Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
09/910,412	GURANTZ ET AL.
Examiner	**Art Unit**
Sumaiya A. Chowdhury	2623

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date
Final	Original	6/27/07
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Search Notes	Application/Control No.	Applicant(s)/Patent under Reexamination	
	09/910,412	GURANTZ ET AL.	
	Examiner	Art Unit	
	Sumaiya A. Chowdhury	2623	

SEARCHED			
Class	Subclass	Date	Examiner
updated	search:		
725	51 54	6/28/2007	SAC

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L2	205	725/51.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/07/09 15:51
L3	122	725/54.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/07/09 15:51
S1	5	725/78.ccls. and ofdm	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 10:43
S2	26	"725"/$.ccls. and ofdm with (reduc$3 less)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 17:56
S3	5724	(time adj division adj duplex)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 17:57
S4	0	(time adj division adj duplex) with (broadcast$3 synchroniz$5 beacon) and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 17:58
S5	318	(time adj division adj duplex) with (broadcast$3 synchroniz$5 beacon)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 18:07
S6	4	(time adj division adj duplex) with (broadcast$3 synchroniz$5 beacon) with shar$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 18:09

EAST Search History

S7	66	(time adj division adj duplex) same (broadcast$3 synchroniz$5 beacon) same shar$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 18:18
S9	1306	((time adj division adj duplex) or tdd) same (synchroniz$5 beacon)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 18:19
S10	833	((time adj division adj duplex) or tdd) with (synchroniz$5 beacon)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 18:20
S11	56	((time adj division adj duplex) or tdd) with (synchroniz$5 beacon) with message$1	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 18:22
S12	43	(((time adj division adj duplex) or tdd) with (synchroniz$5 beacon) with message$1) same channel$1	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 18:29
S13	44	(((time adj division adj duplex) or tdd) with (broadcast synchroniz$5 beacon) with message$1) same channel$1	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 18:39
S14	46	((time adj division adj duplex) or tdd) with beacon	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/27 18:40
S15	1168	adjust$3 with snr	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 10:44

EAST Search History

S16	6	adjust$3 with snr with ofdm	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/29 10:55
S17	26	(adjust$3 with snr) same ofdm	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 10:46
S18	6	"234538".ap.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 12:03
S19	7	"234358".ap.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 14:43
S20	2	"6622304".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 17:28
S21	1	"20020088005".did. and fec	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 17:34
S22	0	"20020088005".did. and (time adj division)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 18:36
S23	2	"20020088005".did. and (division)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 18:37

EAST Search History

S24	0	"20020088005".did. and (snr)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 18:37
S25	1	"20020088005".did. and (ratio)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 18:39
S26	0	"20020088005".did. and (equaliz$5)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 18:39
S27	2	"20020088005".did. and (beacon broadcast$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/28 18:40
S28	37	((adapt$3 adjust$3) with (power adj level)) same ofdm	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/06/29 10:56
S30	1	"6226322".pn. and (frequency adj domain)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/07/09 15:33

PTO/SB/30EFS (08/06)
Approved for use through 08/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	09/910,412	Filing Date	2001-07-21	Docket Number (if applicable)	9202	Art Unit	2623
First Named Inventor	Gurantz			Examiner Name	Chowdhury		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

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

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

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☐ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

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

☒ Other
Extension of time request

FEES

The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.
☒ The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 502165

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature
☐ Applicant Signature

Signature of Registered U.S. Patent Practitioner			
Signature	/michael w. landry/	Date (YYYY-MM-DD)	2007-05-25
Name	Michael W. Landry	Registration Number	38216

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

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

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	09910412
Filing Date:	21-Jul-2001
Title of Invention:	Network interface device and broadband local area network using coaxial cable
First Named Inventor/Applicant Name:	Itzhak Gurantz
Filer:	Michael William Landry
Attorney Docket Number:	9202
Filed as Large Entity	

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 3 months with $0 paid	1253	1	1020	1020

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for continued examination	1801	1	790	790
		Total in USD ($)		**1810**

Electronic Acknowledgement Receipt	
EFS ID:	1814713
Application Number:	09910412
International Application Number:	
Confirmation Number:	2398
Title of Invention:	Network interface device and broadband local area network using coaxial cable
First Named Inventor/Applicant Name:	Itzhak Gurantz
Customer Number:	24244
Filer:	Michael William Landry
Filer Authorized By:	
Attorney Docket Number:	9202
Receipt Date:	25-MAY-2007
Filing Date:	21-JUL-2001
Time Stamp:	22:47:25
Application Type:	Utility

Payment information:

Submitted with Payment	yes
Payment was successfully received in RAM	$1810
RAM confirmation Number	2860
Deposit Account	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)	Multi Part /.zip	Pages (if appl.)

1	Amendment Submitted/Entered with Filing of CPA/RCE	9202-NetworkInterface-RCE-2-v2-EFS.pdf	105023	no	10
Warnings:					
Information:					
2	Extension of Time	9202_Extension-2005-sb0022.pdf	233339	no	1
Warnings:					
Information:					
3	Request for Continued Examination (RCE)	9202-sb0030e_fill.pdf	666265	no	3
Warnings:					
Information:					
4	Fee Worksheet (PTO-06)	fee-info.pdf	8324	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1012951		

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

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

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

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No:	09/910,412 Confirmation no. 2398
Filed:	7/21/2001
Applicant:	Gurantz et al.
Title:	Network Interface Device and Broadband Local Area Network Using Coaxial Cable
Examiner/GAU:	Chowdhury / 2623
Date:	5/25/2007

Request for Continued Examination / Amendment / Reply

Mail Stop RCE (Filed online)
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Dear Sir:

In response to the Office Action mailed 11/28/2006, please amend the above application as follows:

Claim amendments starting on page 2.

Remarks and arguments starting on page 6.

Claim Amendments:

1-4. (Canceled)

5. (Currently amended) A signal distribution network for transmitting modulated signals using coaxial cable building wiring containing a plurality of branches as a communication channel comprising:

a network interface device located at the point of entry of the building wiring that reflects network signals originating in the building wiring back into all branches of the building wiring wherein the reflection introduced by the network interface device ~~is frequency dependent and reflects signals by reflecting a predetermined frequency band of signals~~ produces a multipath signal in the wiring branches that creates impairments to the performance of the communication channel;

at least one signal splitter; and

a plurality of terminal devices, wherein the signal modulation used by the terminal devices is orthogonal frequency division multiplexing to overcome the communication channel impairments caused by the network interface device;

wherein the network interface device provides a path for terminal devices to transmit to and receive from other terminal devices and wherein terminal devices communicate directly with each other to form the signal distribution network.

6-9. (Canceled)

10-17. (Canceled)

18. (Currently amended) The signal distribution network of claim 5, further comprising a method of sharing the communication ~~medium~~ channel between terminal devices using time division duplex protocol for communications that are synchronized by broadcasting a beacon message on the network.

19-22. (Canceled)

23. (Currently amended) The signal distribution network of claim 18 wherein the modulation order of each OFDM carrier is adjusted according to the signal to noise ratio (SNR) at each OFDM carrier frequency to overcome frequency selective channel impairments present in the coaxial building wiring caused by the reflections from the network interface device.

24. (Currently amended) The signal distribution network of claim 18 wherein the power level of each OFDM carrier is adjusted according to the signal loss at each OFDM carrier frequency to overcome frequency selective channel impairments present in the coaxial building wiring caused by the reflections from the network interface device.

25. (Currently amended) A broadband local area network to enable terminal devices to transmit messages to and receive messages from other terminal devices using coaxial cable building wiring as a communication channel comprising a point of entry and a plurality of branches connected to terminal devices, the network comprising:

a network interface device connected to the point of entry of the building wiring comprising:

a first port connected to the point of entry side of a branch of the building wiring;

a second port connected to the terminal device side of a branch of the building wiring; and

a frequency selective signal reflecting circuit connected between the first and second port;

wherein a signal received at the second port is reflected out the second port and back into all the building wiring branches and a reflected signal path is created that produces a multipath signal in the wiring branches that creates impairments to the performance of the communication channel;

a plurality of terminal devices connected to the wiring branches, each terminal device bidirectionally communicating with other terminal devices through the reflected signal path created by

the network interface device using orthogonal frequency division multiplexing (ODFM) modulation to overcome the communication channel impairments caused by the network interface device.

26. (Currently amended) The broadband local area network of claim 25 wherein the modulation order of each OFDM carrier is adjusted according to the signal to noise ratio (SNR) at each OFDM carrier frequency to overcome frequency selective channel impairments present in the coaxial building wiring caused by the reflections from the network interface device.

27. (Currently amended) The broadband local area network of claim 25 wherein the power level of each OFDM carrier is adjusted according to the signal loss at each OFDM carrier frequency to overcome frequency selective channel impairments present in the coaxial building wiring caused by the reflections from the network interface device.

28. (Previously presented) The broadband local area network of claim 25 wherein the frequency used for communicating is above the cable television band.

29. (Currently amended) A broadband local area network for transmitting modulated signals using coaxial cable building wiring containing a plurality of branches comprising:

a network interface device located at the point of entry of the building wiring that reflects network signals originating in the building wiring back into all branches of the building wiring wherein the network interface device is frequency dependent and reflects signals by reflecting a predetermined frequency band of signals, wherein the reflected signals produce a multipath signal in the wiring branches that creates impairments to the performance of the communication channel;

at least one signal splitter; and

a plurality of terminal devices connected to the wiring branches, each terminal device capable of bidirectionally communicating with other terminal devices through the reflected signal path created by the network interface device, wherein the terminal devices perform equalization on the received signal

that restores a flat frequency response to overcome the communication channel impairments caused by the multipath signals.

30. (Currently amended) The network of claim 29 wherein equalization is frequency domain equalization ~~that restores a flat frequency response to overcome multipath effects~~.

31. (Currently amended) The network of claim 29 wherein equalization is time domain equalization ~~that restores a flat frequency response to overcome multipath effects~~.

32. (Currently amended) The network of claim 29 wherein equalization is adaptive ~~and creates a filter response that restores a flat frequency response to overcome communication channel impairments caused by multipath signals~~.

33. (Currently amended) The network of claim 29 wherein the terminal devices use orthogonal frequency division multiplexing (ODFM) modulation to overcome the communication channel impairments caused by the reflected signals.

34. (Currently amended) The network of claim 32 wherein the terminal devices use orthogonal frequency division multiplexing (ODFM) modulation to overcome the communication channel impairments caused by the reflected signals.

35. (Previously presented) The network of claim 34 wherein the terminal devices use forward error correction to recover the transmitted signal without errors.

36. (New) The broadband local area network of claim 25, further comprising a method of sharing the communication channel between terminal devices using time division duplex protocol for communications that are synchronized by broadcasting a beacon message on the network.

37. (New) The broadband local area network of claim 29, further comprising a method of sharing the communication channel between terminal devices using time division duplex protocol for communications that are synchronized by broadcasting a beacon message on the network.

Remarks/Arguments

Claims

Claims 5, 18, and 23-35 were pending in the application. All claims were rejected. Independent claims 5, 18, and 29 are currently amended and dependent claims 23-27, and 30-34 are currently amended. Claims 36 and 37 are new. Claims 5, 18, and 23-37 remain.

Rejections under 35 U.S.C. 103

Claim 5 was rejected under 103(a) as being unpatentable over Li (U.S. 4,633,309) in view of Manchester (U.S. 6,144,399) and Langlais (U.S. 6,019,932).

Claim 5 has been amended to clarify that the reflection introduced by the network interface device produces a multipath signal in the wiring branches that creates impairments to the performance of the communication channel and the signal modulation used by the terminal devices is orthogonal frequency division multiplexing to overcome the communication channel impairments caused by the network interface device and that the network interface device provides a path for terminal devices to transmit to and receive from other terminal devices and wherein terminal devices communicate directly with each other to form the signal distribution network.

No new matter has been added. Support for these amendments to claim 5 are found in the application at page 12, line 24 to page 13, line 4; page 17, lines 27-30; page 6, lines 9-11; page 9, lines 3-6; page 3, lines 31-32; and page 7, line 32 to page 8 line 4.

Regarding the present claims, there is no suggestion or motivation in the references or in the knowledge generally to modify the references or combine the teachings. Neither Li nor Langlais recognizes the multipath condition created by a signal reflection intentionally created within the building wiring, therefore, neither reference suggests or provides motivation to apply OFDM modulation to reflected signals in coaxial cable building wiring to enable communication over the

wiring. Manchester deals with merging telephone and broadband signals onto on coaxial cable and does not teach either reflecting signals or OFDM.

Langlais discloses OFDM for head-end to terminal communication and recognizes that "OFDM is more robust against time domain impulse interference due to its long symbol time… classic impulse noise spreads uniformly across a communication's channel", Col 10, line 55-58. Langlais does not recognize the problem of frequency selective channel impairments caused by signal reflections created by having a signal reflector at the point of entry. **Langlais does not disclose the use or benefit of a signal reflector to create a network signal path.**

Li discloses a signal reflector at the point of entry for reflecting a signal transmitted by a master decoder to several slave decoders. **Li does not recognize the multipath environment created by the high pass signal reflector.** Further, the control message of Li is a narrow band signal that would not require mitigation of impairments. The nature of Li's system is different from applicant's. In Li, the signal transmitted by the master decoder originated at the cable head end, is received by the master decoder, then frequency translated and transmitted towards the point of entry to be reflected by the high pass filter at the point of entry. Communication starts from the head end, passes through the master decoder to the reflector, then to the slave decoders. Communication between slaves is not disclosed and a network among the slaves is not disclosed.

In Li, a slave decoder can receive messages only from a master decoder: "the slave decoder cannot receive control messages other than those which are retransmitted from its master decoder." Li, Col 2, lines 66-68. Li does not disclose a system that creates a network of the terminal devices where terminal devices communicate with other terminal devices, but instead Li only discloses a system that allows one device to broadcast to several devices. Only the master decoder of Li transmits, the slave decoders only receive and they receive messages only from the master decoder. A network is not formed where terminal devices communicate directly with each other, as claimed in claim 5.

It would not be obvious to combine the OFDM transmission system of Langlais with the signal method of Li. Langlais teaches a two-way point to multipoint transmission system using OFDM to establish communication between one upstream unit and a plurality of downstream units. Langlais does not

teach communication between the down stream units. Claim 5 claims communication between the terminal devices. The other reference, Li, does not recognize the multipath environment created by the high pass signal reflector and the need for a mechanism to overcome the channel impairments causes by the multipath signal created by the reflector. There is no motivation in Li or Langlais to apply the teaching of Langlais because there is no problem identified in Li or Langlais of channel impairments due to the signal reflector, as claimed in claim 5. It is only applicant's disclosure that recognizes the problem of multipath condition and the need to overcome the channel impairments when employing a signal reflector, and thus only applicant's disclosure presents the motivation to combine OFDM with a signal reflector. See application page 17, lines 27-30.

Neither Li nor Langlais discloses a network where terminal devices communicate with each other. In both Li and Langlais the slave or down stream units communicate only with a single device, the master or headend unit.

Claim 5 is patentable over the combination of Li and Langlais and allowance is respectfully requested.

Claim 18 has been amended to include the limitation of using time division duplex protocol for communications that are synchronized by broadcasting a beacon message on the network. No new matter has been added. Support for this limitation is found in the application at page 14 lines 13-16. None of the references disclose the use of a beacon message to synchronize communications.

Claim 23 and 24 have been amended to clarify that adjustment of modulation and power level, respectively, at each OFDM carrier frequency is to overcome frequency selective channel impairments present in the coaxial building wiring caused by the reflections from the network interface device. No new matter has been added. Support for this limitation is found in the application at page 17, lines 27-29.

Claim 25 has been amended to clarify that the coaxial cable building wiring is used as a communication channel and that a "reflected signal path is created that produces a multipath signal in the wiring branches that creates impairments to the performance of the communication channel;"

and (ODFM) modulation is used to overcome the communication channel impairments caused by the network interface device. No new matter has been added, support for these amendments are the same as for claim 5. Claim 25 should be allowable as argued above for claim 5.

Claim 26 and 27 have been amended in a manner similar to claims 23 and 24 and should be allowable along with claim 25.

Independent claim 29 has been amended to clarify that the reflected signals produces a multipath signal in the wiring branches that creates impairments to the performance of the communication channel. Claim 29 has been further amended to include the limitation "equalization on the received signal that restores a flat frequency response to overcome the communication channel impairments caused by the multipath signals". This limitation was essentially in previous claims 30 and 31 and further clarifies the function of the equalizer.

Claims 30 and 31 have been amended to remove the limitation moved to claim 29. Claims 29-31 should be allowable with amended claim 29.

Claims 32 has been amended to remove the limitation moved to claim 29. Claims 33 and 34 have been amended to clarify that OFDM is used to overcome the communication channel impairments caused by the reflected signals in addition to the use of equalization. Claims 32-35 should be allowable with amended claim 29.

Equalization disclosed and claimed is useful for correcting impairments to the frequency response of the channel caused by multipath signals that result from the signal reflector. Equalization is not taught by Li or Langlais; neither reference recognized the need for equalization caused by a reflection, particularly a reflection intentionally introduced by the network interface device. Applicant identifies the problem that "In the frequency domain, a reflection produces ripples in the response of the channel, creating amplitude variations across the pass band." Application page 12, lines 39-31. Applicant discloses the solution: "An adaptive equalizer in the terminal device receiver creates a filter response that restores a flat frequency response impaired by the multipath signal." Application page 13, 4-7. Mukherjee (U.S. 6,226,322) discloses equalization on the received signal in a digital-subscriber-line

system, where each terminal communicates only with a central office. Mukherjee's system does not employ a signal reflector to enable device-to-device communication and does not address multipath caused by a signal reflector. The use of an equalizer along with the other elements of applicant's claim, in a network with an intentional signal reflector at the point of entry, is not found in or suggested by Mukherjee or the other prior art.

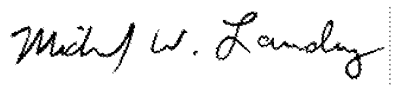
New claims 36 and 37 have been added and dependent on base claims 25 and 29. These claims add the same limitation as claim 18 discussed above.

Conclusion

In view of the foregoing, claim 5, 25, and 29 as amended distinguish the claimed invention from the prior art. These independent claims and the related dependent claims are allowable and such action is respectfully requested.

If it is felt that direct communication would serve to advance prosecution of this case, the examiner is invited to call the attorney at the below listed telephone number.

Respectfully submitted,



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PTO/SB/22 (12-04)
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a) **FY 2005** (*Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).*)	Docket Number (Optional) 9202
Application Number 09/910,412	Filed 7/21/2001
For Network Interface Device and Broadband Local Area Network Using Coaxial Cable	
Art Unit 2623	Examiner Chowdhury

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

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

	Fee	Small Entity Fee	
☐ One month (37 CFR 1.17(a)(1))	$120	$60	$
☐ Two months (37 CFR 1.17(a)(2))	$450	$225	$
☑ Three months (37 CFR 1.17(a)(3))	$1020	$510	$ 1020
☐ Four months (37 CFR 1.17(a)(4))	$1590	$795	$
☐ Five months (37 CFR 1.17(a)(5))	$2160	$1080	$

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

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

☑ Payment by credit card. ~~Form PTO-2038 is attached.~~ Online payment

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

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 502165. I have enclosed a duplicate copy of this sheet.

