 existing research centers in the college of Engineering.
- Engage with industry and federal government to establish new research collaborations.
- Organized workshops and supported proposals for NSF, NIH, DOE, DOD, DARPA, etc.
- Organized workshops for new assistant professors to apply for NSF CAREER Awards. ASU CAREER awards grew from 3 annual awards in 2008 to over 15 CAREER awards by 2012.
- Research Administration and pre-award proposal administration for the schools. Developed a decentralized research administration and advancement team for the Schools supporting 5 schools, 12 departments, over 220 engineering faculty, with funding over \$70M.
- Annual budget over \$7M for supporting research centers, seed funding for new center, cost sharing, proposal support, equipment and infrastructure support, graduate scholarships, and research administration.
- ADR Staffs included, Director of industrial and government liaison, Director of research administration, and 14 research advancement staff.
- Graduate Programs: Recruiting, Fellowships, marketing, outreach, coordination with departments

1997-2001, Adjunct Professor, Electrical and Computer Engineering Dept., The University of Texas, Austin, Texas, Taught graduate courses at UT Austin on Introduction to Telecommunication System and Digital Communications. Co-advised two Ph.D. program committees in IC design and Telecomm (while at Motorola)

1987-1993, NSF Center For Digital / Analog IC (CDADIC) Co-Director, NSF IUCRC Center director at Oregon State University. The CDADIC was established the center in 1987 with focus on integrated circuits at WSU, UW, and OSU with over 20 industrial members - <https://cdadic.oregonstate.edu/>

1987-1993, Assistant / Associate Professor (Tenured) Electrical and Computer Engineering Department, Oregon State University, Corvallis, OR

- Research and classes in Electronics, DSP, Communication system and networks, Wireless systems, MODEMS. Graduated 30 MS and Ph.D. students.
- Faculty Chair, Computer Engineering Program, Developed a new Computer Engineering Program at OSU in 1987

INDUSTRIAL POSITIONS

1993-2001: Motorola Inc., Senior Member of Technical Staff, Personal Communication Sector, Austin, Texas - Worked projects related to wireless communications, two way radios, wireless networks, ADSL and MODEM RF, and related areas.

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- **Motorola Cellular Division, Wireless Technology Center (WITC), 1997-2002.** Responsible for development of integrated circuits and systems for wireless handset. Lead number of projects including cellular (2G, 3G, 4G), wireless connectivity (Bluetooth and WIFI transceiver), GPS and location Receiver, wireless networks, 2-way radios and related areas. Worked on the development of various subcomponents including system design, link budget, RF front-end, RF receiver, RF transmitter, digital audio processing, audio processing, DSP, frequency synthesizer, ADC, DAC, filtering, analog front-end, power management, battery management, and baseband processor, baseband circuits and systems.
- **Motorola Semi-conductor products sector (SPS), Broadband Products Operations, 1995-1997,** Worked on the development of XDSL (ADSL, VDSL, G.lite) systems including OFDM, modulation, synchronization, equalization and the development of a single chip ADSL transceiver (*CopperGold™*). The transceiver contained Analog Front End (A/D, D/A, Hybrid), custom DSP, baseband processor, DMT, modulation/demodulation, FFT, IFFT, echo canceler, time domain equalizer, front-end constellation mapping, Trellis code modulation, Viterbi decoder), audio processing, DSP, signal processing, and an on-chip DSP core.
- **Land Mobile Products Sector LMPS 1993-1995,** Responsible for Wireless digital two-way radios, developed RFIC, RF receiver, RF transmitter, digital audio processing, audio custom IC, DSP, frequency synthesizer, ADC, DAC, hot spot wireless network, next generation of digital two-way radios, *"Talk about Radios"*, Japanese cellular systems (PHS).
- **Standards,** Represented Motorola in various standards including 2G-4G, GPS, Bluetooth working group, WiFi, 802.11, and DSL standards including T1E1, International Telecommunication Unit (ITU), T1E1, ETSI, 3GPPP, Universal ADSL Working Group (UAWG), Bluetooth working group, G.Lite working group, etc.
- **University relations,** Responsible for the development of collaborative research programs with several universities. Responsible for funding research in the areas of Wireless Transceiver IC Design, RF, and mixed-signal and baseband system architecture.

1985-87: Member of Research Staff, Boeing Co., Bellevue, Wa, Flight Systems Research and Technology Center, summer. Design Engineer, Hardware and CAD tool development for system control.

AWARDS

- IEEE Fellow 2004-Present
- IEEE Fellows CAS Committee Chair, 2009-2012
- Global Standards Award, For contributions in the International Telecommunication Unit (ITU) for Asymmetric Digital Subscriber Line (ADSL) G.Lite Standards. Motorola Inc., 1999.
- 10X Cycle Reduction Award, for development of new IC design process from DSP algorithm to IC layout, Motorola Inc., 1995.
- IEEE Darlington best paper Award, IEEE Circuits and Systems Society Best Paper Award, 1995. For "Characterization and Comparison of CMOS FSCL Circuits with Conventional CMOS for mixed-signal ICs," Published at: *IEEE Trans. on Circuits and Systems II, Sept. 93.*

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- Carter Best Teaching Award, College of Engineering Best Teacher Award, Oregon State University, 1992. For “*outstanding and inspirational teaching in the College of Engineering*”. Award is selected by the confidential vote of all of the undergraduate students in the College of Engineering among over 125 professors in the College.
- Industrial University Fellowship (IUF) Award, *National Science Foundation*, 1993.
- Research Initiation Award, *National Science Foundation*, 1990-93.
- Outstanding Graduate Student Scholarship, *Azur-Data Inc.* WSU, 1984

RESEARCH PROJECTS

Partial list of Research Awards (1987-Present):

- **2021-2026 – U.S. Agency for International Development (USAID)**
 - COE – Center of Excellence for Energy, PI and Director, \$22.5M.
- **2020-2022 - The National Science Foundation (NSF)**
 - SII Planning: Center for Next Generation Wireless Spectrum Sharing, PI, \$300K.
- **2002-2020 – The National Science Foundation (NSF) - Connection One**
 - Industry/University Cooperative Research Center (IUCRC), NSF contribution \$1.5M.
 - Annual Industry Contribution: Total over \$5M.
- **2015-2016 – The National Science Foundation (NSF)**
 - Integration of Smart Utility Grids with Dynamic Optical Communication Networks for Intelligent Distribution of Power Workload and Data in Disaster, \$200K
- **2015-2020 – U.S. Agency for International Development (USAID)**
 - PCASE – Center for Energy systems, PI and Director, \$18M.
- **2014-2015 NSF – Connection One**
 - Various projects funded by the Connection one center
- **2013-2014 NASA**
 - Arizona Space Grant Consortium, NASA: Goddard Space Flight Center, RADHARD electronics, \$200K
- **2012-2015 – Solar Energy, Private Donor**
 - Solar Energy Development on international projects, \$2M
- **2011-2014 – Semi-Conductor Research Corporation**
 - Self-Characterization for Calibration and Process Feedback of MEMS Devices, , \$300K
- **2011-2013 - The National Science Foundation (NSF)**
 - Microwave & RF Bio-Sensors for Vital Signs Monitoring Device Design, \$250K
- **2010-2011 – The National Science Foundation**
 - Adaptive Compensation of Analog circuits imperfections using DSP methods, \$150K,

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- **2010-2011 – The National Science Foundation**
 - Autonomous Self-Healing Sensor Network Radio and Mixed-Signal Readout System Design
National Science Foundation (NSF), \$300K
- **2010-2020 – The National Science Foundation (NSF)**
 - QESST NSF ERC Center on Solar Energy, Co-PI, Testbed Director
- **2010-2015 - The National Science Foundation (NSF)**
 - Research Experience for Undergraduate Students, total \$400K
- **2008-2013 - The Science Foundation of Arizona (SFAZ)**
 - PEPER- Photovoltaic Environmental Performance and Reliability for the Arizona-Wide Electric Grid, \$1.2M.
- **2008-2009 - The National Science Foundation (NSF)**
 - Micropower MICS Band RF Transceiver Design (C1/TI Enhancement Project), \$200K
- **2007-2011 – The National Science Foundation (NSF)**
 - Micro-Power Multi-Phase on-chip MEMS Hearing Aid, 2007-2011, \$500K.
- **2007-2009 - The National Science Foundation (NSF)**
 - High Efficiency Power Delivery and Front-End Module Design for Implantable Bio-Sensors
\$480K
- **2005-2009 - The National Science Foundation (NSF)**
 - Cognitive MIMO Communications for Dynamic-Spectrum Wireless Networks \$150K
- **2005-2009 - The National Science Foundation (NSF)**
 - Autonomous Self-Healing Sensor Network Radio, , \$250K
- **2005-2008 BAE Systems**
 - Integrated on-chip Time Measurement Circuits LiDAR; \$650K
- **2005-2008 - Freescale Semiconductor**
 - PWM, Battery & Power management, \$150K
- **2005-2006 - DOD: Defense Advanced Research Projects Agency (DARPA)**
 - Radhard by Design - MRC/DARPA, Total funding \$1.5M
- **2005-2010 - State of Arizona**
 - WINTECH- Wireless Integrated Nano Technology Center Support, 450K annually, total \$2.5M
- **2004-2005 – NASA**
 - Integration of Ultra-Low power RF CMOS, \$127K
- **2004-2008 – Deference Advance Research Project Agency (DARPA)**
 - Implanted Neural-Enabled Prostheses bio-sensor with Sensorimotor Integration, \$500K
- **2004-2008 – Deference Advance Research Project Agency (DARPA)**
 - Nano-Mechanical RF Band pass resonator for 2GHZ RF Applications, with JPL, \$2.2 M,