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

I am the

☐ applicant/inventor.

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

☑ attorney or agent of record. Registration Number 38,216

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

/michael w. landry/ online filing — Signature
5/25/2007 — Date

Michael W. Landry — Typed or printed name
858-229-6801 — Telephone Number

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

☐ Total of _____ forms are submitted.

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

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

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2003

Application or Docket Number: 09/10412

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS		
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	minus 20=	*
INDEPENDENT CLAIMS	minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT		☐

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

SMALL ENTITY TYPE ☐			OTHER THAN SMALL ENTITY	
RATE	FEE	OR	RATE	FEE
BASIC FEE	385.00	OR	BASIC FEE	770.00
X$ 9=		OR	X$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL		OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A — 5/25/07

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 17	Minus	** 20	= 0
Independent	* 3	Minus	*** 3	= 0
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY			OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
~~X$ 9=~~ 85		OR	~~X$18=~~ 30	
~~X43=~~ 10		OR	~~X86=~~ 20	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

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

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/910,412	07/21/2001	Itzhak Gurantz	9202	2398

24244 7590 11/28/2006

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EXAMINER	
CHOWDHURY, SUMAIYA A	
ART UNIT	PAPER NUMBER
2623	

DATE MAILED: 11/28/2006

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

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/910,412	GURANTZ ET AL.	
	Examiner	Art Unit	
	Sumaiya A. Chowdhury	2623	

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

Period for Reply

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

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

Status

1)☒ Responsive to communication(s) filed on *14 September 2006*.

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

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

Disposition of Claims

4)☒ Claim(s) *5,18 and 23-35* is/are pending in the application.

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

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *5,18 and 23-35* is/are rejected.

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

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

Application Papers

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

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

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

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

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

Priority under 35 U.S.C. § 119

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

a)☐ All b)☐ Some * c)☐ None of:

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

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

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

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

Attachment(s)

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

DETAILED ACTION

Response to Arguments

1. Applicant's arguments with respect to claims 5, 18, and 23-35, have been considered but are moot in view of the new ground(s) of rejection.

(a) Applicant argues in regard to claim 5 "Neither Li nor Langlais ...over the building wiring", on page 6, 1st paragraph of the Remarks filed 9/14/06.

In claim 5, Applicant claims "a plurality of terminal devices, wherein the signal modulation used by the terminal devices is orthogonal frequency division multiplexing". Langlais was brought in to teach this particular limitation. In claim 5, Applicant did not claim anything regarding the multipath condition created by a strong signal reflection intentionally created within the building wiring.

(b) Applicant argues in regard to claim 5 "Langlais does not disclose the use or benefit of a signal reflector", on page 6, 2nd paragraph of the Remarks filed 9/14/06.

Li was brought in to teach that particular limitation.

(c) Applicant argues in regard to claim 5 "Li does not disclose a system that enables terminal devices to communicate bidirectionally with other terminal devices, but instead only discloses a system that allows one device to broadcast to several devices", on page 6, 4th paragraph of the Remarks filed 9/14/06.

The slave decoder communicates with the master decoder and vice versa. Therefore, there is bidirectional communication with the reflected signal created by the splitter.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Manchester and Langlais.

Considering claim 5, Li discloses a signal distribution network for transmitting modulated signals using building wiring containing a plurality of branches comprising:

a network interface device (22 – Fig. 2) located at the point of entry of the building wiring (col. 2, lines 15-30) that reflects network signals originating in the building wiring back into all branches of the building wiring (The signal from (26 – Fig. 2) are **reflected** to (28, 30, 32 – Fig. 2). – col. 2, lines 55-65), wherein the network interface device is frequency dependent and reflects signals by reflecting a predetermined frequency band of signals (col. 2, lines 15-20, lines 60-67).

at least one signal splitter (splitter reflector 24 – Fig. 2); and

a plurality of terminal devices (28, 30, 32 – Fig. 2).

However Li fails to teach the following:

The signal distribution network uses coaxial cable wiring;

The signal modulation used by the terminal devices is orthogonal frequency division multiplexing;

In an analogous art, Manchester teaches wherein the building wiring consists of coaxial cable (128, 138, 150 – Fig. 1; col. 3, line 50 – col. 4, line 15) in order to use wiring which is prevalent in existing buildings.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li's invention to include the building wiring is coaxial cable, as taught by Manchester, for the advantage of using wiring which is prevalent in existing buildings.

However, Li and Manchester fail to teach:

The signal modulation used by the terminal devices is orthogonal frequency division multiplexing;

In an analogous art, Langlais discloses a transmission system in which OFDM is employed to provide increased robustness against frequency selective fading or narrowband interference. – col. 10, lines 55-58.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li and Manchester's system to include orthogonal frequency division multiplexing as the desired type of signal modulation, as taught by

Langlais, for the advantage of providing a more robust communication technique for distributing signals.

4. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Manchester and Langlais as applied to claim 5 above, and further in view of Horton.

Considering claim 18, Li, Manchester, and Langlais fail to disclose that the terminal devices communicate with each other using time division duplex protocol.

In an analogous art, Horton discloses a cable network in which Time Division Multiple Access (TDMA) is implemented to facilitate communication in both the upstream and downstream direction – col. 4, lines 9-16.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li, Manchester, and Langlais' system to include TDMA, as taught by Horton, for the advantage of facilitating communications between devices wherein a single frequency supports simultaneous data channels.

5. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li, Manchester, Langlais, and Horton as applied to claim 18 above, and further in view of Ling (6771706).

As for claim 23, Li, Manchester, Langlais, and Horton fail to teach wherein the modulation order of each OFDM carrier is adjusted according to the signal to noise ratio (SNR) at each OFDM carrier frequency.

In an analogous art, Ling teaches the coding for each transmission channel IS adjusted such that the information bit rate matches the transmission capability supported by the channel SNR. Additionally, the modulation scheme for the transmission channel is selected based on the channel SNR. Other processing (e.g., interleaving) may also be adjusted and are within the scope of the invention. The adjustment of the processing for each transmission channel based on the determined SNR for the channel allows the MIMO system to achieve high performance (i.e., high throughput or bit rate for a particular level of performance). – col. 20, lines 45-60

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li, Manchester, Langlais, and Horton's invention to include the above mentioned limitation, as taught by Ling, for the advantage of achieving high throughput or bit rate for a particular level of performance.

6. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li, Manchester, Langlais, and Horton, as applied to claim 18 above, and further in view of Zhang (US 2002/0145968).

As for claim 24, Li, Manchester, Langlais, and Horton fail to teach wherein the power level of each OFDM carrier is adjusted according to the signal loss at each OFDM carrier frequency..

In an analogous art, Zhang teaches the power level of each OFDM carrier is adjusted according to the signal loss at each OFDM carrier frequency – [0015].

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li, Manchester, Langlais, and Horton's invention to include the above mentioned limitation, as taught by Zhang, in order to achieve minimal signal loss.

7. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Langlais.

As for claim 25, Li teaches:

a network interface device (22 - Fig. 2) connected to the point of entry (20 – Fig. 2) of the building wiring comprising:

a first port (Referring to Fig. 2 the port where 20 intersects 22) connected to the point of entry side of a branch of the building wiring – col. 2, lines 15-20;

a second port (Referring to Fig. 2, the port where the incoming signal from the cable distribution is outputted from) connected to the terminal device side of a branch of the building wiring – col. 2, lines 18-28;

a frequency selective signal reflecting circuit (circuitry within 22 which reflects the 10.7 MHz signal) connected between the first and second port - col. 2, lines 55-65;

wherein a signal received at the second port is reflected out the second port and back into all the building wiring branches and a reflect signal path is created (The master decoder 26 sends a signal upstream which is reflected by the network interface device and is subsequently transmitted to the slave decoders (28, 30, 32) – col. 2, lines 55-67).

a plurality of terminal devices (28, 30, 32 – Fig. 2) connected to the wiring branches (control carrier – Fig. 1) – col. 2, lines 20-30, lines 43-67.

each terminal device bidirectionally communicating with other terminal devices through the reflected signal path created by the network interface device (22 – Fig. 2) – (The slave decoder communicates with the master decoder and vice versa. Therefore, there is bidirectional communication with the reflected signal created by the splitter. col. 2, lines 54-67).

However, Li fails to teach

using orthogonal frequency division multiplexing (ODFM) modulation.

In an analogous art, Langlais discloses a transmission system in which OFDM is employed to provide increased robustness against frequency selective fading or narrowband interference. – col. 10, lines 55-58.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li's system to include orthogonal frequency division

multiplexing as the desired type of signal modulation, as taught by Langlais, for the advantage of providing a more robust communication technique for distributing signals.

8. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Langlais as applied to claim 25 above, and further in view of Ling.

Claim 26 contains the limitations of claim 23 and is analyzed as previously discussed with respect to that claim.

9. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Langlais as applied to claim 25 above, and further in view of Zhang.

Claim 27 contains the limitations of claim 24 and is analyzed as previously discussed with respect to that claim.

10. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Langlais as applied to claim 25 above, and further in view of Van Cleave (4864613).

As for claim 28, Li and Langlais fail to teach the frequency used for communicating is above the cable television band.

In an analogous art, Van Cleave teaches signals are converted to an intermediate frequency above the cable television band, in order to reduce distortion – col. 6, lines 50-63.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li and Langlais' invention to include the above mentioned limitation, as taught by Van Cleave, for the advantage of reducing distortion.

11. Claims 29, 30, and 33, are rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Manchester, Langlais, and Mukherjee (6226322)

Claim 29 contains the limitations of claims 5 and 25 and is analyzed as previously discussed with respect to those claims. Claim 29 additionally calls for the following:

wherein the terminal devices perform equalization on the received signal.

In an analogous art, Mukherjee teaches the terminal devices perform equalization on the received signal – col. 8, lines 40-52.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li, Manchester, and Langlais' invention to include the above mentioned limitation, as taught by Mukherjee, for the advantage of flattening the signal spectrum and compensating for phase distortion.

As for claim 30, Li, Manchester, Langlais, and Mukherjee disclose the claimed limitations. In particular, Mukherjee teaches equalization is frequency domain equalization that restores a flat frequency response to overcome multipath effects.

As for claim 33, Li, Manchester, Langlais, and Mukherjee, disclose the claimed limitations. In particular, Langlais teaches wherein the terminal devices use orthogonal frequency division multiplexing (OFDM) modulation – col. 10, lines 55-58.

12 Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li, Manchester, Langlais, and Mukherjee as applied to claim 29 above, and further in view of Kapoor (6,396,886).

As for claim 31, Li, Manchester, Langlais, and Mukherjee fail to teach wherein equalization is time domain equalization that restores a flat frequency response to overcome multipath effects.

In an analogous art, Kapoor teaches wherein equalization is time domain equalization that restores a flat frequency response to overcome multipath effects – col. 6, lines 47-63.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li, Manchester, Langlais, and Mukherjee's invention to

include the above mentioned limitation, as taught by Kapoor, for the advantage of restoring the frequency envelope.

13. Claims 32 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li, Manchester, Langlais, and Mukherjee as applied to claim 29 above, and further in view of Ise (6778601).

As for claim 32, Li, Manchester, Langlais, and Mukherjee fail to teach wherein equalization is adaptive and creates a filter response that restores a flat frequency response to overcome communication channel impairments caused by multipath signals.

In an analogous art, Ise teaches wherein equalization is adaptive and creates a filter response that restores a flat frequency response to overcome communication channel impairments caused by multipath signals (see abstract, col. 4, lines 33-47, col. 5, lines 17-27, lines 40-50).

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li, Manchester, Langlais, and Mukherjee 's invention to include the above mentioned limitation, as taught by Ise, in order to inhibit an excessive peak in the filter characteristic.

As for claim 34, Li, Manchester, Langlais, Mukherjee, and Ise disclose the claimed limitations. In particular, Langlais teaches wherein the terminal devices use orthogonal frequency division multiplexing (OFDM) modulation – col. 10, lines 55-58.

14. Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li, Manchester, Langlais, and Mukherjee as applied to claim 34 above, and further in view of Nakakita (6061820).

As for claim 35, Li, Manchester, Langlais, and Mukherjee fail to teach wherein the terminal devices use forward error correction to recover the transmitted signal without errors.

In an analogous art, Nakakita teaches forward error correction is used so that the errors that occur can be recovered – col. 64, lines 53-60.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li, Manchester, Langlais, and Mukherjee's invention to include the above mentioned limitation, as taught by Nakakita, for the advantage of transmitting signals without errors.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

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

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sumaiya A. Chowdhury whose telephone number is (571) 272-8567. The examiner can normally be reached on Mon-Fri, 9-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chris Grant can be reached on (571) 272-7292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SAC

CHRISTOPHER GRANT
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

Notice of References Cited	Application/Control No. 09/910,412	Applicant(s)/Patent Under Reexamination GURANTZ ET AL.	
	Examiner Sumaiya A. Chowdhury	Art Unit 2623	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,622,304	09-2003	Carhart, Thomas W.	725/74
*	B	US-5,726,701	03-1998	Needham, Bradford H.	725/105
*	C	US-4,222,066	09-1980	Zelenz, Martin L.	380/208
*	D	US-6,381,745	04-2002	Paul, Lawrence Marc	725/69
*	E	US-4,933,745	06-1990	O'Shea et al.	257/724
*	F	US-5,969,582	10-1999	Boesch et al.	333/129
*	G	US-6,091,932	07-2000	Langlais, Brian	725/111
*	H	US-2001/0021998	09-2001	Margulis, Neal	725/81
*	I	US-4,633,309	12-1986	Li et al.	380/242
*	J	US-6,144,399	11-2000	Manchester et al.	725/127
*	K	US-4,864,613	09-1989	Van Cleave, James	380/220
*	L	US-6,778,601	08-2004	Ise et al.	375/232
*	M	US-6,061,820	05-2000	Nakakita et al.	714/751

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Notice of References Cited	Application/Control No. 09/910,412	Applicant(s)/Patent Under Reexamination GURANTZ ET AL.	
	Examiner Sumaiya A. Chowdhury	Art Unit 2623	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2002/0145968	10-2002	Zhang et al.	370/206
*	B	US-6,771,706	08-2004	Ling et al.	375/267
*	C	US-6,396,886	05-2002	Kapoor, Samir	375/350
*	D	US-6,226,322	05-2001	Mukherjee, Subahashish	375/229
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	3	ofdm with snr with adjust$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/20 11:43
S2	19	(ofdm orthogonal) with (snr (signal near2 noise)) with adjust$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/20 11:43
S3	16	(ofdm orthogonal) with (snr (signal near2 noise)) with adjust$3 not S1	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/20 15:01
S4	0	(ofdm orthogonal) with ((signal near2 loss)) with adjust$3 with power	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/20 14:58
S5	0	(ofdm orthogonal) with ((signal near2 loss)) with adjust$3 with power	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/20 15:02
S6	6	(ofdm orthogonal) same ((signal near2 loss)) same adjust$3 same power	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/20 15:02
S7	934	(fec (forward adj error)) with recover$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 09:40
S8	37	(fec (forward adj error)) with recover$3 and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 09:41

EAST Search History

S9	37	(fec (forward adj error)) with recover$3 with "without" with error$1	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 09:44
S10	8	equaliz$5 with adapt$3 with filter with (flat near2 frequency)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 10:48
S11	35	equaliz$5 same adapt$3 same filter same (flat near2 frequency)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 10:49
S12	1	equaliz$5 same adapt$3 same filter same (flat near2 frequency) and "20010022812".did.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 10:49
S13	1	equaliz$5 same adapt$3 same filter same (flat near2 frequency) and "6778601".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 10:52
S14	1	equaliz$5 and adapt$3 and filter and (flat near2 frequency) and "6778601".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 11:08
S15	2	(time adj domain adj equaliz$5) same (flat adj frequency)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 11:23
S16	5	(time with domain with equaliz$5) same (flat adj frequency)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 11:36

EAST Search History

S17	0	(time with domain with equaliz$5) same (restor$3 with (flat adj frequency))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 13:05
S18	0	(frequency with domain with equaliz$5) same (restor$3 with (flat adj frequency))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 13:07
S19	1618	(frequency with domain with equaliz$5)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 13:07
S20	27	(frequency with domain with equaliz$5) with restor$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 13:31
S21	0	(frequency with domain with equaliz$5) with restor$3 with flat	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 13:07
S22	51	(ofdm) same (snr) same adjust$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 14:07
S24	17	(ofdm) same (snr) same adjust$3 same power	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 14:52
S25	0	(ofdm) same (signal adj loss) same adjust$3 same power	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 14:52

EAST Search History

S26	242	(ofdm) same adjust$3 same power	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 14:52
S27	124	(ofdm) same (adjust$3 with power)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 14:53
S28	24	(ofdm) same (adjust$3 with power) same (loss lost reduc$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 14:55
S29	4	(ofdm) same (adjust$3 with power) same (loss lost)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 14:56
S33	317	frequency with above with cable with band	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 15:43
S34	21	frequency with above with cable with band with communicat$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 15:48
S35	3	(frequency near2 above) with cable with band with communicat$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 15:49
S36	2	frequency with above with (cable adj (television tv)) with band with communicat$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 15:50

EAST Search History

S37	3	frequency with higher with (cable adj (television tv)) with band with communicat$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 15:51
S38	2	frequency with more with (cable adj (television tv)) with band with communicat$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 15:58
S41	28	frequency with more with (cable adj (television tv)) with band	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 15:58
S42	31	frequency with above with (cable adj (television tv)) with band	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/21 15:58
S44	607	reflect$3 same (communicat$3 bidirectional$2 two-way) same (ofdm orthogonal)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/22 10:48
S45	207	reflect$3 same ((communicat$3 bidirectional$2 two-way) with (ofdm orthogonal))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/22 10:49
S46	124	reflect$3 with ((communicat$3 bidirectional$2 two-way) with (ofdm orthogonal))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/22 11:08
S47	0	reflect$3 with ((communicat$3 bidirectional$2 two-way) with (ofdm orthogonal)) and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/22 10:49

EAST Search History

S48	21	reflect$3 with ((communicat$3 bidirectional$2 two-way) with (ofdm (orthogonal adj frequency)))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/11/22 11:47

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No:	09/910,412
Filed:	7/21/2001
Applicant:	Gurantz et al.
Title:	Network Interface Device and Broadband Local Area Network Using Coaxial Cable
Examiner/GAU:	Chowdhury / 2623
Date:	9/14/2006

Amendment / Reply

Mail Stop Amendment (Filed online)
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Dear Sir:

In response to the Office Action mailed 5/26/2006, please amend the above application as follows:

Claim amendments starting on page 2.

Remarks and arguments starting on page 5.

Claim Amendments:

1-4. (Canceled)

5. (Currently amended) A signal distribution network for transmitting modulated signals using coaxial cable building wiring containing a plurality of branches comprising:

a network interface device located at the point of entry of the building wiring that reflects network signals originating in the building wiring back into all branches of the building wiring wherein the network interface device is frequency dependent and reflects signals by reflecting a predetermined frequency band of signals;

at least one signal splitter; and

a plurality of terminal devices, wherein the signal modulation used by the terminal devices is orthogonal frequency division multiplexing.