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Sayfe@asu.edu

- **2003-2005 - DOD-ARMY-ARL: Army Research Office (ARO)**
 - Implanted Neuro-sensor, \$175K
- **2002-2005 - Intel Corporation**
 - Design of Multi-Standard RF Front-End Circuits for Cellular and WiFi, \$300K
- **2002 – SRC**
 - LOW POWER ULTRA - WIDE BAND GEOLACTION SYSTEMS, \$65K.
- **2001-2003 - SRC (Semi-conductors research Corp)**
 - Ultra-Wideband Transceivers for cellular and WiFi 802.11, \$225K
- **1987-1993 - The National Science Foundation**
 - Center for the Design of Analog/Digital IC's (CDADIC) 1987-1995, At Oregon State, \$1.5M
- **1992-1994 – Motorola LMPS**
 - Low Power IF processing for Direct Digital Transceivers, \$100K,
- **1993 - Hewlett-Packard**
 - Hewlett-Packard Faculty Chair position in Mixed-Signal IC, HP, \$500K
- **1992-1993 - The National Science Foundation**
 - National Science Foundation, Motorola Inc. Faculty Industry Fellowship, \$250K,
- **1992-1993 - The National Science Foundation**
 - National Science Foundation, Research Initiation Award (RIA) (same as current CAREER Award), Synthesis and Automatic Derivation of Multi-Rate VLSI Arrays for DSP Algorithms, \$320K.
- **1988-1992 – Center for the Design of Analog/Digital IC's (CDADIC)**
 - CDADIC, various projects on Low-Noise Source Coupled Logic (SCL), Mixed-Mode IC's, CDADIC \$350K.
- **1988- Tektronix Inc.**
 - Decimation Filters for A/D Noise Enhancements, Tektronix, Inc., \$100K,
- **1987-1993 – DARPA, MOSIS, Tektronix, IT, Motorola**
 - Various grants for IC Fabrication (DARPA/MOSIS, VLSI)
 - Testing equipment (Tek, HP)
 - DSP system development (TI, Motorola)

PROFESSIONAL RECOGNITION

- IEEE Fellow, 2004-Present
- IEEE Fellow Committee Chair, CAS, 2008-2010
- IEEE Fellow Committee member, 2007-2010.
- IEEE Senior Member, 1993-Present, IEEE Member 1987-1992.

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Sayfe@asu.edu

- IEEE Faculty Advisor, Oregon State University, 1987-1990

IEEE Editorials

- IEEE Microwave Magazine, Editor,
- IEEE System Journal, Associate Editor, 2010-2011.
- IEEE Transactions on VLSI, Associate Editor, Jan 2001-2008.
- IEEE Communication Magazine, Editor, Feature Issues on “Circuits for Wireless and Wireline Communications,” April 1999.
- IEEE Transactions on Microwave Theory and Techniques , editor, Special Issue on: "Radio Frequency IC Design,” Dec. 1998.
- IEEE Transactions on Circuits and Systems-II, editor, Special Issue on: “Low-Power Wireless Communication Systems,” June 1997.
- Associate Editor, IEEE Transactions on Circuits and Systems-II, 1993-1996.
- *Editor and Reviewer for many IEEE journals and conferences*
- *Founding member of IEEE RF Integrated Circuits Symposium*
- *Associate Editor, IEEE Communications, Tutorial & Surveys Magazine, 2006-2009.*

Conference Organizations

- RFIC Executive Committee members, 2000-2017
- RFIC Steering Committee Member, RFIC symposium, 1996-2017.
- RFIC Founding member, 1995-96.
- Technical Program Chair, IEEE International Sym. on Circuits and Systems, Phoenix, AZ, 2002.
- ISSCC Admin Council, Conferences Committee 2000-2005.
- General Chair, Radio Frequency IC (RFIC) Symposium, Seattle, WA, 2002.
- Technical Program Chair, RFIC Symposium, Phoenix, AZ, 2001.
- Finance Chair, RFIC symposium, Boston, MA, 2000.
- Publicity Chair, RFIC symposium, Los Angeles, CA, 1999.
- Transactions Chair, RFIC symposium, Baltimore, MD, 1998.
- General Chair, Int. Sym. on Low-Power Electronics and Design (ISLPED), Monterey, CA, 97.
- Executive Committee Member, Int. Symp. On Low-Power Electronics and Design, 96-2000.
- Technical Program Committee Member of the following conferences:
 - International Conference on Circuits and Systems: 1996, 2000, 2001, 2004-2008
 - RFIC Symposium, 1996-2018
 - Application Specific Array Processing (ASAP): 2000-2002
 - Technical Program Chair, Int. Sym. on Low-Power Electronics and Design, Monterey, CA, 96.