6-9. (Canceled)

10-17. (Canceled)

18. (Currently amended) The signal distribution network of claim [[6]] 5, further comprising a method of sharing the communication medium between terminal devices using time division duplex protocol.

19-22. (Canceled)

23. (New) The signal distribution network of claim 18 wherein the modulation order of each OFDM carrier is adjusted according to the signal to noise ratio (SNR) at each OFDM carrier frequency.

24. (New) The signal distribution network of claim 18 wherein the power level of each OFDM carrier is adjusted according to the signal loss at each OFDM carrier frequency.

25. (New) A broadband local area network to enable terminal devices to transmit messages to and receive messages from other terminal devices using coaxial cable building wiring comprising a point of entry and a plurality of branches connected to terminal devices, the network comprising:

a network interface device connected to the point of entry of the building wiring comprising:

a first port connected to the point of entry side of a branch of the building wiring;

a second port connected to the terminal device side of a branch of the building wiring; and

a frequency selective signal reflecting circuit connected between the first and second port;

wherein a signal received at the second port is reflected out the second port and back into all the building wiring branches and a reflect signal path is created;

a plurality of terminal devices connected to the wiring branches, each terminal device bidirectionally communicating with other terminal devices through the reflected signal path created by the network interface device using orthogonal frequency division multiplexing (ODFM) modulation.

26. (New) The broadband local area network of claim 25 wherein the modulation order of each OFDM carrier is adjusted according to the signal to noise ratio (SNR) at each OFDM carrier frequency.

27. (New) The broadband local area network of claim 25 wherein the power level of each OFDM carrier is adjusted according to the signal loss at each OFDM carrier frequency.

28. (New) The broadband local area network of claim 25 wherein the frequency used for communicating is above the cable television band.

29. (New) A broadband local area network for transmitting modulated signals using coaxial cable building wiring containing a plurality of branches comprising:

a network interface device located at the point of entry of the building wiring that reflects network signals originating in the building wiring back into all branches of the building wiring wherein the network interface device is frequency dependent and reflects signals by reflecting a predetermined frequency band of signals;

at least one signal splitter; and

a plurality of terminal devices connected to the wiring branches, each terminal device capable of bidirectionally communicating with other terminal devices through the reflected signal path created by the network interface device, wherein the terminal devices perform equalization on the received signal.

30. (New) The network of claim 29 wherein equalization is frequency domain equalization that restores a flat frequency response to overcome multipath effects.

31. (New) The network of claim 29 wherein equalization is time domain equalization that restores a flat frequency response to overcome multipath effects.

32. (New) The network of claim 29 wherein equalization is adaptive and creates a filter response that restores a flat frequency response to overcome communication channel impairments caused by multipath signals.

33. (New) The network of claim 29 wherein the terminal devices use orthogonal frequency division multiplexing (ODFM) modulation.

34. (New) The network of claim 32 wherein the terminal devices use orthogonal frequency division multiplexing (ODFM) modulation.

35. (New) The network of claim 34 wherein the terminal devices use forward error correction to recover the transmitted signal without errors.

Remarks/Arguments

Claims

Claims 1-9 and 17-22 were pending in the application. Claims 1-9 and 17-22 were rejected. Claims 1-4, 6-17, and 19-22 are canceled. Claims 5 and 18 are currently amended and claims 23-35 are new. Claims 5, 18, and 23-35 remain.

Rejections under 35 U.S.C. 102

The Examiner has rejected claims 1-5, 8-9, and 22 under 35 U.S.C. 102(b) as being anticipated by Li (U.S. 4,633,309). The new and amended claims currently presented include limitations not disclosed in Li.

Rejections under 35 U.S.C. 103

Claim 6, which added to claim 5 the limitation of using OFDM for modulation of the network signal, was rejected under 103(a) as being unpatentable over Li in view of Langlais (U.S. 6,019,932). Claim 5 has been amended to include this limitation of claim 6. Amended claim 5 also includes the limitations of claims 7-9, now canceled. The limitations of claim 5 were in previous dependent claims and no new matter has been added.

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). See MPEP section 2143.

Regarding the present claims, there is no suggestion or motivation in the references or in the knowledge generally to modify the references or combine the teachings. Neither Li nor Langlais recognizes the multipath condition created by a strong signal reflection intentionally created within the building wiring, therefore, neither reference suggests or provides motivation to apply OFDM modulation to reflected signals in coaxial cable building wiring to enable communication over the wiring.

Langlais discloses OFDM for head-end to terminal communication and recognizes that "OFDM is more robust against time domain impulse interference due to its long symbol time… classic impulse noise spreads uniformly across a communication's channel", Col 10, line 55-58. Langlais does not recognize the problem of frequency selective channel impairments caused by signal reflections created by having a strong signal reflector at the point of entry. **Langlais does not disclose the use or benefit of a signal reflector.**

Li discloses a signal reflector at the point of entry for reflecting a signal transmitted by a master decoder to several slave decoders. **Li does not recognize the multipath environment created by the high pass signal reflector.** Further, the control message of Li is not a broadband signal that would require mitigation of impairments. The nature of Li's system is different from applicants. The signal transmitted by the master decoder originated at the cable head end, is received by the master decoder, then frequency translated and transmitted towards the point of entry to be reflected by the high pass filter at the point of entry.

In Li, a slave decoder can receive messages only from a master decoder: "the slave decoder cannot receive control messages other than those which are retransmitted from its master decoder." Li, Col 2, lines 66-68. Li does not disclose a system that enables terminal devices to communicate bidirectionally with other terminal devices, but instead only discloses a system that allows one device to broadcast to several devices.

It would not be obvious to combine the OFDM transmission system of Langlais with the signal method of Li. Langlais teaches a two-way point to multipoint transmission system using OFDM to establish communication between one upstream unit and a plurality of downstream units. Langlais does not

teach communication between the down stream units. The other reference, Li, does not recognize the multipath environment created by the high pass signal reflector and the need for a mechanism to overcome the frequency selective channel impairments required by a broadband signal. There is no motivation in Li or Langlais to apply the teaching of Langlais because there is no problem identified in Li or Langlais of frequency selective fading due to the signal reflector. It is only applicant's disclosure that recognizes the problem of multipath condition and the need to overcome the frequency selective channel impairments when employing a signal reflector, and thus applicant's disclosure presents the motivation to combine OFDM with a signal reflector. See application page 17, lines 27-30.

Claim 18 is currently amended to depend on claim 5. New claims 23 and 24 depend on claim 5. Support for these limitations is found is the application at page 18, lines 12-28. No new matter has been added.

Claim 6 is patentable over the combination of Li and Langlais and allowance is respectfully requested.

New Claims

New claims 25-28 are presented. Support for these claims is found in the application in original claims 1, 5, 6, 7, 8, and page 18, lines 12-28. No new matter has been added. These claims include limitations of using a signal reflector with ODFM modulation and are patentable over Li and Langlais as argued above for claim 6.

New claims 29-35 are presented. Support for these claims is found in the original claims and the application page 12, line 24 to page 13, line 9; page 13, line 30-32; and page 19, lines 14-18 (related to equalizers), and page 19, lines 6-1 (related to error correction). No new matter has been added.

Equalization disclosed and claimed is useful for correcting impairments to the frequency response of the channel caused by multipath signals that result from the signal reflector. Equalization is not taught by Li or Langlais; neither reference recognized the need for equalization. Applicant identifies the problem that "In the frequency domain, a reflection produces ripples in the response of the channel, creating amplitude variations across the pass band." Application page 12, lines 39-31. Applicant

discloses the solution: "An adaptive equalizer in the terminal device receiver creates a filter response that restores a flat frequency response impaired by the multipath signal." Application page 13, 4-7. The use of an equalizer in a network with an intentional signal reflector at the point of entry is not found in or suggested by the prior art.

New claims 25 and 29 are patentable over the prior art and allowance is respectfully requested.

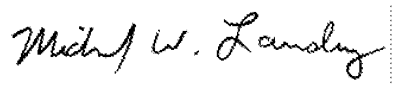
Conclusion

In view of the foregoing, claim 5 as amended and new claims 25 and 29 distinguish the invention from Li and Langlais. These independent claims and the related dependent claims are allowable and such action is respectfully requested.

If it is felt that direct communication would serve to advance prosecution of this case, the examiner is invited to call the attorney at the below listed telephone number.

Date: 9/14/2006

Respectfully submitted,



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PTO/SB/21 (02-04)
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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	09 / 910,412
Filing Date	7/21/2001
First Named Inventor	Gurantz
Art Unit	2623
Examiner Name	
Attorney Docket Number	9202

Total Number of Pages in This Submission: 11

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
- ☐ Fee Attached
- ☑ Amendment/Reply
- ☐ After Final
- ☐ Affidavits/declaration(s)
- ☑ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Response to Missing Parts/ Incomplete Application
- ☐ Response to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
- ☐ After Allowance communication to Technology Center (TC)
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☑ Other Enclosure(s) (please Identify below):

Remarks

Request for Interview

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name	Michael W. Landry
Signature	/michael w. landry/
Date	9/14/2006

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below.

Typed or printed name	Michael W. Landry		
Signature	/michael w. landry/ online filing	Date	9/14/2006

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

Electronic Patent Application Fee Transmittal

Application Number:	09910412
Filing Date:	21-Jul-2001
Title of Invention:	Network interface device and broadband local area network using coaxial cable
First Named Inventor:	Itzhak Gurantz
Filer:	Michael William Landry
Attorney Docket Number:	9202
Filed as Small Entity	

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 1 month with $0 paid	2251	1	60	60

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**60**

Electronic Acknowledgement Receipt

EFS ID:	1202267
Application Number:	09910412
Confirmation Number:	2398
Title of Invention:	Network interface device and broadband local area network using coaxial cable
First Named Inventor:	Itzhak Gurantz
Customer Number:	24244
Filer:	Michael William Landry
Filer Authorized By:	
Attorney Docket Number:	9202
Receipt Date:	14-SEP-2006
Filing Date:	21-JUL-2001
Time Stamp:	18:52:30
Application Type:	Utility
International Application Number:	

Payment information:

Submitted with Payment	yes
Payment was successfully received in RAM	$60
RAM confirmation Number	630
Deposit Account	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)	Multi Part	Pages

1	Extension of Time	9202_Extension-2005-sb0022.pdf	223142	no	1
Warnings:					
Information:					
2	Letter Requesting Interview with Examiner	Interview-PTOL413A-fill.pdf	248313	no	1
Warnings:					
Information:					
3		9202-NetworkInterface-RCE-OA-Response-v2.pdf	98368	yes	8

Multipart Description

Doc Desc	Start	End
Amendment - After Non-Final Rejection	1	1
Claims	2	4
Applicant Arguments/Remarks Made in an Amendment	5	8

Warnings:					
Information:					
4	Transmittal letter	9202-Transmittal-OA-resp-ext-online-emb.pdf	50348	no	1
Warnings:					
Information:					
5	Fee Worksheet (PTO-875)	fee-info.pdf	8156	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	628327		

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

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

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

PTO/SB/22 (12-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARMENT OF COMMERCE
Under the paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless if displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a) **FY 2005** *(Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).)*	Docket Number (Optional) 9202
Application Number 09/910,412	Filed 7/21/2001
For Network Interface Device and Broadband Local Area Network Using Coaxial Cable	
Art Unit 2623	Examiner Chowdhury

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

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

	Fee	Small Entity Fee	
☑ One month (37 CFR 1.17(a)(1))	$120	$60	$ 60
☐ Two months (37 CFR 1.17(a)(2))	$450	$225	$
☐ Three months (37 CFR 1.17(a)(3))	$1020	$510	$
☐ Four months (37 CFR 1.17(a)(4))	$1590	$795	$
☐ Five months (37 CFR 1.17(a)(5))	$2160	$1080	$

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

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

☑ Payment by credit card. ~~Form PTO-2038 is attached.~~ Online payment

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

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 502165. I have enclosed a duplicate copy of this sheet.

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

I am the

☐ applicant/inventor.

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

☑ attorney or agent of record. Registration Number 38,216

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

/michael w. landry/ online filing	9/14/2006
Signature	Date
Michael W. Landry	858-229-6801
Typed or printed name	Telephone Number

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

☐ Total of _____ forms are submitted.

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

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

PTOL-413A (09-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Applicant Initiated Interview Request Form

Application No.: 09/910,412 First Named Applicant: Gurantz
Examiner: Sujatha R Sharma Art Unit: 2623 Status of Application: Pending, non-final rejection

Tentative Participants:
(1) Examiner **(2)** _____

(3) Applicant's attorney **(4)** _____

Proposed Date of Interview: As arranged with examiner **Proposed Time:** After 9:00 am PST **(AM/PM)**

Type of Interview Requested:
(1) ☑ **Telephonic** **(2)** ☐ **Personal** **(3)** ☐ **Video Conference**

Exhibit To Be Shown or Demonstrated: ☐ **YES** ☑ **NO**
If yes, provide brief description: _____

Issues To Be Discussed

Issues (Rej., Obj., etc)	Claims/ Fig. #s	Prior Art	Discussed	Agreed	Not Agreed
(1) Amended Claims	5, 18	Li/Langlais	[ ]	[ ]	[ ]
(2) New Claims	23-35	Li/Langlais	[ ]	[ ]	[ ]
(3)			[ ]	[ ]	[ ]
(4)			[ ]	[ ]	[ ]

[ ] Continuation Sheet Attached

Brief Description of Arguments to be Presented:

(1) Claims as amended distinguish the invention from Li in view of Langlais, are not obvious, and are allowable.

(2) New claims include limitations that are allowable over Li/Langlais; Li/Langlais does not provide motivation to combine references.

An interview was conducted on the above-identified application on _____.
NOTE: This form should be completed by applicant and submitted to the examiner in advance of the interview (see MPEP § 713.01).
This application will not be delayed from issue because of applicant's failure to submit a written record of this interview. Therefore, applicant is advised to file a statement of the substance of this interview (37 CFR 1.133(b)) as soon as possible.

_____ Applicant/Applicant's Representative Signature

Michael W. Landry
Typed/Printed Name of Applicant or Representative

38,216
Registration Number, if applicable

_____ Examiner/SPE Signature

This collection of information is required by 37 CFR 1.133. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 21 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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

PATENT APPLICATION FEE DETERMINATION RECORD
Effective December 8, 2004

09/910,412

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS		
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	minus 20=	*
INDEPENDENT CLAIMS	minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT		☐

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

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	150.00	OR	BASIC FEE	300.00
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL		OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A — 10/14/05

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 11	Minus	** 20	* 1
Independent	* 2	Minus	*** 3	* 1
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B — 4/17/06

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 15	Minus	** 20	= —
Independent	* 3	Minus	*** 3	= —
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C — 9/14/06

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 15	Minus	** 20	= —
Independent	* 3	Minus	*** 3	= —
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	1
X100=	1	OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE	1	OR	TOTAL ADDIT. FEE	

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

FORM PTO-875 (Rev. 10/05) — Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/910,412	07/21/2001	Itzhak Gurantz	9202	2398

24244 7590 05/26/2006

MICHAEL W LANDRY
5098 SEACHASE STREET
SAN DIEGO, CA 92130

EXAMINER	
CHOWDHURY, SUMAIYA A	
ART UNIT	**PAPER NUMBER**
2623	

DATE MAILED: 05/26/2006

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

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/910,412	GURANTZ ET AL.	
	Examiner	Art Unit	
	Sumaiya A. Chowdhury	2623	

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

Period for Reply

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

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

Status

1)☒ Responsive to communication(s) filed on *4/17/06*.

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

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

Disposition of Claims

4)☒ Claim(s) *1-9 and 17-22* is/are pending in the application.

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

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9 and 17-22* is/are rejected.

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

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

Application Papers

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

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

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

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

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

Priority under 35 U.S.C. § 119

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

a)☐ All b)☐ Some * c)☐ None of:

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

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

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

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

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4/17/06 has been entered.

Claim Rejections - 35 USC § 102

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

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1, 5, 8-9, and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by Li (4,633,309).

As for claims 1 and 22, Li teaches a network interface device (22 - Fig. 2) connected to building wiring, the building wiring comprising a point of entry (20 – Fig. 2) and a plurality of branches connected to terminal devices (26, 28, 30, & 32 – Fig. 2), for creating a signal distribution system (Fig. 2) comprising:

a first port (Referring to Fig. 2 the port where 20 intersects 22) connected to the point of entry side of a branch of the building wiring – col. 2, lines 15-20;

a second port (Referring to Fig. 2, the port where the incoming signal from the cable distribution is outputted from) connected to the terminal device side of a branch of the building wiring – col. 2, lines 18-;

a signal reflecting circuit (circuitry within 22 which reflects the 10.7 MHz signal) connected between the first and second port – col. 2, lines 55-65.

wherein a signal received at the second port is reflected out the second port and wherein all terminal devices connected to the network interface device receive the reflected signal – (The master decoder 26 sends a signal upstream which is reflected by the network interface device and is subsequently transmitted to the slave decoders (28, 30, 32) – col. 2, lines 55-67).

Considering claim 5, Li discloses a signal distribution network for transmitting modulated signals using building wiring containing a plurality of branches comprising

a network interface device (22 – Fig. 2) that reflects network signals originating in the building wiring back into all branches of the building wiring (The signal from (26 – Fig. 2) are **reflected** to (28, 30, 32 – Fig. 2). – col. 2, lines 55-65);

at least one signal splitter (splitter reflector 24 – Fig. 2); and

a plurality of terminal devices (28, 30, 32 – Fig. 2).

Considering claim 8, Li teaches the network interface device (22 – Fig. 2) is located at the point of entry of the building wiring – col. 2, lines 15-30.

Considering claim 9, Li teaches the network interface device is frequency dependent and reflects signals by reflecting a predetermined frequency band of signals – col. 2, lines 15-20, lines 60-67.

4. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li as applied to claim 1 above, and further in view of Carhart (6622304).

Considering claim 4, Li fails to teach the claimed limitations.

In an analogous art, Carhart teaches the network interface device wherein the signal reflecting circuit comprises a splitter (31,32) with a first tap port (port connected to splitter (31) towards the bottom right splitter (32)), a second tap port (port connected to splitter (31) towards low pass filter (30)) and a common port (port connected to splitter (31) towards the top right splitter (32)), wherein the power at the first and second tap ports is coupled bi-directionally to the common port.

the common port connected to a branch of building wiring (The port connected to splitter (31) towards the top right splitter (32) is connected to splitter (32) which is connected to output port (35), which is attached to coaxial cable (23). – col. 9, lines 30-35 & lines 5-10);

a first filter (high pass filter 33 – Fig. 3) for separating bands of frequencies connected to the first tap port (High pass filter (33) is connected to splitter (32) which is connected to the first tap port in splitter (31). – col. 9, lines 51-56, col. 10, lines 8-12);

means (30-32) for reflecting signal energy connected to the first filter (col. 10, lines 6-18);

and a second filter (low pass filter 30 – Fig. 3) for separating band of frequencies connected between the second tap port and the point of entry (port 34 – Fig. 3; col. 9, lines 35-43).

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li's invention to include the above mentioned claim limitations, as taught by Carhart, for the advantage of allowing devices in a network to communicate with each other.

5. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li as applied to claim 5 above, and further in view of Manchester (6144399).

Considering claim 7, Li fails to teach the building wiring is coaxial cable.

In an analogous art, Manchester teaches wherein the building wiring consists of coaxial cable (128, 138, 150 – Fig. 1; col. 3, line 50 – col. 4, line 15) in order to use wiring which is prevalent in existing buildings.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li's invention to include the building wiring is coaxial cable, as taught by Manchester, for the advantage of using wiring which is prevalent in existing buildings.

6. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li as applied to claim 1 above, and further in view of Boesch (5,969,582).

Considering claim 2, Li fails to disclose that the signal reflecting circuit comprises a parallel resonant circuit.

In an analogous art, Boesch discloses a system in which a parallel resonant circuit is implemented to reflect the energy. The resonant frequency of a parallel resonant circuit is the frequency at which the parallel impedance is maximum, thus allowing the signal to be effectively reflected. – col. 4, lines 63-67 & col. 5, lines 1-5.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li's system to include a parallel resonant circuit in the signal reflecting circuit, as taught by Boesch, for the advantage of reflecting energy such that terminal devices could transmit/receive messages.

7. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li as applied to claim1 above, and further in view of O'Shea (4,933,745).

Considering claim 3, Li fails to disclose the network interface device wherein the signal reflecting circuit comprises a series resonant circuit.

In an analogous art, O'Shea discloses a system in which a series resonant circuit is implemented to reflect the energy. The resonant frequency of a series resonant circuit is the frequency at which the series impedance is a minimum, thus allowing the signal to be effectively reflected. - col. 5, lines 1-10

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li's system to include a series resonant circuit in the signal reflecting circuit, as taught by O'Shea, for the advantage of reflecting energy such that terminal devices could transmit/receive messages.

8. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li as applied to claim 5 above, and further in view of Langlais (6,091,932)

Considering claim 6, Li fails to disclose the signal distribution network, wherein the signal modulation is orthogonal frequency division multiplexing.

In an analogous art, Langlais discloses a transmission system in which OFDM is employed to provide increased robustness against frequency selective fading or narrowband interference. – col. 10, lines 55-58.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li's system to include orthogonal frequency division multiplexing as the desired type of signal modulation, as taught by Langlais, for the advantage of providing a more robust communication technique for distributing signals.

9. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li as applied to claim 5 above, and further in view of Margulis (2001/0021998)

Considering claim 17, Li fails to disclose that the signal distribution network uses code division multiplex for signal modulation.

In an analogous art, Margulis discloses a system in which code division multiplex is implemented – paragraph 0055, 0063, and 0070.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li's system to include code division multiplex, as taught by Margulis, for the advantage of providing high user capacity and protection from interference from other signals.

10. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li and Langlais as applied to claim 6 above, and further in view of Horton (6,788,707).

Considering claim 18, Li and Langlais fail to disclose that the terminal devices communicate with each other using time division duplex protocol.

In an analogous art, Horton discloses a cable network in which Time Division Multiple Access (TDMA) is implemented to facilitate communication in both the upstream and downstream direction – col. 4, lines 9-16.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li and Langlais' system to include TDMA, as taught by Horton, for the advantage of facilitating communications between devices wherein a single frequency supports simultaneous data channels.

11. Claims 19 & 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li as applied to claim 1/5 above, and further in view of Zelenz (4222066).

As for claim 19, Li fails to disclose wherein the signal reflecting circuit comprises an impedance mismatch.

In an analogous art, Zelenz discloses wherein the signal reflecting circuit (Fig. 3) comprises an impedance mismatch – col. 3, lines 27-32.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Li's invention to include wherein the signal reflecting circuit comprises an impedance mismatch, as taught by Zelenz, for the advantage of reflecting almost all of the incident power.

Claims 21 contain the limitations of claim 19 and is analyzed as previously discussed with respect to that claim.

12. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li and Carhart as applied to claim 4 above, and further in view of Zelenz.

Claims 20 contain the limitations of claim 19 and is analyzed as previously discussed with respect to that claim.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sumaiya A. Chowdhury whose telephone number is (571) 272-8567. The examiner can normally be reached on Mon-Fri, 9-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chris Grant can be reached on (571) 272-7292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SAC

CHRISTOPHER GRANT
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

Notice of References Cited	Application/Control No. 09/910,412	Applicant(s)/Patent Under Reexamination GURANTZ ET AL.	
	Examiner Sumaiya A. Chowdhury	Art Unit 2623	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,622,304	09-2003	Carhart, Thomas W.	725/74
*	B	US-5,726,701	03-1998	Needham, Bradford H.	725/105
*	C	US-4,222,066	09-1980	Zelenz, Martin L.	380/208
*	D	US-6,381,745	04-2002	Paul, Lawrence Marc	725/69
*	E	US-4,933,745	06-1990	O'Shea et al.	257/724
*	F	US-5,969,582	10-1999	Boesch et al.	333/129
*	G	US-6,091,932	07-2000	Langlais, Brian	725/111
*	H	US-2001/0021998	09-2001	Margulis, Neal	725/81
*	I	US-4,633,309	12-1986	Li et al.	380/242
*	J	US-6,144,399	11-2000	Manchester et al.	725/127
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
09/910,412	GURANTZ ET AL.
Examiner	**Art Unit**
Sumaiya A. Chowdhury	2623

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date
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Claim		Date
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Search Notes	Application/Control No.	Applicant(s)/Patent under Reexamination
	09/910,412	GURANTZ ET AL.
	Examiner	Art Unit
	Sumaiya A. Chowdhury	2623

SEARCHED			
Class	Subclass	Date	Examiner
725	51 54	5/3/2006	SAC

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
Consulted Hai Tran, AU 2623, Class 725	5/2/2006	SAC
Consulted Jason Salce, AU 2623, Class 725	5/2/2006	SAC
Consulted Vivek Srivastava, AU 2623, Class 725	5/2/2006	SAC
Consulted Andrew Koenig, AU 2623, Class 725	5/22/2006	SAC
Consulted Vivek Srivastava, AU 2623, Class 725	5/22/2006	SAC
Consulted Dominic Saltarelli, AU 2623, Class 725	5/23/2006	SAC
Consulted Ngoc Vu, AU 2623, Class 725	5/23/2006	**SAC**

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	0	"4633309".pn. and (coax coaxial)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/24 10:20
L2	1	(coax$3) with (building adj wiring) and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/24 10:21
L3	2	(coax$3) same (building adj wiring) and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/24 10:21
L4	166	(coax$3) same (building) and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/24 10:21
L5	73	(coax$3) with (building) and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/24 10:22
L6	13	splitter same ((coax$3) with (building)) and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/24 10:22
S2	477	"725"/$.ccls. and lan same signal	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/22 15:32
S3	89	"725"/$.ccls. and lan same (signal with computer)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/02 15:37

EAST Search History

S4	41	"725"/$.ccls. and lan same (signal same computer) same broadcast	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/02 15:38
S7	227	(signal adj reflect$3) with (impedance adj mismatch)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/03 14:18
S8	0	(signal adj reflect$3 adj circuit) with (impedance adj mismatch)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/03 14:19
S9	1	(reflect$3 adj circuit) with (impedance adj mismatch)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/03 15:53
S10	1011	(circuit) with (impedance adj mismatch)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/03 15:53
S11	1827	(reflect$3) with (impedance adj mismatch)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/03 15:54
S12	5	(reflect$3) with (impedance adj mismatch) and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/03 15:55
S13	99	725/54.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/03 17:43

EAST Search History

S14	176	725/51.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/03 17:43
S15	98	reflector and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/22 15:34
S16	8858	port same (signal with (reflect$3 mirror$3 bounc$3))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/23 12:08
S17	23	port same (signal with (reflect$3 mirror$3 bounc$3)) and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/23 12:11
S18	33	port same (signal with (reflect$3 mirror$3 bounc$3)) and "709"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/23 12:14
S19	224	port same (signal with (reflect$3 mirror$3 bounc$3)) and "370"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/23 12:16
S20	14	port same (signal with (reflect$3 mirror$3 bounc$3)) and (home adj network)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/23 14:14
S21	53	port same (signal with (reflect$3 mirror$3 bounc$3)) and (home with network)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/23 12:17

EAST Search History

S22	8	reflect$3 same (home adj network) and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/23 15:38
S23	33	reflect$3 with split$4 and "725"/$. ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/23 15:39

OIPE IAP28 APR 17 2006 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No:	09/910,412
Filed:	7/21/2001
Applicant:	Gurantz et al.
Title:	Network Interface Device and Broadband Local Area Network Using Coaxial Cable
Examiner/GAU:	Chowdhury / 2611
Date:	4/11/2006

Request for Continued Examination / Amendment / Reply

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

Dear Sir:

In response to the Office Action mailed 1/11/2006, please amend the above application as follows:

Claim amendments starting on page 2.

Drawing amendments starting on page 5.

Remarks and arguments starting on page 6.

Certificate of Mailing

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:

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

Date: 4/11/06

Signed: Michael W. Landry

Name: Michael W. Landry

Claim Amendments:

1. (Currently amended) A network interface device connected to building wiring, the building wiring comprising a point of entry and a plurality of branches connected to terminal devices, for creating a signal distribution system comprising

a first port connected to the point of entry side of a branch of the building wiring;

a second port connected to the terminal device side of a branch of the building wiring; and

a signal reflecting circuit connected between the first and second port;

wherein a signal received at the second port is reflected out the second port and wherein all terminal devices connected to the network interface device receive the reflected signal.

2. (Original) The network interface device of claim 1, wherein the signal reflecting circuit comprises a parallel resonant circuit.

3. (Original) The network interface device of claim 1, wherein the signal reflecting circuit comprises a series resonant circuit.

4. (Original) The network interface device of claim 1, wherein the signal reflecting circuit comprises

a splitter/combiner with a first tap port, a second tap port and a common port, wherein the power at the first and second tap ports is coupled bi-directionally to the common port;

the common port connected to a branch of building wiring;

a first filter for separating bands of frequencies connected to the first tap port;

means for reflecting signal energy connected to the first filter; and

a second filter for separating band of frequencies connected between the second tap port and the point of entry.

5. (Currently amended) A signal distribution network for transmitting modulated signals using building wiring containing a plurality of branches comprising

a network interface device that reflects network signals originating in the building wiring back into all branches of the building wiring;

at least one signal splitter; and

a plurality of terminal devices.

6. (Original) The signal distribution network of claim 5, wherein the signal modulation is orthogonal frequency division multiplexing.

7. (Original) The signal distribution network of claim 5, wherein the building wiring is coaxial cable.

8. (Original) The signal distribution network of claim 5, wherein the network interface device is located at the point of entry of the building wiring.

9. (Previously presented) The signal distribution network of claim 5, wherein the network interface device is frequency dependent and reflects signals by reflecting a predetermined frequency band of signals.

10. (Canceled)
11. (Canceled)
12. (Canceled)
13. (Canceled)
14. (Canceled)

15. (Canceled)

16. (Canceled)

17. (Previously presented) The signal distribution network of claim 5, wherein the signal modulation is code division multiplex.

18. (Previously presented) The signal distribution network of claim 6, further comprising a method of sharing the communication medium between terminal devices using time division duplex protocol.

19. (New) The network interface device of claim 1 wherein the signal reflecting circuit comprises an impedance mismatch.

20. (New) The network interface device of claim 4 wherein the means for reflecting signal energy produces an impedance mismatch.

21. (New) The signal distribution network of claim 5, wherein the network interface device uses an impedance mismatch to reflect the network signals.

22. (New) A network interface device connected to building wiring, the building wiring comprising a point of entry and a plurality of branches connected to terminal devices, for creating a signal distribution system consisting of

a first port connected to the point of entry side of a branch of the building wiring;

a second port connected to the terminal device side of a branch of the building wiring; and

a signal reflecting circuit connected between the first and second port;

wherein a signal received at the second port is reflected out the second port.

Drawing Amendments

Replacement drawing sheets for figures 1 to 5 (all figures) are attached. These formal drawings replace previously filed informal drawings.

Remarks/Arguments

Formal drawings are enclosed for Figs. 1 to 5 to replace previously filed informal drawings.

The substance of interview 10 Feb 2006 is that claims 1, 4, and 5 where discussed and applicant proposed to amend the claims to overcome the rejection of record. Such amendment to claims is made above and remarked below.

Claims

Claims 1-9 and 17-18 were pending in the application. Claims 1-9 and 17-18 where rejected. Claims 1 and 5 are currently amended and claims 19-21 are new. Claims 1-9 and 17-22 remain.

Rejections under 35 U.S.C. 102

The Examiner has rejected claims 1, 4-5, 7-9 under 35 U.S.C. 102(e) as being anticipated by Carhart (U.S. 6,622,304).

Claim 1 is currently amended to add the limitation wherein a signal received at the second port is reflected out the second port and wherein all terminal devices connected to the network interface device receive the reflected signal. Support for this amendment is found in the application page 9 lines 5-6, Fig. 2 and Fig. 3. This amended distinguishes the claim from the device disclosed in Carhart, which does not reflect a signal out the port from which the signal was received. Carhart only passes the signal to another port of the device. In Carhart, all devices do not receive the reflected signal because the signal does not reflect out the port that received the signal, therefore devices in the wiring branch that originated the signal do not receive the reflected signal.

Claim 5 is currently amended to add the limitation that the network interface device reflects network signals originating in the building wiring back into all branches of the building wiring. Support for this amendment is found in the application page 7 line 32 to page 8 line 9, page 9 lines 5-6, and Fig. 2. This amended distinguishes the claim from the device disclosed in Carhart, which does not reflect the

signal to all of the wiring, namely Carhart's device does not reflect the signal back to the wiring from which the signal was received.

Claim 4 depends on amended claim 1 and includes the limitations of that claim and therefore is allowable along with claim 1.

Claims 7, 8, and 9 depend on amended claim 5 and include the limitations of that claim and therefore are allowable along with claim 5.

Rejections under 35 U.S.C. 103

Claims 2, 3, 6, 17, and 18 have been rejected based on 35 USC 103(a). In view of the amendments above to base claims 1 and 5 upon which these claims depend, these dependent claims should also be allowable.

New Claims

New claims 19-21 are dependent claims and add the limitation of an impedance mismatch used for reflecting signals. Support for these claim amendments is found in the application including at page 8 line 25 and page 9 line 8.

New independent claim 22 has been added. This claim uses the closed ended term "consisting", thus limiting the claim to a two-port device. This claim is distinguished from Carhart's device, which has at least three ports.

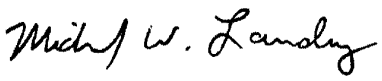
Conclusion

In view of the foregoing, claims 1 and 5 as amended distinguish the invention from Carhart. Dependent claims 2-4, 6-9, and 17-21 are allowable as depending on allowable base claims 1 and 5. Independent claim 22 is allowable as being distinguished from Carhart.

If it is felt that direct communication would serve to advance prosecution of this case, the examiner is invited to call the attorney at the below listed telephone number.

Date: 4/11/2006

Respectfully submitted,



Michael W. Landry
Attorney for Applicants
Reg. No. 38,216
5098 Seachase St.
San Diego CA 92130
858-229-6801 mlandry@iprsolutions.com

OIPE IAP28
APR 17 2006
PATENT & TRADEMARK OFFICE

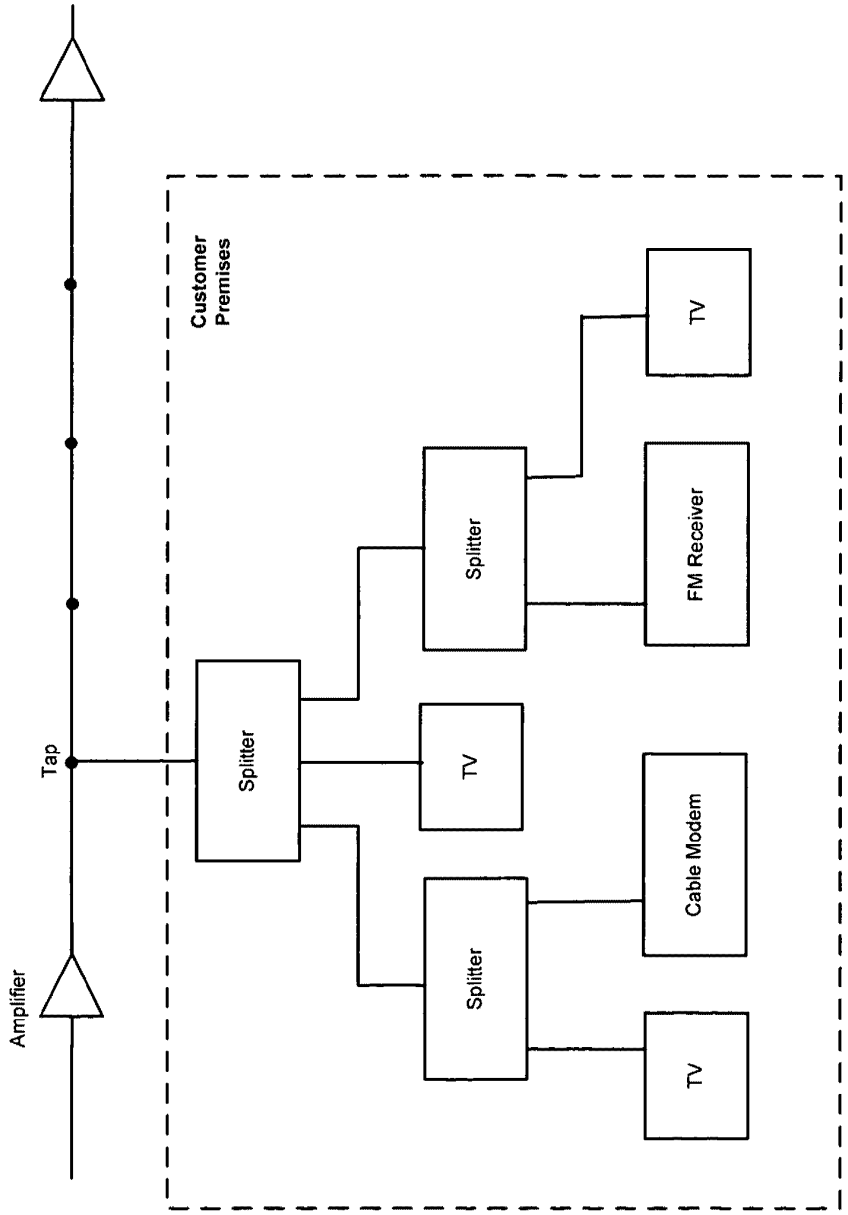
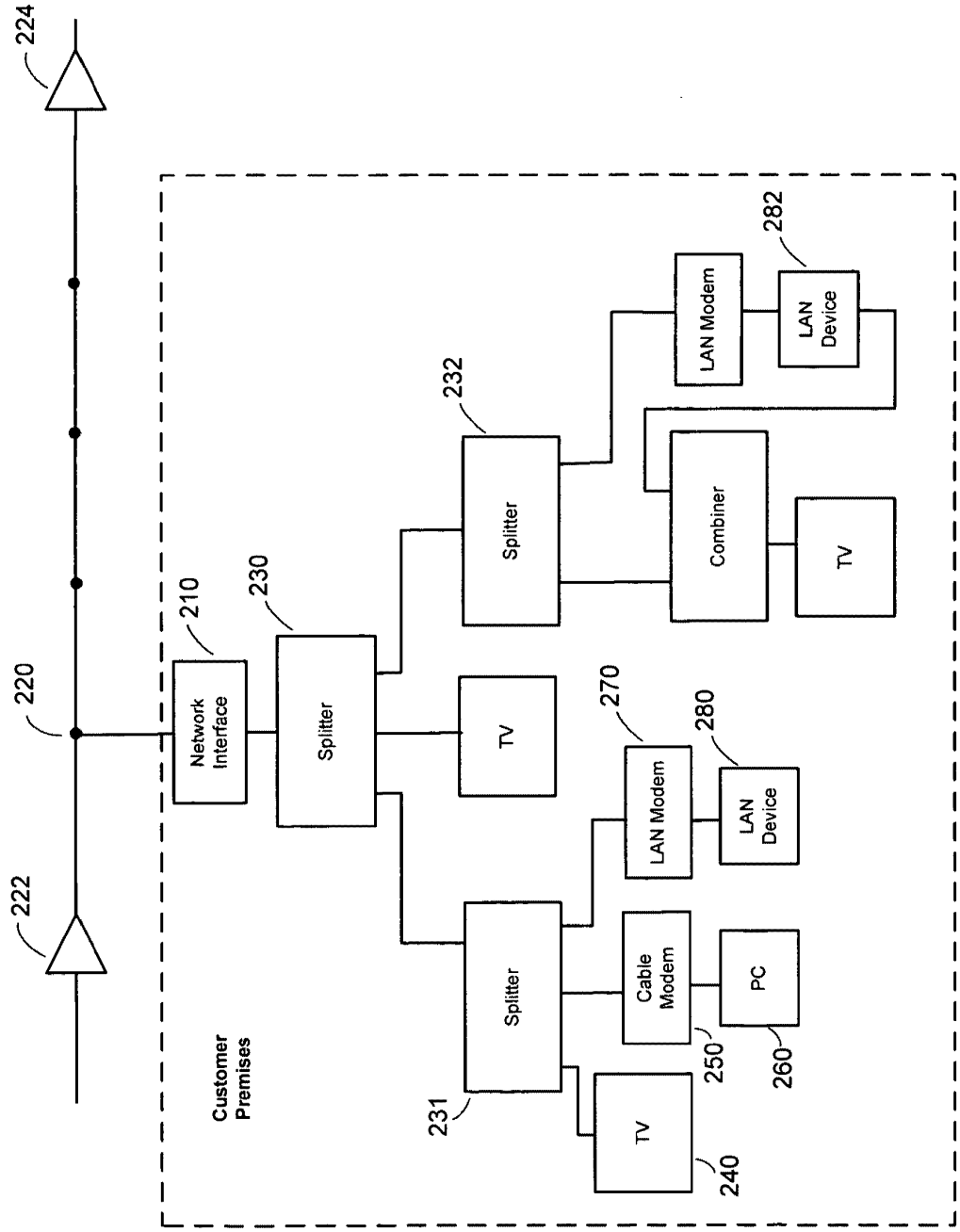