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- Arizona Telecom Comm (ATIC)
- GLS VLSI 1998, Lafayette, Louisiana, 1998
- VLSI Design 98, Chennai, India, Jan. 1998.
- ICECS, Lisbon, Portugal, 98.
- Application Specific Array Processing, 1995-97, 2000
- Vehicular Technology Conference, 1995-97.
- Inter. Conf. on Intelligent Information Systems, D.C., 1994-95.
- IEEE Pacific Rim Conference on Communications & Computers, Victoria, BC, Canada, 1991.

Invited talks, Panelist, Session Chairs, Workshop Speaker

- Conference chair, Technical Program committee chair and TPC member, tutorials, workshops, session chair, etc. in RFIC, ISSCC, ISCAS, VLSI, ICASSP, Low-Power Symposium, ICC, Application Specific IC's, IMS, MTT, etc.

CONSULTANT

- Intel Inc. Chandler, AZ, 2002-2006: Development of 3G-4G Wireless transceiver.
- Sony Inc., San Diego, CA and Tokyo, Japan, 2002-2004: Review and development of various telecom cellular system architecture including 3G system architecture, and GPS system.
- Motorola Inc. 2002-2005: Supporting development of BT, WiFi, E911, GPS integrated circuits and systems for the cellular and mobile handsets.
- Hewlett Packard, Corvallis, OR – 1990-1993: Various project on development of custom analog and digital IC's for printer and inkjet system. Some of this work was under consultation, and some under various research grants with Oregon State University.
- Tektronix Inc, Beaverton, OR - 1988-1990: Design and Implementation of Data acquisition system for Spectrum analyzer, development of custom DSP algorithm for the Tektronix spectrum analyzer including system architecture, simulation, analysis, and design of oversampled data acquisition system.
- Boeing Commercial Aircraft, BCAC, Renton, WA - 1985-1987: Development of Airplane Controller Model, Simulation and Implementation of Flight control, Model reduction, and system control.

EXPERT WITNESS (Patent, IP)

Patent litigation, patent validity, IPR, expert reports, deposition, testimony, and trade secrets in the following areas (Complete list of cases available):

- Analog and Digital IC
- Radio Frequency Integrated Circuits
- Power Management, Battery Management, PMIC
- Wireless communication, 3G, 4G, OFDM, WiFi, 802.11, Bluetooth, and related areas
- Audio and acoustic signal processing, Audio Array processing
- Communication networks, Communication system

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- Signal Processing, adaptive signal processing
- DSL, xDSL, VDSL, OFDM, Multi-Tone, and related areas
- Cable MODEM DOCIS MODEM, and related areas.
- Hearing AID
- Bio-Electronics, Heart monitoring system, Bi-sensors
- Satellite communications, Satellite Transceiver, ECHO and Multi-path cancelation circuits
- Wireline Communications, MODEM, Digital Subscriber Line, ADSL, VDSL, MODEM
- Wireless LAN, Wi-Fi, 802.11
- Bluetooth
- ZIGBEE
- GPS system, GPS receiver
- MEMS, Bulk Acoustic Wave Filters, SAW, MEMS resonators, MEMS accelerometer
- Wireless Standards (ITU, ETSI, 3GPP, LTE) including AMPS, GSM, CDMA, WCDMA, LTE, 1G, 2G, 3G, 4G, BT, WiFi (802.11)
- Wireline standards including DSL, MODEM and DOCIS, and related standards ITU/ETSI

PATENTS, PUBLICATIONS

Patents and Patent Applications

ID	title	assignee	inventor/author
AU-2003222007-A8	Oscillator frequency correction in gps signal acquisition	Motorola Inc	Sayfe Kiaei, Thomas M King, George J Geier
WO-03093858-A3	Oscillator frequency correction in gps signal acquisition	Motorola Inc	Thomas M King, George J Geier, Sayfe Kiaei
WO-2004048909-A3	Compressed vector-based spectral analysis method and system for nonlinear rf blocks	Univ Arizona, Shahin Farahani, Sayfe Kiaei, Nazanin Darbanian	Shahin Farahani, Sayfe Kiaei, Nazanin Darbanian
US-2006226909-A1	Monolithic supply-modulated rf power amplifier and dc-dc power converter ic	Siamak Abedinpour, Sayfe Kiaei	Siamak Abedinpour, Sayfe Kiaei
US-7218085-B2	Integrated ZVS synchronous buck DC-DC converter with adaptive control	Arizona Board Of Regents	Siamak Abedinpour, Sayfe Kiaei
US-7372333-B2	Monolithic supply-modulated RF power amplifier and DC-DC power converter IC	Arizona Board Of Regents, Acting For And On Behalf Of Arizona State University	Siamak Abedinpour, Sayfe Kiaei
US-7528754-B1	Finite impulse response digital to analog converter	Arizona Board Of Regents	Bertan Bakaloglu, Sayfe Kiaei, Shahin Taleie
US-2018049703-A1	Wireless in-shoe physical activity monitoring	Timothy W. Markison, Sayfe Kiaei, Gary McCoy	Timothy W. Markison, Sayfe Kiaei, Gary McCoy
US-10264996-B2	Method and apparatus for wirelessly monitoring repetitive bodily movements	Sayfe Kiaei	Sayfe Kiaei
US-2019231226-A1	Method and apparatus for wirelessly monitoring repetitive bodily movements	Sayfe Kiaei	Sayfe Kiaei
US-10653337-B2	Local object detection system	Timothy W. Markison, Sayfe Kiaei, Gary McCoy	Timothy W. Markison, Sayfe Kiaei, Gary McCoy
US-2020266708-A1	Electronic circuit and method of controlling three-level switching converters	Arizona Board Of Regents On Behalf Of Arizona State University	Parisa Mahmoudidaryan, Sayfe Kiaei, Bertan Bakaloglu
US-11108325-B2	Electronic circuit and method of controlling three-level switching converters	Arizona Board Of Regents On Behalf Of Arizona State University	Parisa Mahmoudidaryan, Sayfe Kiaei, Bertan Bakaloglu
US11129547B2	Wireless in-shoe physical activity monitoring	Sigmasense LLC	Timothy W. Markison, Sayfe Kiaei, Gary McCoy