FIG. 1
Prior Art

OIPE IAP28
APR 17 2006
PATENT & TRADEMARK OFFICE

FIG. 2



OIPE IAP28
APR 17 2006
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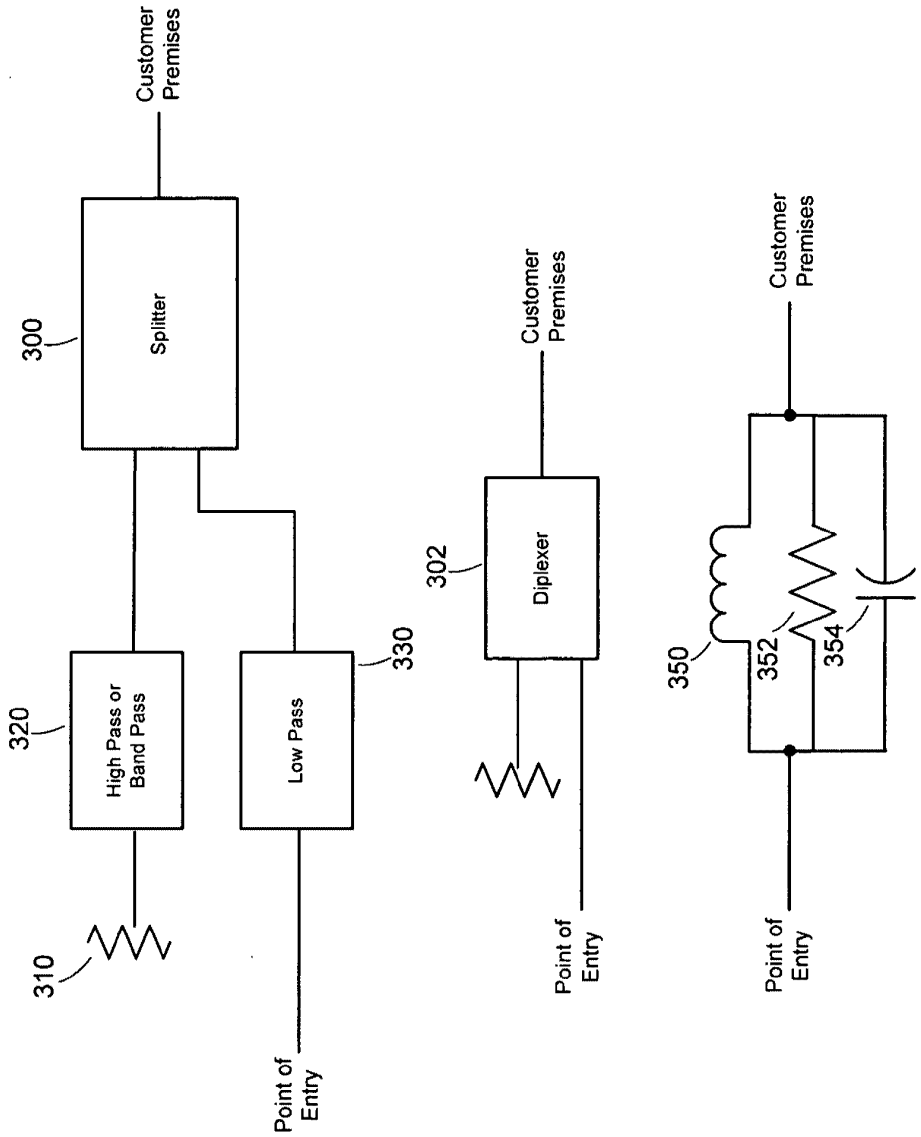

FIG. 3

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APR 17 2006
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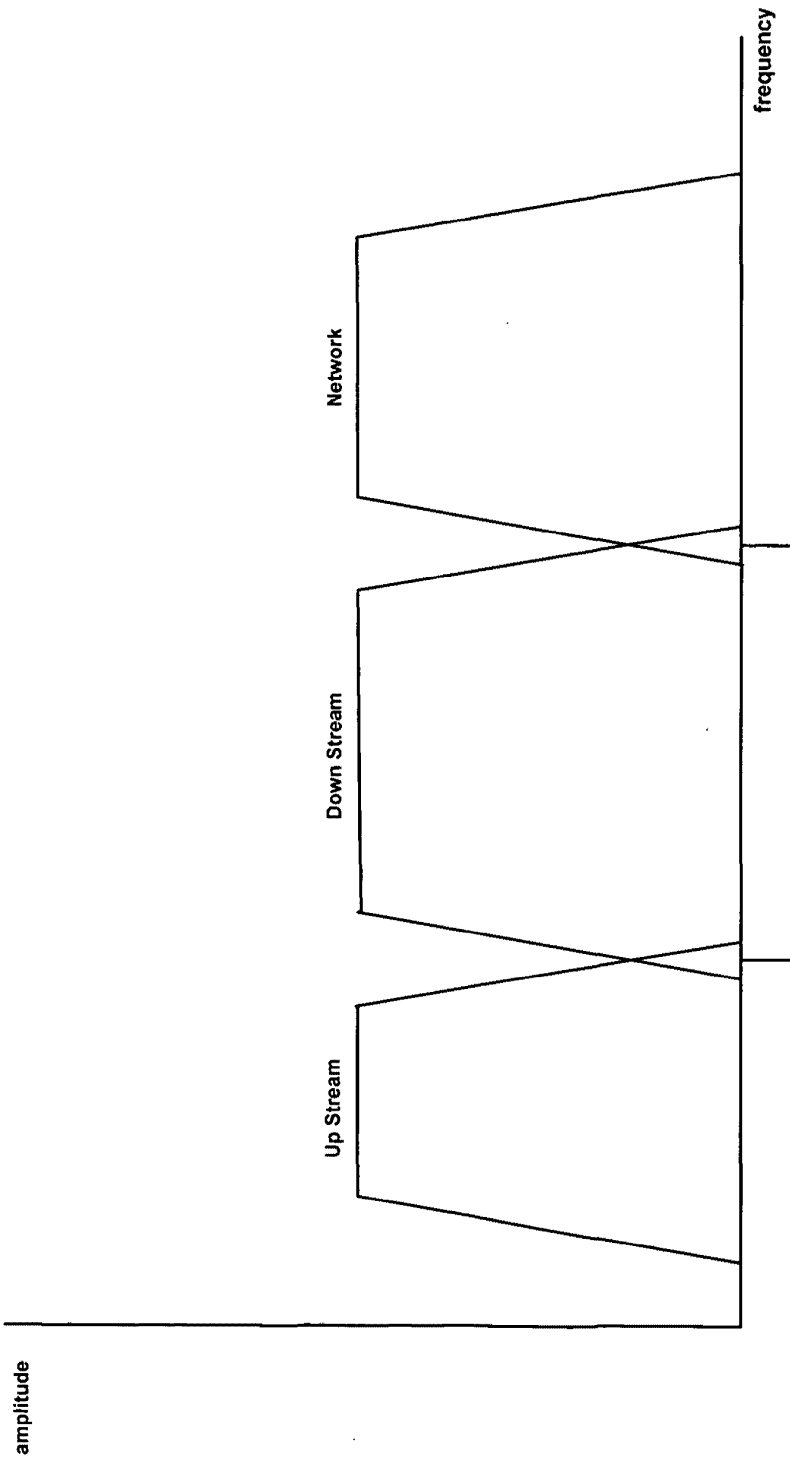

FIG. 4

OIPE IAP28 APR 17 2006 PATENT & TRADEMARK OFFICE

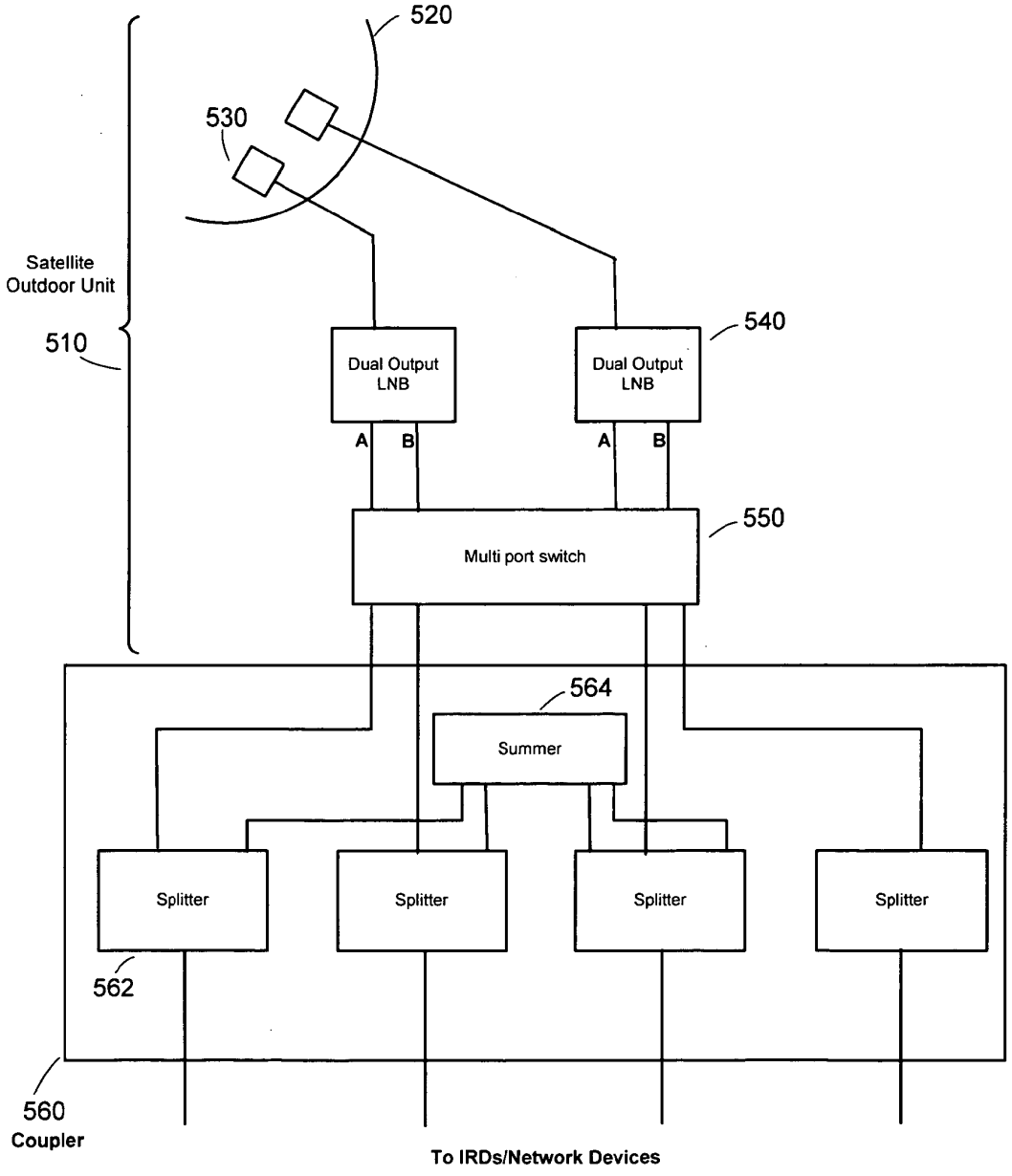

FIG. 5

RCE 12611

PTO/SB/30 (04-05)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

OIPE IAP28 APR 17 2006 PATENT & TRADEMARK OFFICE

Request for Continued Examination (RCE) Transmittal

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

Application Number	09/910,412
Filing Date	7/21/2001
First Named Inventor	Gurantz
Art Unit	2611
Examiner Name	Chowdhury
Attorney Docket Number	9202

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

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

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

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

ii. ☐ Other _____

b. ☑ Enclosed

i. ☑ Amendment/Reply

ii. ☐ Affidavit(s)/ Declaration(s)

iii. ☐ Information Disclosure Statement (IDS)

iv. ☑ Other Reply Postcard

2. Miscellaneous

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

b. ☐ Other _____

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

a. ☑ The Director is hereby authorized to charge the following fees, any underpayment of fees, or credit any overpayments, to Deposit Account No. 502165. I have enclosed a duplicate copy of this sheet.

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

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

04/18/2006 HDESTA1 00000019 09910412
01 FC:1801 790.00 OP

iii. ☐ Other _____

b. ☐ Check in the amount of $ _____ enclosed

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

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

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Signature	Michael W. Landry	Date	4/11/2006
Name (Print/Type)	Michael W. Landry	Registration No.	38,216

CERTIFICATE OF MAILING OR TRANSMISSION

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

Signature	Michael W. Landry		
Name (Print/Type)	Michael W. Landry	Date	4/11/2006

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

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

PATENT APPLICATION FEE DETERMINATION RECORD
Effective December 8, 2004

09/910,412

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS		
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	minus 20=	*
INDEPENDENT CLAIMS	minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT		☐

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

SMALL ENTITY TYPE ☐ OR OTHER THAN SMALL ENTITY

RATE	FEE		RATE	FEE
BASIC FEE	150.00	OR	BASIC FEE	300.00
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL		OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A — 10/14/05

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 11	Minus	** 20	*
Independent	* 2	Minus	*** 3	*
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY OR OTHER THAN SMALL ENTITY

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B — 4/17/06

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 15	Minus	** 20	= —
Independent	* 3	Minus	*** 3	= —
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

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

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/910,412	07/21/2001	Itzhak Gurantz	9202	2398

24244 7590 02/17/2006

MICHAEL W LANDRY
5098 SEACHASE STREET
SAN DIEGO, CA 92130

EXAMINER	
CHOWDHURY, SUMAIYA A	
ART UNIT	PAPER NUMBER
2611	

DATE MAILED: 02/17/2006

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

Interview Summary	Application No.	Applicant(s)	
	09/910,412	GURANTZ ET AL.	
	Examiner	Art Unit	
	Sumaiya A. Chowdhury	2611	

All participants (applicant, applicant's representative, PTO personnel):

(1) *Sumaiya A. Chowdhury*. (3)*Michael W. Landry*.

(2) *Chris Grant (SPE)*. (4)_____.

Date of Interview: *10 February 2006*.

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal [copy given to: 1)☐ applicant 2)☐ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: _____.

Claim(s) discussed: *1, 4, and 5*.

Identification of prior art discussed: *Carhart*.

Agreement with respect to the claims f)☒ was reached. g)☐ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *Applicant proposed to ammend the claims to overcome the rejection of record* .

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN A NON-EXTENDABLE PERIOD OF THE LONGER OF ONE MONTH OR THIRTY DAYS FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

CHRISTOPHER GRANT
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

_____
Examiner's signature, if required

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews
Paragraph (b)
In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:
- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:
1) A brief description of the nature of any exhibit shown or any demonstration conducted,
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
   (The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/910,412	07/21/2001	Itzhak Gurantz	9202	2398

24244 7590 01/11/2006

MICHAEL W LANDRY
5098 SEACHASE STREET
SAN DIEGO, CA 92130

EXAMINER	
CHOWDHURY, SUMAIYA A	
ART UNIT	PAPER NUMBER
2611	

DATE MAILED: 01/11/2006

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

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/910,412	GURANTZ ET AL.	
	Examiner	Art Unit	
	Sumaiya A. Chowdhury	2611	

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

Period for Reply

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

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

Status

1)☒ Responsive to communication(s) filed on *14 October 2005*.

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

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

Disposition of Claims

4)☒ Claim(s) *1-9,17 and 18* is/are pending in the application.

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

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9,17 and 18* is/are rejected.

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

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

Application Papers

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

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

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

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

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

Priority under 35 U.S.C. § 119

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

a)☐ All b)☐ Some * c)☐ None of:

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

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

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

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

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments filed 10/14/05 have been fully considered but they are not persuasive.

(a) Applicant argues that "**The two-port network interface reflects signals transmitted to the second port back out the same port...The signals are not passed to another output port through a filter connecting between output ports, as in Carhart**" on page 6, 2nd paragraph, of the amendment filed 10/14/05.

In response, applicant is arguing that which is not claimed.

(b) Applicant argues that "**The signal transmitted from a communication station or centralized computer does not pass back down the same wire...In Carhart's approach, signals do not reach all devices in the building wiring**" on page 6, 1st paragraph, of the amendment filed 10/14/05.

In response, applicant is arguing that which is not claimed.

(c) Applicant argues that "**Claim 1 claims a 2-port network interface device installed between the POE and the remaining building wiring with a signal reflector between the two ports. The disclosure of Carhart does not disclose a 2-port network interface device with a signal reflecting circuit connected between the port connected to the POE side of the building wiring and the port connected to**

the terminal device side of the building wiring" on page 7, 3rd paragraph, of the amendment filed 10/14/05.

In response, applicant claimed that the network interface device **comprises** a first port, a second port, and a signal reflecting circuit. Applicant did not claim that the network interface device **consists** of the above mentioned elements. Therefore it is open ended, and the Carhart reference does meet the limitations.

(d) Applicant argues that "**The plurality of branches of the building wiring in Carhart do not experience signal coupling, as in applicant's invention and claim.**" on page 7, 5th paragraph, of the amendment filed 10/14/05.

In response, Applicant's arguments with respect to claim 5 have been considered but are moot in view of the new ground(s) of rejection.

(e) Applicant argues that "**This different from Carhart's splitter/reflector, which employs coupling of signal between output ports, not signal reflecting using an impedance mismatch**" on page 8, 1st paragraph, of the amendment filed 10/14/05.

In response, applicant is arguing that which is not claimed.

(f) Applicant argues that "**Carhart does not have the frequency dependent signal coupling element located at the POE, but instead locates his signal passing circuit below the point of entry between splitter output ports**" on page 8, 4th paragraph, of the amendment filed 10/14/05.

In response, Carhart's network interface device is located at the POE and the signal passing circuit is located in the network interface device. Hence, the signal passing circuit is located at the POE.

(g) Applicant argues that "**The reflecting circuit of applicant's invention is an element that reflects the signal back to the path through which it was transmitted**" on page 9, 1st paragraph, of the amendment filed 10/14/05.

In response, applicant is arguing that which is not claimed.

(h) Applicant argues that "**the prior art references must teach or suggest all the claim limitations...Boesh does not suggest or provide motivation to apply the parallel resonant circuits to reflect signals in coaxial cable building wiring to enable communication over the wiring**" on page 9, 2nd and 3rd paragraph, of the amendment filed 10/14/05.

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

In this case, Carhart fails to disclose that the signal reflecting circuit comprises a parallel resonant circuit. Boesch was brought in to teach which a parallel resonant circuit implemented to reflect the energy. All the limitations were met by combining the two references.

(i) Applicant argues that "**it would not be obvious to combine the series resonant circuit of O'Shea with the signal interface system of Carhart**" on page 9, 4th paragraph, of the amendment filed 10/14/05.

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

In this case, Carhart fails to disclose the network interface device wherein the signal reflecting circuit comprises a series resonant circuit. O'Shea was brought in to teach a series resonant circuit implemented to reflect the energy. All the limitations were met by combining the two references.

(j) Applicant argues that "**it would not be obvious to combine the OFDM transmission system of Langlais with the signal interface system of Carhart**" on page 10, 2nd paragraph, of the amendment filed 10/14/05.

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

In this case, Carhart failed to disclose the signal distribution network, wherein the signal modulation is orthogonal frequency division multiplexing. Langlais was brought in to teach discloses a transmission system in which OFDM is employed to provide increased robustness against frequency selective fading or narrowband interference. All the limitations were met by combining the two references.

Claim Rejections - 35 USC § 102

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

A person shall be entitled to a patent unless –

> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States

only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 4-5, and 7-9, are rejected under 35 U.S.C. 102(e) as being anticipated by Carhart (6,622,304).

Considering claim 1, Carhart discloses a network interface device (splitter reflector 25 – Fig. 2) connected to building wiring (coaxial cable 23 – Fig. 2, col. 8, lines 18-22), the building wiring comprising a point of entry (coaxial cable drop 24 – Fig. 2) and a plurality of branches connected to terminal devices (communications station 22 & central computing apparatus 21 – Fig. 2) for creating a signal distribution system (system 20 - Fig. 2, col. 8, lines 55-61) comprising

a first port (port 34 – Fig. 3, col. 9, lines 30-36) connected to the point of entry side of a branch of the building wiring;

a second port (port 35 – Fig. 3, col. 9, lines 60-63) connected to the terminal device side of a branch of the building wiring;

and a signal reflecting circuit (splitter reflector 25 – Fig. 2 & 3, col. 9, lines 9-14 & lines 30-35, col. 14, lines 66-67, col. 15, lines 1-10) connected between the first and second port.

Considering claim 5, Carhart discloses a signal distribution network (system 20 – Fig. 2, col. 8, lines 55-61) for transmitting modulated signals (col. 11, lines 9-12, col. 13, lines 58-66, col. 14, lines 23-26) using building wiring (coaxial cable 23) containing a plurality of branches comprising

a network interface device (splitter reflector 25 – Fig. 2) that reflects network signals originating in the building wiring back into the building wiring (The signals from (22 – Fig. 2) are coupled and **reflected** to (21 – Fig. 2). - col. 9, lines 9-14, col. 14, lines 66-67, col. 15, lines 1-10);

at least one signal splitter (splitter reflector 25 – Fig. 2); and

a plurality of terminal devices (communications station 22 & central computing apparatus 21 – Fig. 2).

Considering claim 4, Carhart discloses the network interface device wherein the signal reflecting circuit comprises a splitter (31,32) with a first tap port (port connected to splitter (31) towards the bottom right splitter (32)), a second tap port (port connected to splitter (31) towards low pass filter (30)) and a common port (port connected to splitter (31) towards the top right splitter (32)), wherein the power at the first and second tap ports is coupled bi-directionally to the common port;

the common port connected to a branch of building wiring (The port connected to splitter (31) towards the top right splitter (32) is connected to splitter (32) which is connected to output port (35), which is attached to coaxial cable (23). – col. 9, lines 30-35 & lines 5-10);

a first filter (high pass filter 33 – Fig. 3) for separating bands of frequencies connected to the first tap port (High pass filter (33) is connected to splitter (32) which is connected to the first tap port in splitter (31). – col. 9, lines 51-56, col. 10, lines 8-12);

means (30-32) for reflecting signal energy connected to the first filter (col. 10, lines 6-18);

and a second filter (low pass filter 30 – Fig. 3) for separating band of frequencies connected between the second tap port and the point of entry (port 34 – Fig. 3; col. 9, lines 35-43).

Considering claim 7, Carhart discloses the signal distribution network, wherein the building wiring is coaxial cable (col. 8, lines 18-20 & lines 58-61).

Considering claim 8, Carhart discloses the signal distribution network, wherein the network interface device (splitter reflector 25 – Fig. 2) is located at the point of entry

(coaxial cable drop 24 – Fig. 2) of the building wiring (23 – Fig. 2, The reflector (25) is connected to the CATV System (10) through coaxial cable drop (24). The reflector (25) has an input port (34) connected to the coaxial cable drop (24) through which the CATV cable signals enter. – col. 9, lines 30-37).

Considering claim 9, Carhart discloses the signal distribution network, wherein the network interface device (splitter reflector 25 – Fig. 2) is frequency dependent and reflects signals by reflecting a predetermined frequency band of signals (The reflector (25) comprises of filters which allow signals of selected frequencies to pass through. The signals which do not comply with the cutoff frequency are **reflected**. The filters and splitters in reflector (25) are bidirectional, as can be seen in Fig. 3. As a result, signals are coupled and outputted to port (35). - col. 9, lines 30-38 & lines 60-67, col. 10, lines 3-18).

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of Boesch (5,969,582).

Considering claim 2, Carhart fails to disclose that the signal reflecting circuit comprises a parallel resonant circuit.

In an analogous art, Boesch discloses a system in which a parallel resonant circuit is implemented to reflect the energy. The resonant frequency of a parallel resonant circuit is the frequency at which the parallel impedance is maximum, thus allowing the signal to be effectively reflected. – col. 4, lines 63-67 & col. 5, lines 1-5.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include a parallel resonant circuit in the signal reflecting circuit, as taught by Boesch, for the advantage of reflecting energy such that terminal devices could transmit/receive messages.

3. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of O'Shea (4,933,745).

Considering claim 3, Carhart fails to disclose the network interface device wherein the signal reflecting circuit comprises a series resonant circuit.

In an analogous art, O'Shea discloses a system in which a series resonant circuit is implemented to reflect the energy. The resonant frequency of a series resonant circuit is the frequency at which the series impedance is a minimum, thus allowing the signal to be effectively reflected. - col. 5, lines 1-10

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include a series resonant circuit in the signal reflecting circuit, as taught by O'Shea, for the advantage of reflecting energy such that terminal devices could transmit/receive messages.

4. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of Langlais (6,091,932)

Considering claim 6, Carhart fails to disclose the signal distribution network, wherein the signal modulation is orthogonal frequency division multiplexing.

In an analogous art, Langlais discloses a transmission system in which OFDM is employed to provide increased robustness against frequency selective fading or narrowband interference. – col. 10, lines 55-58.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include orthogonal frequency division multiplexing as the desired type of signal modulation, as taught by Langlais, for the advantage of providing a more robust communication technique for distributing signals.

5. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of Margulis (2001/0021998)

Considering claim 17, Carhart fails to disclose that the signal distribution network uses code division multiplex for signal modulation.

In an analogous art, Margulis discloses a system in which code division multiplex is implemented – paragraph 0055, 0063, and 0070.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include code division multiplex, as taught by Margulis, for the advantage of providing high user capacity and protection from interference from other signals.

6. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of Langlais as applied to claim 6 above, and further in view of Horton (6,788,707).

Considering claim 18, Carhart discloses a signal distribution network wherein terminal devices communicate with each other. However, he fails to disclose that the terminal devices communicate with each other using time division duplex protocol.

In an analogous art, Horton discloses a cable network in which Time Division Multiple Access (TDMA) is implemented to facilitate communication in both the upstream and downstream direction – col. 4, lines 9-16.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include TDMA, as taught by Horton,

for the advantage of facilitating communications between devices wherein a single frequency supports simultaneous data channels.

Conclusion

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

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

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sumaiya A. Chowdhury whose telephone number is (571) 272-8567. The examiner can normally be reached on Mon-Fri, 8-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chris Grant can be reached on (571) 272-7292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SAC

CHRISTOPHER GRANT
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
09/910,412	GURANTZ ET AL.
Examiner	**Art Unit**
Sumaiya A. Chowdhury	2611

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date								
Final	Original	1/5/06								
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Search Notes

Application/Control No.	Applicant(s)/Patent under Reexamination
09/910,412	GURANTZ ET AL.
Examiner	**Art Unit**
Sumaiya A. Chowdhury	2611

SEARCHED			
Class	Subclass	Date	Examiner
725	80	1/5/2006	SAC

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
Consulted Chris Grant AU 2611, Class 725	1/4/2006	SAC

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	206	725/80.CCLS.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/01/05 14:44

OIPE IAP87
OCT 14 2005
PATENT & TRADEMARK OFFICE

2611

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No:	09/910,412
Filed:	7/21/2001
Applicant:	Gurantz et al.
Title:	Network Interface Device and Broadband Local Area Network Using Coaxial Cable
Examiner/GAU:	Chowdhury / 2611
Date:	10/12/2005

Amendment/Reply

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

Dear Sir:

In response to the Office Action mailed 7/28/2005, please amend the above application as follows:

Claim amendments starting on page 2.

Remarks and arguments starting on page 5.

Certificate of Mailing

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:

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

Date: 10/12/05

Signed: Michael W. Landry

Name: Michael W. Landry

Claim Amendments:

1. (Original) A network interface device connected to building wiring, the building wiring comprising a point of entry and a plurality of branches connected to terminal devices, for creating a signal distribution system comprising

a first port connected to the point of entry side of a branch of the building wiring;

a second port connected to the terminal device side of a branch of the building wiring; and

a signal reflecting circuit connected between the first and second port.

2. (Original) The network interface device of claim 1, wherein the signal reflecting circuit comprises a parallel resonant circuit.

3. (Original) The network interface device of claim 1, wherein the signal reflecting circuit comprises a series resonant circuit.

4. (Original) The network interface device of claim 1, wherein the signal reflecting circuit comprises

a splitter/combiner with a first tap port, a second tap port and a common port, wherein the power at the first and second tap ports is coupled bi-directionally to the common port;

the common port connected to a branch of building wiring;

a first filter for separating bands of frequencies connected to the first tap port;

means for reflecting signal energy connected to the first filter; and

a second filter for separating band of frequencies connected between the second tap port and the point of entry.

5. (Currently amended) A signal distribution network for transmitting modulated signals using building wiring containing a plurality of branches comprising

a network interface device that ~~couples~~ reflects network signals originating in the building wiring back into the building wiring;

at least one signal splitter; and

a plurality of terminal devices.

6. (Original) The signal distribution network of claim 5, wherein the signal modulation is orthogonal frequency division multiplexing.

7. (Original) The signal distribution network of claim 5, wherein the building wiring is coaxial cable.

8. (Original) The signal distribution network of claim 5, wherein the network interface device is located at the point of entry of the building wiring.

9. (Currently amended) The signal distribution network of claim 5, wherein the network interface device is frequency dependent and ~~couples~~ reflects signals by reflecting a predetermined frequency band of signals.

10. (Canceled)

11. (Cancelled)

12. (Canceled)

13. (Canceled)

14. (Canceled)

15. (Canceled)

16. (Canceled)

17. (Currently amended) The signal distribution network of claim [[12]] 5, wherein the signal modulation is code division multiplex.

18. (Currently amended) The signal distribution network of claim [[16]] 6, further comprising a method of sharing the communication medium between terminal devices using time division duplex protocol.

Remarks/Arguments

Each of the cited references has been reviewed and the rejections made to the claims have been considered.

Claims

Claims 1-18 were pending in the application. Claims 1-18 where rejected. Claims 5-9 and 17-18 are amended, claims 10-16 are canceled. Claims 1-9 and 17-18 remain. The rejection of the remaining claims is traversed.

Rejections under 35 U.S.C. 102

The Examiner has rejected claims 1, 4-5, 7-9, 11-12, and 14-15 under 35 U.S.C. 102(e) as being anticipated by Carhart (U.S. 6,622,304).

Carhart discloses a system for permitting interface between a centralized in-home computing apparatus and a plurality of remotely situated in-home communications stations. A two-way signal path is created between the centralized computing apparatus and the communications stations by the use of a frequency sensitive splitter/reflector positioned at the cable TV drop point entering the home. The splitter/reflector blocks signals from the communications stations and computing apparatus from moving into the CATV system while allowing signals from the CATV system to move through the splitter/reflector to the communications stations and computing apparatus.

It is important to note that the reflector/splitter in Carhart is at least a 3-port device or 4-port device, as shown in Fig. 3 and Fig. 4. The communications stations connect to one output port and the centralized computing apparatus connects to a separate output port. A filter (33) internal to the splitter/reflector passes in-home signals from the communications stations connected at one port to the centralized computing apparatus connected at another port. In Carhart's disclosure, each output port requires a tap or splitter (32) and a filter (33). Fig. 4 shows a 4-port device with 3 output ports that requires a 3-way coupler to pass the signal between outputs (35). The complexity of Carhart's splitter/reflector grows significantly as output ports are added.

The device in Carhart, although called "reflector", functions as a signal circulator that passes a signal from one output port through a filter (33) to another output port (col. 10, lines 12-18). In Carhart, the signal passing circuit, a high-pass or band-pass filter (33) associated with each output, is connected between splitters (32) **passing signal between two output ports.** The coupled signal passes through the filter. In Carhart, all devices that communicate with the centralized computer or each other must be connected to the reflector/splitter at the point of entry. The signal transmitted from a communication station or centralized computer **does not pass back down the same wire**, but only passes to another output port. Therefore, other devices in the same wiring branch as the transmitting device will not receive the transmitted signal. In Carhart's approach, signals do not reach all devices in the building wiring.

The network interface device of applicant's invention is a two-port device. The first port connects to the point of entry. The second port is connected to the terminal device side of the building wiring. The signal reflecting circuit is connected between the point of entry (first port) and terminal device side (second port). The terminal device side of the building is accessed through a splitter (230). **The two-port network interface reflects signals transmitted to the second port back out the same port.** The reflection is achieved by an impedance mismatch in the frequency band that is reflected. (application page 8 lines 23-31; and pages 9-10) The signals are not passed to another output port through a filter connecting between output ports, as in Carhart. This distinction is important in differentiating the approach in Carhart with the approach and claims of the applicants. Applicant's signal reflecting circuit is installed upstream from a main point of entry splitter, Carhart's signal passing is done inside his splitter. In Carhart, the centralized computing apparatus is connected to one output port; communications stations are connected to a different output port of the splitter/reflector. In Carhart, the transmitted signals are not reflected back down the same wire.

In applicants' invention, any node connected to the building wiring can communicate with any other node. All nodes transmit signals toward the network interface device at the point of entry, the network interface device reflects those signals back to all wiring branches of the building wiring including the wire originating the transmission. Any signal transmitted up any wiring branch is reflected back down all wiring branches. Resulting from the true reflecting nature of applicant's device, any node connected in the building wiring, even through a second level splitter, for example splitter 231 in Fig.

2, can transmit signals to and receive from any other node in any branch of the wiring, including nodes in the same branch as the transmitting node. Because applicant's reflecting network interface device is a two-port device that can be inserted in-line ahead of the point of entry splitter, no splitters in the wiring need to be replaced. In Carhart's approach, the conventional point of entry splitter must be replaced and have sufficient ports to allow connection of all the nodes.

As shown in Fig. 2 of the present application, the splitter 230 can be an N-way splitter without added complexity of the network interface 210. The complexity of Carhart's splitter/reflector grows significantly as the number of output ports increases, as shown in his Fig. 3 and 4.

Claim 1 claims a 2-port network interface device installed between the point of entry and the remaining building wiring with a signal reflector between the two ports. The disclosure of Carhart does not disclose a 2-port network interface with a signal reflecting circuit connected between the port connected to the point of entry side of building wiring and the port connected to the terminal device side of the building wiring. Carhart discloses at least a 3-port device with a signal passing circuit connected between two output ports.

Applicant believes that Claim 1 is patentable over Carhart and allowance is respectfully requested.

Regarding claim 5, amended to replace "couples" with reflects, the splitter reflector 25 of Carhart does not reflect network signals originating in the building wiring back into the building wiring, as described above, but instead Carhart passes a signal from one port to another port and does not couple the signal back into the wiring branch used to transmit the signal to the splitter/reflector. The plurality of branches of the building wiring in Carhart do not experience signal coupling, as in applicant's invention and claim. Applicant believes that Claim 5 is patentable over Carhart and allowance is respectfully requested.

Claim 11 is canceled.