Standards Contributions

1. "Spectral Compatibility of ADSL: Frequency Overlap vs. FDM," T1E1, Dec. 97.
2. "Echo Cancellation for G.Lite Universal ADSL," OFDM, Universal ADSL Working Group, Atlanta, GA, Jan 98.
3. "8-bit QAM Constellation effects on reach for universal ADSL," OFDM, Universal ADSL Working Group, Atlanta, GA, Jan 98.
4. "Trellis Code Modulation coding gain for OFDM," Universal ADSL Working Group, Atlanta, GA, Jan 98.
5. "Monte Carlo Modeling and simulation of twisted pair wiring for OFDM," Universal ADSL Working Group, Atlanta, GA, Jan 98.
6. "Overlap Upstream/Downstream spectral allocation for OFDM ADSL," International

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Telecommunication Unit, Chicago, March 98.

7. "Echo Cancellation for ADSL OFDM," International Telecommunication Unit, Antwerp, Belgium, 98.
8. "Performance of Echo Cancellation ADSL in OFDM system in the presence of Near End Cross Talk (NEXT)," International Telecommunication Unit, Honolulu, Hawaii, June 98.
9. Presentations and editorials at various XDSL and OFDM standards: ITU, ETSI, UAWG, and T1E1, 97-99.
10. Presentations and editorials at various 3G and 4G and wireless standards including ITU, 3GPP, 802.11, BT,

Books

"Design, Modeling and Testing of Data Converters, P Carbone, S Kiaei," F Xu - 2014 – Springer, © Springer-Verlag Berlin Heidelberg 2014

Refereed Journal Papers

1. CMOS Full-Duplex Mixer-First Receiver With Adaptive Self-Interference Cancellation S. -A. Ayati; A. Alizadeh; S. Kiaei, IEEE Transactions on Circuits and Systems I, Jan 2021.
2. A 10-W X-Band Class-F High-Power Amplifier in a 0.25μm GaAs pHEMT Technology, A. Alizadeh; M. Yaghoobi; M. Meghdadi; A. Medi; S. Kiaei, IEEE Transactions on Microwave Theory and Techniques, Jan 2021.
3. An X-Band Class-J Power Amplifier With Active Load Modulation to Boost Drain Efficiency A. Alizadeh; S. Hassanzadehyamchi; A. Medi; S. Kiaei, IEEE Transactions on Circuits and Systems I: Sep 2020
4. In-Field Recovery of RF Circuits from Wearout Based Performance Degradation D. Chang; J. N. Kitchen; S. Kiaei; S. Ozev, IEEE Transactions on Emerging Topics in Computing, Jun 2020
5. A 50-V Isolation, 100-MHz, 50-mW Single-Chip Junction Isolated DC-DC Converter With Self-Tuned Maximum Power Transfer Frequency, C. Liu; D. Mandal; Z. Yao; M. Sun; J. Todsén; B. Johnson; S. Kiaei; B. Bakkaloglu, IEEE Transactions on Circuits and Systems II: Express Briefs, May 2019
6. Wideband Hybrid Envelope Tracking Modulator With Hysteretic-Controlled Three-Level Switching Converter and Slew-Rate Enhanced Linear Amplifier, P. Mahmoudidaryan; D. Mandal; B. Bakkaloglu; S. Kiaei, IEEE Journal of Solid-State Circuits, 2019.
7. Low-Power/Low-Voltage Integrated CMOS Sense Resistor-Free Analog Power/Current Sensor Compatible With High-Voltage Switching DC-DC Converter, S. Singh; D. Mandal; B. Bakkaloglu; S. Kiaei IEEE Transactions on Circuits and Systems I, 2019
8. Adaptively Biased Output Cap-Less NMOS LDO With 19 ns Settling Time, D. Mandal; C. Desai; B. Bakkaloglu; S. Kiaei, IEEE Transactions on Circuits and Systems II: Express Briefs, 2019
9. Chirag Desai; Debashis Mandal; Bertan Bakkaloglu; Sayfe Kiaei, "A 1.66 mV FOM Output Cap-Less LDO With Current-Reused Dynamic Biasing and 20 ns Settling Time," IEEE Solid-State Circuits Letters Year: 2018, Volume: 1, Issue: 2, Pages: 50-53
10. Debashis Mandal ; Chirag Desai ; Bertan Bakkaloglu ; Sayfe Kiaei, Adaptively Biased Output Cap-Less NMOS LDO with 19 ns Settling-Time;; IEEE Transactions on Circuits and Systems II: Feb 2019
11. Ayati, Mandal, Bakkaloglu, Kiaei, "Integrated Quasi-Circulator With RF Leakage Cancellation for Full-Duplex Wireless Transceivers," IEEE Trans of Microwave theory and techniques, Dec 2017.
12. "A 50-mA 99.2% Peak Current Efficiency, 250-ns Settling Time Digital Low-Dropout Regulator With Transient Enhanced PI Controller", ChaiYong Lim ; Debashis Mandal ; Bertan Bakkaloglu ; Sayfe Kiaei; IEEE Transactions on Very Large Scale Integration (VLSI) Systems; Year: 2017, Volume: 25, Issue: 8; Pages: 2360 - 2370