Regarding claim 4, in light of the arguments of claim 1 upon which this claim depends, claim 4 should be allowable. Further, a limiting element "means for reflecting signal energy connected to the first

filter" is described in the specification at page 8 line 25 and in Fig. 3 as an impedance mismatch 310. This different from Carhart's splitter/reflector, which employs coupling of signal between output ports, not signal reflecting using an impedance mismatch. Applicant believes that Claim 4 is patentable over Carhart and allowance is respectfully requested

Regarding claim 7, in light of the arguments of claim 5 upon which this claims depend, claim 7 should be allowable.

Claim 14 is canceled.

Regarding claim 8 and 9, in light of the arguments of claim 5 upon which these claims depend, claim 8 and 9 should be allowable. Additionally, claim 8 contains the limitation that "the network interface device is located at the point of entry of the building wiring". This limitation distinguishes this claim from the disclosure in Carhart because Carhart does not have the frequency dependent signal coupling element located at the point of entry, but instead locates his signal passing circuit below the point of entry and between splitter output ports. As discussed above, the location of the reflection is critical to achieving the objective of transmitting modulated signals using building wiring; without the reflection occurring at the point of entry, not all wiring branches receive the signals transmitted from within the building wiring. The reflection at the point of entry can be generated by applicant's device physically located external to the point of entry. (Application page 7 line 27 to page 8 line 4) Carhart requires a new splitter device, applicant's approach does not. Claim 9 has been amended to replace "couples" with reflects for consistency with the amendment to claim 5. Applicant believes that claims 8 and 9 are patentable over Carhart and allowance is respectfully requested.

Claim 12 has been canceled.

Claim 15 has been canceled.

Rejections under 35 U.S.C. 103

Regarding claim 2, rejected as being unpatentable over Carhart in view of Boesch (5,969,582), in light of the arguments of claim 1 upon which this claim depends, claim 2 should be allowable. Further, it would not be obvious to combine the parallel resonant circuit of Boesch with the signal reflecting circuit of Carhart. As discussed above, the signal "reflecting" aspect of Carhart is actually a signal passing element, where the signal passes from one port to another through a frequency selective filter. The reflecting element of applicant's invention is an element that reflects the signal back to the path through which it was transmitted. Boesch discloses a parallel resonant circuit to reflect energy for the purpose of impedance matching and blocking the transmission of power in a signal path. The teaching in Boesch is not to reflect energy to couple a signal through a network of wiring, as in the applicant's invention.

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). See MPEP section 2143.

In the present case, there is no suggestion or motivation in the references or in the knowledge generally to modify the references or combine the teachings. Boesch does not suggest or provide motivation to apply the parallel resonant circuits to reflect signals in coaxial cable building wiring to enable communication over the wiring.

Regarding claim 3, rejected as being unpatentable over Carhart in view of O'shea (4,933,745), in light of the arguments of claim 1 upon which this claim depends, claim 3 should be allowable. Further, it would not be obvious to combine the series resonant circuit of O'Shea with the signal interface system of Carhart. O'Shea teaches using a series resonant circuit for the purpose of creating an RF switch,

where diode biasing controls the creation of an open circuit or a short. O'Shea does not suggest or provide motivation to apply the parallel resonant circuits to reflect signals in coaxial cable building wiring to enable communication over the wiring.

Regarding claims 6, rejected as being unpatentable over Carhart in view of Langlais (6,091,932), in light of the arguments of claim 5 upon which this claim depends, claims 6 should be allowable. Further, it would not be obvious to combine the OFDM transmission system of Langlais with the signal interface system of Carhart. Langlais teaches a two-way point to multipoint transmission system using OFDM to establish communication between one upstream unit and a plurality of downstream units. Langlais does not teach communication between the down stream units. The communication path formed by the interface system of Carhart does not result in frequency selective fading due to multipath. Carhart teaches coupling the signal from one device through the splitter to another device. Carhart uses low loss coupling that results in a high signal level coupled to other ports. No electrical signal reflections are created where a multipath signal with delay and amplitude difference relative to the main signal is created. The network formed by the applicant's invention produces a true signal reflection that passes back down the same cable where the signal originated. This creates a multipath condition and frequency. See application page 12 lines 24 – 31. There is no motivation in Carhart or Langlais to apply the teaching of Langlais because there is no problem identified in Carhart of frequency selective fading.

Claims 13 and 16 have been canceled.

Claim 10 has been canceled.

Claim 17 has been amended to depend on claim 5. In light of the arguments to claim 5 above, upon which this claim depends, claim 17 should be allowable.

Claim 18 has been amended to depend on claim 6. In light of the arguments to claim 5 and 6 above, upon which this claim depends, claim 18 should be allowable.

Conclusion

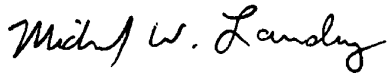
In view of the foregoing, claims 1-4 are in condition for allowance, and claims 5-9 and claims 17-18 as amended are in condition for allowance and such action is respectfully requested.

In the event that the arguments above are not persuasive, applicant requests an interview with the examiner. Attached is form PTOL-413A – Applicant initiated interview request.

If it is felt that direct communication would serve to advance prosecution of this case, the examiner is invited to call the attorney at the below listed telephone number.

Date: 10/12/2005

Respectfully submitted,



Michael W. Landry
Attorney for Applicants
Reg. No. 38,216
5098 Seachase St.
San Diego CA 92130
858-229-6801
mlandry@iprsolutions.com

OIPE IAP87
OCT 14 2005
PATENT & TRADEMARK OFFICE

PTOL-413A (09-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Applicant Initiated Interview Request Form

Application No.: 09/910,412 First Named Applicant: Gurantz
Examiner: Sumaiya Chowdhury Art Unit: 2611 Status of Application: Pending, non-final rejection

Tentative Participants:
(1) Examiner (2) _____
(3) Applicant's attorney (4) _____

Proposed Date of Interview: As arranged with examiner **Proposed Time:** 8:00 am PST **(AM/PM)**

Type of Interview Requested:
(1) ☑ **Telephonic** (2) ☐ **Personal** (3) ☐ **Video Conference**

Exhibit To Be Shown or Demonstrated: ☐ **YES** ☑ **NO**
If yes, provide brief description: _____

Issues To Be Discussed

Issues (Rej., Obj., etc)	Claims/ Fig. #s	Prior Art	Discussed	Agreed	Not Agreed
(1) Rej.	1-4	Carhart	[ ]	[ ]	[ ]
(2) Rej.	5-9,17-18	Carhart/others	[ ]	[ ]	[ ]
(3)			[ ]	[ ]	[ ]
(4)			[ ]	[ ]	[ ]

[ ] Continuation Sheet Attached

Brief Description of Arguments to be Presented:

(1) Arguments traverse rejections, claims are not anticipated by Carhart and are allowable.

(2) Amendments and arguments, claims are not anticipated/obvious by Carhart and others.

An interview was conducted on the above-identified application on _____.
NOTE: This form should be completed by applicant and submitted to the examiner in advance of the interview (see MPEP § 713.01).
This application will not be delayed from issue because of applicant's failure to submit a written record of this interview. Therefore, applicant is advised to file a statement of the substance of this interview (37 CFR 1.133(b)) as soon as possible.

Applicant/Applicant's Representative Signature

Examiner/SPE Signature

Michael W. Landry
Typed/Printed Name of Applicant or Representative

38,216
Registration Number, if applicable

This collection of information is required by 37 CFR 1.133. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 21 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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

PATENT APPLICATION FEE DETERMINATION RECORD

Effective December 8, 2004

09/910,412

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS		
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	minus 20=	*
INDEPENDENT CLAIMS	minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT		☐

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

SMALL ENTITY TYPE ☐			OR	OTHER THAN SMALL ENTITY	
RATE	FEE			RATE	FEE
BASIC FEE	150.00		OR	BASIC FEE	300.00
X$ 25=			OR	X$50=	
X100=			OR	X200=	
+180=			OR	+360=	
TOTAL			OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A	(Column 1)		(Column 2)	(Column 3)
10/14/05	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	* 11	Minus	** 20	= /
Independent	* 2	Minus	*** 3	= /
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY			OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE			RATE	ADDITIONAL FEE
X$ 25=			OR	X$50=	
X100=			OR	X200=	
+180=			OR	+360=	
TOTAL ADDIT. FEE			OR	TOTAL ADDIT. FEE	

AMENDMENT B	(Column 1)		(Column 2)	(Column 3)
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C	(Column 1)		(Column 2)	(Column 3)
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
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X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

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

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/910,412	07/21/2001	Itzhak Gurantz	9202	2398

24244 7590 07/28/2005

MICHAEL W LANDRY
5098 SEACHASE STREET
SAN DIEGO, CA 92130

EXAMINER	
CHOWDHURY, SUMAIYA A	
ART UNIT	**PAPER NUMBER**
2611	

DATE MAILED: 07/28/2005

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

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/910,412	GURANTZ ET AL.	
	Examiner	Art Unit	
	Sumaiya A. Chowdhury	2611	

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

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

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

Disposition of Claims

4)☒ Claim(s) 1-18 is/are pending in the application.

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

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-18 is/are rejected.

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

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

Application Papers

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

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

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

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

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

Priority under 35 U.S.C. § 119

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

a)☐ All b)☐ Some * c)☐ None of:

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

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

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

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

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

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

A person shall be entitled to a patent unless –

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

Claims 1, 4-5, 7-9, 11-12, and 14-15 are rejected under 35 U.S.C. 102(e) as being anticipated by Carhart (6,622,304).

Considering claim 1, Carhart discloses a network interface device (splitter reflector 25 – Fig. 2) connected to building wiring (coaxial cable 23 – Fig. 2, col. 8, lines 18-22), the building wiring comprising a point of entry (coaxial cable drop 24 – Fig. 2) and a plurality of branches connected to terminal devices (communications station 22 & central computing apparatus 21 – Fig. 2) for creating a signal distribution system (system 20 - Fig. 2, col. 8, lines 55-61) comprising

a first port (port 34 – Fig. 3, col. 9, lines 30-36) connected to the point of entry side of a branch of the building wiring;

a second port (port 35 – Fig. 3, col. 9, lines 60-63) connected to the terminal device side of a branch of the building wiring;

and a signal reflecting circuit (splitter reflector 25 – Fig. 2 & 3, col. 9, lines 9-14 & lines 30-35, col. 14, lines 66-67, col. 15, lines 1-10) connected between the first and second port.

Considering claim 5, Carhart discloses a signal distribution network (system 20 – Fig. 2, col. 8, lines 55-61) for transmitting modulated signals (col. 11, lines 9-12, col. 13, lines 58-66, col. 14, lines 23-26) using building wiring (coaxial cable 23) containing a plurality of branches comprising

a network interface device (splitter reflector 25 – Fig. 2) that couples network signals originating in the building wiring back into the building wiring (col. 9, lines 9-14, col. 14, lines 66-67, col. 15, lines 1-10);

at least one signal splitter (splitter reflector 25 – Fig. 2); and

a plurality of terminal devices (communications station 22 & central computing apparatus 21 – Fig. 2).

Considering claim 11, Carhart discloses a signal distribution network for transmitting modulated signals (col. 11, lines 9-17, col. 13, lines 58-66, col. 14, lines 23-26) using building wiring (coaxial cable 23 – Fig. 2) comprising

at least one signal splitter (splitter reflector 25 – Fig. 2); and

at least one frequency dependent signal coupling element (high pass filter 33 – Fig. 3) connected to a signal splitter (splitter 32 – Fig. 3; The high pass filter (33) is frequency dependent, allowing only signals over a selected cutoff frequency to pass through; - col. 10, lines 8-15); and

a plurality of terminal devices (communications station 22 & central computing apparatus 21 – Fig. 2) connected to signal splitters (col. 9, lines 5-15).

Considering claim 4, Carhart discloses the network interface device wherein the signal reflecting circuit comprises a splitter (31,32) with a first tap port (port connected to splitter (31) towards the bottom right splitter (32)), a second tap port (port connected to splitter (31) towards low pass filter (30)) and a common port (port connected to splitter (31) towards the top right splitter (32)), wherein the power at the first and second tap ports is coupled bi-directionally to the common port;

the common port connected to a branch of building wiring (The port connected to splitter (31) towards the top right splitter (32) is connected to splitter (32) which is connected to output port (35), which is attached to coaxial cable (23). – col. 9, lines 30-35 & lines 5-10);

a first filter (high pass filter 33 – Fig. 3) for separating bands of frequencies connected to the first tap port (High pass filter (33) is connected to splitter (32) which is connected to the first tap port in splitter (31). – col. 9, lines 51-56, col. 10, lines 8-12);

means (30-32) for reflecting signal energy connected to the first filter (col. 10, lines 6-18);

and a second filter (low pass filter 30 – Fig. 3) for separating band of frequencies connected between the second tap port and the point of entry (port 34 – Fig. 3; col. 9, lines 35-43).

Considering claims 7 and 14, Carhart discloses the signal distribution network, wherein the building wiring is coaxial cable (col. 8, lines 18-20 & lines 58-61).

Considering claim 8, Carhart discloses the signal distribution network, wherein the network interface device (splitter reflector 25 – Fig. 2) is located at the point of entry (coaxial cable drop 24 – Fig. 2) of the building wiring (23 – Fig. 2, The reflector (25) is

connected to the CATV System (10) through coaxial cable drop (24). The reflector (25) has an input port (34) connected to the coaxial cable drop (24) through which the CATV cable signals enter. – col. 9, lines 30-37).

Considering claim 9, Carhart discloses the signal distribution network, wherein the network interface device (splitter reflector 25 – Fig. 2) is frequency dependent and couples signals by reflecting a predetermined frequency band of signals (The reflector (25) comprises of filters which allow signals of selected frequencies to pass through. The signals which do not comply with the cutoff frequency are reflected. The filters and splitters in reflector (25) are bidirectional, as can be seen in Fig. 3. As a result, signals are coupled and outputted to port (35). - col. 9, lines 30-38 & lines 60-67, col. 10, lines 3-18).

Considering claim 12, Carhart discloses the signal distribution network, wherein the frequency dependent signal coupling element (high pass filter 33) reflects a predetermined frequency band of signals (The high pass filter (33) is frequency dependent, reflecting signals below a selected cutoff frequency; - col. 10, lines 8-15).

Considering claim 15, Carhart discloses the signal distribution network, wherein the frequency dependent signal coupling element is located at the point of entry of the building wiring (High pass filter (33) is located in reflector (25) which is located at the

point of entry of the building wiring where signals from the CATV system are received. – col. 9, lines 30-36)

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of Boesch (5,969,582).

Considering claim 2, Carhart fails to disclose that the signal reflecting circuit comprises a parallel resonant circuit.

In an analogous art, Boesch discloses a system in which a parallel resonant circuit is implemented to reflect the energy. The resonant frequency of a parallel resonant circuit is the frequency at which the parallel impedance is maximum, thus allowing the signal to be effectively reflected. – col. 4, lines 63-67 & col. 5, lines 1-5.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include a parallel resonant circuit in

the signal reflecting circuit, as taught by Boesch, for the advantage of reflecting energy such that terminal devices could transmit/receive messages.

3. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of O'Shea (4,933,745).

Considering claim 3, Carhart fails to disclose the network interface device wherein the signal reflecting circuit comprises a series resonant circuit.

In an analogous art, O'Shea discloses a system in which a series resonant circuit is implemented to reflect the energy. The resonant frequency of a series resonant circuit is the frequency at which the series impedance is a minimum, thus allowing the signal to be effectively reflected. - col. 5, lines 1-10

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include a series resonant circuit in the signal reflecting circuit, as taught by O'Shea, for the advantage of reflecting energy such that terminal devices could transmit/receive messages.

4. Claims 6, 13, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of Langlais (6,091,932)

Considering claims 6, 13 and 16, Carhart fails to disclose the signal distribution network, wherein the signal modulation is orthogonal frequency division multiplexing.

In an analogous art, Langlais discloses a transmission system in which OFDM is employed to provide increased robustness against frequency selective fading or narrowband interference. – col. 10, lines 55-58.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include orthogonal frequency division multiplexing as the desired type of signal modulation, as taught by Langlais, for the advantage of providing a more robust communication technique for distributing signals.

5. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of Paul (6,381,745).

Considering claim 10, Carhart discloses the signal distribution network, wherein the network interface device is direction dependent and couples signals by power summing signals from at least two branches (The network interface device (25) is direction dependent and couples signals. For instance in Fig. 3, the signal outputted onto port 35 could be a signal coupled from high pass filter (33) and splitter (31) – col. 9, lines 51-58). However, Carhart fails to disclose that the signals are coupled by a power summer.

In an analogous art, Paul discloses a system in which a combiner (113 – Fig. 1) which combines at least two signals is applied to provide the advantage of supplying a single composite output signal – col. 4, lines 19-35.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include a combiner which combines at least two signals, as taught by Paul, for the advantage of supplying a single composite output signal.

6. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of Margulis (2001/0021998)

Considering claim 17, Carhart fails to disclose that the signal distribution network uses code division multiplex for signal modulation.

In an analogous art, Margulis discloses a system in which code division multiplex is implemented – paragraph 0055, 0063, and 0070.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include code division multiplex, as taught by Margulis, for the advantage of providing high user capacity and protection from interference from other signals.

7. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Carhart in view of Langlais as applied to claim 16 above, and further in view of Horton (6,788,707).

Considering claim 18, Carhart discloses a signal distribution network wherein terminal devices communicate with each other. However, he fails to disclose that the terminal devices communicate with each other using time division duplex protocol.