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18. Chang, D.; Kitchen, J.N.; Bakkaloglu, B.; Kiaei, S.; Ozev, S., "Design-Time Reliability Enhancement Using Hotspot Identification for RF Circuits," in *IEEE transactions on Very Large Scale Integration (VLSI) Systems*, -vol. 24, no. 3, pp. 1179-1183, 2016
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20. Junghan Lee; Tino Copani; Terry Mayhugh Jr.; Bhaskar Aravind; Sayfe Kiaei; Bertan Bakkaloglu., "A 280 mW, 0.07% THD+N class-D audio amplifier using a frequency-domain quantizer," *Analog Integrated Circuits and Signal Processing*, 173-186, 2012.
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Conference Publications

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2. 27.5 A 91%-Efficiency Envelope-Tracking Modulator Using Hysteresis-Controlled Three-Level Switching Regulator and Slew-Rate-Enhanced Linear Amplifier for LTE-80MHz Applications P. Mahmoudidaryan; D. Mandal; B. Bakkaloglu; S. Kiaei, 2019 IEEE International Solid- State Circuits Conference - (ISSCC), 2019
3. Integrated High-Efficiency Single-Inductor CCM Boost Converter for Multi-Junction PV Energy Harvesting, Q. Peng; D. Mandal; P. Mahmoudidaryan; B. Bakkaloglu; S. Kiaei, 2019 IEEE Applied Power Electronics Conference and Exposition (APEC), 2019
4. Sense resistor-free analog power sensor for boost converter with 14.1% gain error and 9.4% offset error, Shrikant Singh ; Debashis Mandal ; Bertan Bakkaloglu ; Sayfe Kiaei; 2018 IEEE 9th Latin American Symposium on Circuits & Systems (LASCAS), 2018
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123. "CMOS Source-Couple Logic for Mixed-Mode VLSI," Proc. of International Symposium on Circuits and Systems, New Orleans, Louisiana, pp. 1608-1611, May 1990. [S. Kiaei, S.H. Chee, D. Allstot]
124. "VLSI Design of Multi-Rate Arrays," Proc. of International Conference on Acoustics, Speech, and Signal Processing, New Mexico, pp. 1049-1052, 1990. [L. Aihua, S. Kiaei]
125. "Comparison of Low-Noise Current-Mode Logic Circuits for High Performance Mixed-Mode Applications," Proc. of International Symposium on Circuits and Systems, New Orleans, Louisiana, May 1990. [S. H. Chee, S. Chow, S.S. Lee, S. Kiaei, D. Allstot]
126. "VLSI Design of Dynamically Reconfigurable Array Processors-DRAP," Proc. of International Conference on Acoustics, Speech, and Signal Processing, Glasgow, Scotland, 1989. [S. Kiaei, J. Durgham]
127. "VLSI Design of Bit/Serial Adaptive IIR Filters," Proc. of IEEE Pacific Conference on Communications, Computers, and Signal Processing, Victoria, Canada, pp. 650-652, June 1989. [R. Badyal, S. Kiaei]
128. "CCA Approach for ARMA Spectral Analysis," Proc. of IEEE International Symposium on Circuits and Systems, Portland, OR, pp. 1319-1322, May 1989. [S. Kiaei, L. Luo]
129. "Canonical Correlation Analysis (CCA) for ARMA Spectral Estimation," IEEE International Symposium on Circuits and Systems, May, 1989. [Kiaei, S.; Luo, L.]

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- 130. "VLSI Implementation of Adaptive Bit/Serial IIR Filters," IEEE Pacific Rim Conference on Communications, Computers and Signal Processing, June 1989. [Badyal, R.; Kiaei, S.]
- 131. "VLSI design of WAP for Recursive Equations," VLSI Signal Processing, 1988. [S. Kiaei, U. Desai]
- 132. "Independent Data Flow Wavefront Array Processors for Recursive Equations," Proc. of 20th Annual Conference on Information Sciences and Systems, Princeton University, NJ, 1986. [S. Kiaei, U. Desai]
- 133. "A Stochastic Realization Approach to Reduced-Order Hierarchical Estimation," Proc. of 24th IEEE Conference on Dec., Ft. Lauderdale, FL, pp. 416-421, December 1985. [U. Desai, S. Kiaei]
- 134. "Hierarchical Estimation Algorithms," Proc. of IEEE Conference on Man, Cybernetics, and Systems, Tucson, AZ, October 1985. [U. Desai S. Kiaei]
- 135. "Approximation of Markovian Models with Non-Constant Parameters," Proc. of 23rd IEEE Conference on Dec., Las Vegas, NV, pp. 1642-1644, December 1984. [U. Desai, S. Banerjee, S. Kiaei]
- 136. "A Canonical Correlation Approach to Reduced-Order LQR Design," Proc. of 23rd IEEE Conference on Dec., Las Vegas, NV, pp. 1523-1528, December 1984. [U. Desai, S. Banerjee, S. Kiaei]

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GRADUATE STUDENT ADVISEES & RESEARCH PROJECT

(Partial list of Students graduated, current employment to the best of my knowledge)

1. J. Durgam, VLSI Design of Dynamically Reconfigurable Array Processors, MSEE, 1988. Intel.
2. J. Gilbert, Minimization Techniques for PLAs, MSEE, 1988, Tektronix Inc.
3. L. Luo, CCA Methods for ARMA Spectral Estimation, MSEE, 1989. Berkeley Research Center
4. E. Zahl, Enhancement Methods for A/D Noise Reduction, MSEE, 1989. AT&T
5. L. Aihua, Synthesis of MRAs, MSEE, 1990. Intel.
6. F. Aslam, Image Restoration Methods, MSEE, 1990.
7. S.H. Chee, FSCL Circuits for Mixed-Mode IC's, MSEE, 1990. Linear Tech.
8. C. Dawson, MSEE, 1990. Boeing
9. A. Chow, Source-Coupled Logic ALU, MSEE, 1990. Intel
10. S. Maskai, Decimation Filters Using FSCL Circuits, MSEE, 1991. Intel
11. L. Louis, VLSI Implementation of Toeplitz Matrices, MSEE, 1991.
12. R. Badyal, Bit/Serial VLSI Design of IIR Filters, MSEE, 1992, HP
13. Lap Mui, Piece-Wise Linear Schedule for VLSI Arrays, MSEE, 1992. HP
14. S. Abdennadher, Adaptive Sigma-Delta Modulators, MSEE, 1992. Level One / Intel.
15. H. Bribech, Second Order Adaptive A/D Schemes, MSEE, 1992.
16. B. Hickman, MSEE, 92. Tektronix
17. M. Maleki, Current-Mode Flash A/D, MSEE, 1992. University of Oregon
18. Man Wong, Low-Noise Decimation Filter for Mixed-Mode ICs, MSEE, 1993, Motorola.
19. Anu Krishna Swamy, Low Noise IC Blocks for Mixed-mode IC's, MSEE, 1993, Ph.D., 1997.
20. Manu Srivastava, Comparison of Differential Logic (FSCL, CVSL, DSL), MSEE, 1994, Intel.
21. Joel Oren, VLSI Design of Asynchronous FIR Filters, MSEE thesis, Feb. 1994. E-Systems.
22. Y. Zheng, VLSI Design and Synthesis of Multi-Rate Arrays, Ph.D. March 94, Hughes Research.
23. Satish Kulkarni, Low-Sensitivity Filters, MSEE, 1995, Motorola.
24. Amit Dutta, Multi-user Interference Cancellation, Ph.D, Dec. 97, Faculty, India.
25. Dwight Poplin, Multiplierless MPEG Decoder, MSEE, 1996. HP.
26. Maxim Scarpa, Adaptive I/Q Miss-match Correction for Direct Conversion Receivers, MSEE 1998.
27. Jeff McNeal, Sigma-Delta Frequency-to-Time Conversion, MSEE, 1998. Level One Comm.
28. Julia Vogel, Adaptive DC offset Cancellation, MSEE, 1998. Faculty in Germany.
29. Takao Inoue, MS, Echo Cancellation for ADSL, 1998. MSEE, The U of Texas at Austin.
30. Navid Lashkarian, Frequency off-set estimation and Synchronization of OFDM systems, Ph.D., June 1999. Broadcom Inc. & Faculty at UC San Jose.

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31. Guner Arslan, (co-advisor with B. Evans), "Fast Equalization for DMT systems, with applications to ADSL," Ph.D. The University of Texas at Austin, 2000
32. Salem Abdennadher, I/Q Mismatch Correction for RF Wireless transceivers, Ph.D., Level One Comm/Intel.
33. Can Sandalci, DSL Line Driver, Ph.D., 2001, Intel.
34. Dean Badillo, Low-Cost VCO Ring Oscillators, PhD, 2004, Intel, Chandler,
35. Siamak Abedinpour, PhD, 2005 Freescale, Tempe, Arizona
36. Hemanth Shivalingaiah, Multi-Band Low Noise Amplifiers, Ph.D., 2006, Intel,
37. Shahin Farahani, PhD, 2006, Qualcomm Inc,
38. Nazanin Darbanian, M.S. Freescale, Tempe, Arizona
39. *Joe Rutkowski, Joseph, MS, 2004, Phillips.*
40. *Chaudhuri, Bikram, Synthesizer, MS/PhD, MS 2004.*
41. *Zhang, Jiandong, MEMs, MEMS, December-04*
42. *Afsahi, Ali, MS/PHD, UC San Diego, QUALCOMM, Connection One*
43. *Chen, Xiaomin, UWB, PHD, 2007, SRC/Motorola*
44. *Jali, Hilda, Power Management, MS, June-05,*
45. *Xuejin Wang, RF Optimization, 2006 CAD tools, PhD, Neo-Linear*
46. *Umar Lyles, Power Amplifier, MS, 2006. Texas Instruments*
47. MS, Erika Munoz, RADHARD, 2007, Intel
48. Waleed Khali, (Co-Advisor), Professor at Ohio State
49. Jennifer Kitchen, PhD, 2009, Professor at ASU
50. Shahin Mehdizad Taleie, RFDAC, PhD, 2009, Qualcomm
51. Ilker Deligoz, PHD, 2009, Qualcomm
52. Hyung Kim, PhD, Jan 2010, Intel
53. Jung Le, PhD 2010, Intel, TI
54. Syed Naqvi, PhD, 2012, Intel.
55. Todd Martin, MS, 2011, TI
56. Seungkee Min, PhD, 2011, Intel
57. Ali Meamar, Post Doc, RFIC 2013
58. Hitesh Khunti, MS 2013, Qualcom
59. Debashis Mandal, Post Doc, Research faculty 2015-2018
60. Edgar Martinez, PhD, 2015, Qualcomm
61. Chirag Desai, MS, 2016, Qualcom
62. Sanjay Avasarala, MS, 2016

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- 63. Li Ming, MS, 2017
- 64. Qirong Peng, MS, 2017,
- 65. Yu Geng, PhD, 2018
- 66. Amir Ayati, PhD Aug 2018; Qualcomm
- 67. Pasisa Mahmoudi, PhD, May 2019, Qualcomm
- 68. Chai Yong, MS: 2015, PHD: 2019, Qualcomm
- 69. Shrikant Singh, MS: 2016, PhD, 2019, Movandi
- 70. Amir Alizadeh, Research Faculty 2019-Present
- 71. Ata S. PhD, 2021, Ata Sarrafinejad, PhD, 2021

UNIVERSITY COMMITTEES

Various Committees at ASU, Oregon State University, etc.

INDUSTRY COMMITTEES

- Arizona Telecommunications and Information Council (ATIC), Board Member
- CAS Fellows Committee (ends December 31, 2006)
- *IEEE CAS Phoenix Chapter Organizers (the committee is in the process of determining new chair – current chair not active)*
- *Executive Committee, RFIC 2006.*
- *Technical Program Comm, IEEE RFIC 2006.*
- *Executive Committee, Conferences, International Solid State System's Conference.*
- *IEEE CAS Society, VLSI Technical Comm. Member*
- *Editorial Board, IEEE Communications Surveys & Tutorials*
- *Radio Frequency Integrated Circuits- RFIC 2006*
- *IEEE RF Integrated Circuits Conference, Committee Chair for two workshops*
- *International Microwave Symposium, IMS-MTT 2006*
- *Int. Symposium on Circuits and Systems - ISCAS 2006*
- *Wireless Networks & Emerging Technologies, WNET06*
- *Midwest Symposium on Circuits and System*
- *Arizona Governor IT Advisory Committee – GITA*
- *Arizona Telecom – ATIC*

INSTRUCTIONAL SUMMARY

- Digital IC Design, Analog IC Design, Advance CMOS Analog IC, VLSI, RFIC Design
- Wireless Transceiver Design, Wireless Communications, GPS, Telecomm Systems, Digital Communication

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- Signal Processing, Advance digital signal processing, Communication, Digital Communication, Digital Audio Processing, Adaptive array processing
- Computer Architecture, Microprocessor System Architecture, Pipeline Array Processing