In an analogous art, Horton discloses a cable network in which Time Division Multiple Access (TDMA) is implemented to facilitate communication in both the upstream and downstream direction – col. 4, lines 9-16.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Carhart's system to include TDMA, as taught by Horton, for the advantage of facilitating communications between devices wherein a single frequency supports simultaneous data channels.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sumaiya A. Chowdhury whose telephone number is (571) 272-8567. The examiner can normally be reached on Mon-Fri, 8-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chris Grant can be reached on (571) 272-7292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SAC

CHRISTOPHER GRANT
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

Notice of References Cited	Application/Control No. 09/910,412	Applicant(s)/Patent Under Reexamination GURANTZ ET AL.	
	Examiner Sumaiya A. Chowdhury	Art Unit 2611	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-6,622,304	09-2003	Carhart, Thomas W.	725/74
	B	US-5,969,582	10-1999	Boesch et al.	333/129
	C	US-4,933,745	06-1990	O'Shea et al.	257/724
	D	US-6,091,932	07-2000	Langlais, Brian	725/111
	E	US-6,788,707	09-2004	Horton et al.	370/474
	F	US-2001/0021998	09-2001	Margulis, Neal	725/81
	G	US-6,381,745	04-2002	Paul, Lawrence Marc	725/69
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
09/910,412	GURANTZ ET AL.
Examiner	**Art Unit**
Sumaiya A. Chowdhury	2611

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date
Final	Original	7/13/05
	1	√
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Claim		Date
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WASHINGTON, D.C. 20231
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Bib Data Sheet

CONFIRMATION NO. 2398

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/910,412	07/21/2001 RULE	725	2611	9202

APPLICANTS

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Ladd Eiwardani, La Jolla, CA;
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Brett Bernath, San Diego, CA;
Magnus Berggren, San Diego, CA;

** CONTINUING DATA **********

THIS APPLN CLAIMS BENEFIT OF 60/288,967 05/04/2001 SAC

** FOREIGN APPLICATIONS **********

NONE SAC

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** SMALL ENTITY **
** 09/06/2001

Foreign Priority claimed	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ yes ☒ no	CA	5	18	3

35 USC 119 (a-d) conditions met ☐ yes ☒ no ☐ Met after Allowance

Verified and Acknowledged Examiner's Signature SAC Initials

ADDRESS

24244

TITLE

Network interface device and broadband local area network using coaxial cable

FILING FEE RECEIVED	FEES: Authority has been given in Paper	
355	No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

1

Search Notes

Application/Control No.	Applicant(s)/Patent under Reexamination	
09/910,412	GURANTZ ET AL.	
Examiner	**Art Unit**	
Sumaiya A. Chowdhury	2611	

SEARCHED			
Class	Subclass	Date	Examiner
725	51, 54, 80	7/13/2005	SAC

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
Consulted Reuben Brown Class 725, AU 2611	7/8/2005	SAC
Consulted Chris Grant Class 725, AU 2611	7/8/2005	SAC
Consulted Son Huynh Class 725, AU 2611	7/12/2005	SAC
Consulted Vivek Srivastava Class 725, AU 2611	7/12/2005	SAC

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L16	1	"6788707".pn. and (tdma tdd (time division)) and (client terminal user subscriber device)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/14 09:28
L15	2	"6788707".pn. and (tdma tdd)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/14 09:27
L13	2	"6788707".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/14 09:27
L14	0	((tdma tdd (time adj division)) same (device terminal communicat$5 client$2)) and @rlad<"20010504" and "6788707".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/14 09:26
L12	159	((tdma tdd (time adj division)) same (device terminal communicat$5 client$2)) and @rlad<"20010504" and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/14 09:26
L11	6993	((tdma tdd (time adj division)) same (device terminal communicat$5 client$2)) and @rlad<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/14 09:19
L7	9419	(tdma tdd (time adj division)) and @rlad<"20010504" and (shar$3 common)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/14 09:16
L6	12418	(tdma tdd (time adj division)) and @rlad<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/14 09:14

L5	1	"910412".ap. and (time adj division)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/14 09:13
L4	5	"910412".ap.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/14 09:07
L2	0	"910412".ap. and (time adj division)	USPAT	OR	ON	2005/07/14 09:06
L1	3	"910412".ap.	USPAT	OR	ON	2005/07/14 09:06
S182	1	"6167061".pn. and (time adj division)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 17:19
S181	0	"6167061".pn. and tdm	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 17:13
S180	2	"6167061".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 17:13
S179	32	S177 and S178 and @rlad<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 17:13
S178	11314	"725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 17:08
S177	12936	time adj division adj multiplex	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 17:08

S176	4	tdd and "725"/$.ccls. and @rlad<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 16:58
S175	20	tdd and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 16:58
S174	5	S173 and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 16:57
S173	929	((tdd or (time adj division adj duplex)) same (communicat$5 shar$4 transmit$3 receiv$3 device$2)) and @rlad<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 16:56
S172	153	((tdd or (time adj division adj duplex)) same shar$3) and @rlad<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 16:56
S171	1172	(tdd or (time adj division adj duplex)) and @rlad<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 16:51
S169	13350	(tdd or (time adj division adj duplex))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 16:50
S168	1	"910412".ap. and (power with sum$4)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 16:03

S167	1	"910412".ap. and power	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 16:02
S166	5	"910412".ap.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 16:02
S165	274	(reflect$4 same (series adj resonan$4)) and @ay<"20010504" and (signal energy)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 15:12
S164	305	(reflect$4 same (series adj resonan$4)) and @ay<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 15:12
S163	649	(reflect$4 same (series adj resonan$4))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 15:11
S162	13	(reflect$4 same (series adj resonan$4)) with energy and @ay<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 15:10
S161	26	(reflect$4 same (series adj resonan$4)) with energy	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/13 15:05
S157	61	(time adj division) and S129 and @ay<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 16:50

S156	61	(time adj division) and S129	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 16:49
S155	0	"6622304".pn. and (time adj division)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 16:49
S128	2	"6622304".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 16:48
S154	0	S151 and "725"/$.ccls. and @ay>"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 16:20
S152	68	S151 and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 16:19
S151	46203	resonan$3 adj circuit	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 16:18
S150	25	S129 and (code adj division adj multipl$2) and @ay<"20010504"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 15:48
S149	25	S129 and (code adj division adj multipl$2)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 15:48

S147	1	S134 and (coupling coupled)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 15:47
S148	1	S134 and (third adj frequency)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 15:44
S146	1	S134 and (coupl$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 15:43
S145	1	S134 and (coupl$3 same splitter)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 15:38
S144	2	S134 and "23"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 15:24
S143	1	S134 and sum$4	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 15:11
S142	1	S134 and power	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 15:07
S140	2	S134 and ("25" same frequency)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 15:04

S131	8	S129 and (resonan$5 adj1 circuit)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 13:51
S130	8	S129 and (resonan$2 adj1 circuit)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 13:48
S129	767	725/74-85.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 13:40
S127	93	("4847829").URPN.	USPAT	OR	ON	2005/07/12 09:13
S126	13	("4564940" | "4675866" | "4686698" | "4710917" | "4716585" | "4814869" | "4847829" | "4885747" | "4893326" | "4935924" | "4977449" | "5014267" | "5341374").PN.	US-PGPUB; USPAT; USOCR	OR	ON	2005/07/12 09:04
S125	2	"5534914".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 09:00
S124	1	"5901340".pn. and (parallel series)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 09:00
S112	2	"5901340".pn. and (frequency coupl$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 16:24
S123	1	"5488413".pn. and cdma and interference and capacity	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 15:44

S122	1	"5488413".pn. and cdma	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 15:43
S120	16	"725"/$.ccls. and (cdma same interference) and capacity and @ay<"2001"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 15:19
S119	40	"725"/$.ccls. and (cdma and interference and capacity) and @ay<"2001"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 15:19
S118	4	"725"/$.ccls. and (cdma same interference same capacity) and @ay<"2001"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 15:18
S117	90	"725"/$.ccls. and cdma and @ay<"2001"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 15:15
S116	11306	"725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 15:14
S115	1	"5901340".pn. and ("100" same frequency)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 15:14
S114	1	"5901340".pn. and ("100")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 14:53

S113	1	"5901340".pn. and (frequency same coupl$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 14:49
S111	2	"6091932".pn. and ofdm	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 14:34
S110	11	"725"/$.ccls. and (ofdm same interference) and @ay<"2001"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 13:32
S109	22	"725"/$.ccls. and (ofdm and interference) and @ay<"2001"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 13:24
S108	34	"725"/$.ccls. and (ofdm) and @ay<"2001"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 13:23
S107	90	"725"/$.ccls. and (ofdm)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 13:02
S95	1	"5901340".pn. and (frequency same couple$2)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 12:50
S94	2	"5901340".pn. and (frequency couple$2)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 12:41

S93	1	"5901340".pn. and "frequency"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 12:41
S92	1	"5901340".pn. and "50"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 12:36
S91	1	"5901340".pn. and "38"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 12:31
S90	2	"5901340".pn. and (coaxial)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 12:27
S89	2	"5901340".pn. and (couple$2)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 12:17
S88	1	"5901340".pn. and (modulat$2)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 11:49
S87	1	"5901340".pn. and (capacitor inductor resistor)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 10:54
S86	1	"5901340".pn. and (parallel series)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 10:33

S85	2	"5901340".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 10:30
S84	1	S79 AND modulate$2 and (couple$2 combine$2) and splitter	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 10:30
S83	0	S78 AND modulate$2 and (couple$2 combine$2) and splitter	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 09:36
S82	0	S77 AND modulate$2 and (couple$2 combine$2) and splitter	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 09:35
S81	1	S76 AND modulate$2 and (couple$2 combine$2) and splitter	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 09:35
S80	1	S75 AND modulate$2 and (couple$2 combine$2) and splitter	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 09:35
S75	2	"5488412".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 09:33
S79	2	"4885747".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 09:09

S78	2	"5255267".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 09:09
S76	2	"5374952".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 09:05
S77	2	"5283789".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/11 09:02
S74	4	menand.in. and toggle	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/07 14:01
S73	50	menand.in.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/07 14:01
S72	50	((remote adj control$3) same (channel with (up down)) same (sequen$5 successive)) and @ay<"2000" and ("725"/$.ccls. or "348"/$.ccls.)	USPAT	OR	ON	2005/07/07 13:11
S70	288	(remote adj control$3) same (channel with (up down)) and @ay<"2000" and ("725"/$.ccls. or "348"/$.ccls.) and (sequen$5 successive)	USPAT	OR	ON	2005/07/07 13:11
S71	415	(remote adj control$3) same (channel with (up down)) and @ay<"2000" and ("725"/$.ccls. or "348"/$.ccls.) and (sequen$5 successive order)	USPAT	OR	ON	2005/07/07 13:09
S69	448	(remote adj control$3) same (channel with (up down)) and @ay<"2000" and ("725"/$.ccls. or "348"/$.ccls.)	USPAT	OR	ON	2005/07/07 13:08
S68	709	(remote adj control$3) same (channel with (up down)) and @ay<"2000"	USPAT	OR	ON	2005/07/07 13:07

S67	845	(remote adj control$3) same (channel with (up down))	USPAT	OR	ON	2005/07/07 13:06
S66	1244	(remote adj control$3) same channel same (up down)	USPAT	OR	ON	2005/07/07 13:05
S63	1	"6598226".pn. and channel	USPAT	OR	ON	2005/07/07 13:04
S62	1	"6598226".pn. and (lcd display)	USPAT	OR	ON	2005/07/07 09:55
S61	1	"6598226".pn.	USPAT	OR	ON	2005/07/06 15:49
S60	166	(channel WITH (computer adj program) or (processing adj program)) and (epg (program adj guide))	USPAT	OR	ON	2005/07/06 13:28
S59	375	((computer adj program) or (processing adj program)) and channel and (epg (program adj guide))	USPAT	OR	ON	2005/07/06 13:11
S58	375	((computer adj program) or (processing adj program)) and channel and (epg (program adj guide))	USPAT	OR	ON	2005/07/06 13:06
S55	21051	((computer adj program) or (processing adj program)) and channel	USPAT	OR	ON	2005/07/06 13:05
S57	947	S56 and (television tv stb)	USPAT	OR	ON	2005/07/06 13:01
S56	1165	S55 and (("725"/$.ccls.) or ("348"/$.ccls.))	USPAT	OR	ON	2005/07/06 13:01
S54	17	("5371553").URPN.	USPAT	OR	ON	2005/07/06 13:00
S53	1	("5086385").PN.	US-PGPUB; USPAT; USOCR	OR	ON	2005/07/06 12:52
S52	1	"5371553".pn.	USPAT	OR	ON	2005/07/06 12:52
S51	34	725/59.ccls.	USPAT	OR	ON	2005/07/06 12:51
S50	0	("2002/0019982").URPN.	USPAT	OR	ON	2005/07/06 10:26
S49	11	S47 and "725"/$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/05 17:21
S48	0	S47 and "725".ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/05 17:21

S47	641	aratani.in.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/05 17:21
S1	54	725/59.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/05 17:20
S46	1	S39 and "706"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/01 09:16
S45	1	S39 and "725"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/01 09:16
S44	1	S39 and (cssm)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/01 09:11
S41	1	S39 and (display video)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/01 09:03
S43	1	S39 and ("722" "725" "723")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/01 08:57
S42	1	S39 and "722"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/01 08:56

S40	1	S39 and "734"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/01 08:53
S39	2	"5642153".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/01 08:50
S38	1	"5642153".pn. and display	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/01 08:50
S37	1	"5642153".pn. and tuner	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 17:37
S36	166	(display and ((program near5 (relationship associate))near5 channel$1))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 15:49
S35	1	S17 and "4B"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 15:37
S34	1	S17 and "204"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 15:37
S33	1	S17 and "38"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 15:29

S32	1	S17 and "5"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 15:28
S31	1	S17 and TUNER	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 15:25
S30	1	S17 and "21"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 15:24
S29	1	S17 and "61"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 15:22
S28	2	S17 and "4"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 15:15
S19	1	S17 and "6B"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 15:15
S27	1	S17 and (execut$6)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 14:21
S26	0	S17 and (web internet www album imag$2)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 14:21

S25	2	S17 and (web program internet)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 14:21
S24	1	S17 and ("204" same "205")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 14:18
S22	1	S17 and "204"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 14:03
S21	1	S17 and controller	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 14:02
S20	1	S17 and "205"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 14:02
S18	1	S17 and eeprom	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 13:03
S17	2	"6075570".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 12:24
S15	2	"6075570".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 12:24

S16	2	"5642153".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 09:04
S14	76	S13 and S9	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 09:03
S11	11	S8 and (program near5 (relationship associate))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 08:54
S10	124	S8 and (storage RAM ROM memory)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 08:52
S9	80	S8 and storage	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 08:52
S8	135	S7 and (channel$1 near5 (program near5 selection))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 08:52
S7	1437	S6 and display	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 08:51
S6	2228	S5 and (select$3 near5 (broadcast$3 near5 signal))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 08:51

S5	143180	(tv television) and (receiver stb "set top box")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 08:50
S4	162	725/80.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/30 08:49
S3	85	725/54.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/29 17:19
S2	155	725/51.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/06/29 17:06

S141	1	S134 and (couple$2 combine$2)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 14:49
S139	2	S134 and "10"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 14:39
S138	1	S134 and ("25" SAME ("10" or "24"))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 14:29
S137	2	S134 and "25"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 14:24
S136	1	S134 and coaxial	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 14:24
S135	1	S134 and modulat$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 14:13
S134	2	"6622304".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 13:54
S132	74	LAN SAME (resonan$5 adj circuit)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/07/12 13:54

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PTO/SB/05 (03-01)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	9202
First Inventor	Gurantz
Title	Network interface device and broadband ...
Express Mail Label No.	ET615612080US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. [X] Fee Transmittal Form (e.g., PTO/SB/17) *(Submit an original and a duplicate for fee processing)*
2. [X] Applicant claims small entity status. See 37 CFR 1.27.
3. [X] Specification [Total Pages 24]
   (preferred arrangement set forth below)
   - Descriptive title of the invention
   - Cross Reference to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to sequence listing, a table, or a computer program listing appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
4. [X] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 5]
5. Oath or Declaration [Total Pages 3]
   a. [X] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 CFR 1.63 (d)) *(for continuation/divisional with Box 18 completed)*
      i. [ ] DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1 63(d)(2) and 1.33(b).
6. [ ] Application Data Sheet. See 37 CFR 1.76

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7. [ ] CD-ROM or CD-R in duplicate, large table or Computer Program *(Appendix)*
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ACCOMPANYING APPLICATION PARTS

9. [X] Assignment Papers (cover sheet & document(s))
10. [X] 37 CFR 3.73(b) Statement *(when there is an assignee)* [X] Power of Attorney
11. [ ] English Translation Document *(if applicable)*
12. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
13. [ ] Preliminary Amendment
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16. [ ] Nonpublication Request under 35 U.S.C 122 (b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent.
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18. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:*

[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No. _____/_____

Prior application information. *Examiner* _____ *Group Art Unit.* _____

For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

19. CORRESPONDENCE ADDRESS

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FEE TRANSMITTAL for FY 2001

Patent fees are subject to annual revision

TOTAL AMOUNT OF PAYMENT ($) 355

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Gurantz
Examiner Name	
Group Art Unit	
Attorney Docket No.	9202

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1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:
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FEE CALCULATION

1. BASIC FILING FEE

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101	710	201	355	Utility filing fee	355
106	320	206	160	Design filing fee	
107	490	207	245	Plant filing fee	
108	710	208	355	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 355

2. EXTRA CLAIM FEES

		Extra Claims		Fee from below		Fee Paid
Total Claims		-20** =		X	=	
Independent Claims		- 3** =		X	=	
Multiple Dependent					=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	80	202	40	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim, if not paid
109	80	209	40	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

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FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for *ex parte* reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	390	216	195	Extension for reply within second month	
117	890	217	445	Extension for reply within third month	
118	1,390	218	695	Extension for reply within fourth month	
128	1,890	228	945	Extension for reply within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,240	241	620	Petition to revive - unintentional	
142	1,240	242	620	Utility issue fee (or reissue)	
143	440	243	220	Design issue fee	
144	600	244	300	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Processing fee under 37 CFR 1.17(q)	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	710	246	355	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	710	249	355	For each additional invention to be examined (37 CFR § 1.129(b))	
179	710	279	355	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid SUBTOTAL (3) ($)

SUBMITTED BY				Complete (if applicable)	
Name (Print/Type)	Michael W. Landry	Registration No. (Attorney/Agent)	38,216	Telephone	619-518-6979
Signature	Michael W. Landry			Date	7/21/01

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Network Interface Device and Broadband Local Area Network Using Coaxial Cable

RELATED APPLICATIONS

This application claims the benefit of United States provisional application No. 60/288967 filed 5/4/2001 entitled: Network interface and broadband local area network using coaxial cable.

TECHNICAL FIELD

This invention relates to broadband communication networks and specifically to network interface devices and network wiring.

BACKGROUND

In a coaxial cable based local area network (LAN), communication between nodes occurs over a shared coaxial cable. When the coaxial cable used for the LAN is shared with a community aerial television (CATV) or cable TV service the signals must be separated to avoid interference. The LAN signal can use one band of frequencies and the cable TV service can use a different band. A typical cable TV configuration for a home is shown in Fig. 1. Signal splitters are used to distribute downstream signals from the point of entry (POE) to the various terminals in the home, which can include cable converter boxes, televisions, and cable modems, generally referred to as customer premise equipment (CPE). Each terminal device may have the ability to transmit as well as

receive. The upstream signal transmitted by the terminal device flows through the signal splitters back to the POE and to the cable plant. The signal splitters are functioning as signal combiners for upstream signals. Good quality splitters used in a properly wired system will provide a high level of isolation between terminal devices connected to the building wiring.

Signal splitters, shown in Fig 2., are commonly used in home and other building type coaxial cable wiring. They have an input port and multiple output ports. The input port can also be considered a common port. The output ports can also be considered tap ports. Splitters are generally passive devices and can be constructed using lumped element circuits with discrete transformers, inductors, capacitors, and resistors. Splitters can also be constructed using strip line or microstrip circuits. A typical two-way splitter splits the power equally between the two output ports if each port is terminated equally. Thus each output would have a power level 3 dB lower than the input. Ideally, a splitter transfers all power from the input port to the output ports. In a practical implementation there is a modest power loss in the splitter due to impedance mismatches, non-zero resistances, dissipative losses in circuit elements, and other non-ideal properties. These losses amount to approximately 0.5 dB, thus a practical two-way splitter provides -3.5dB power level to each output. A splitter may have 3 or more tap ports. There is typically an N-way splitter at the point of entry of a building.

Splitters are generally bi-directional; they can also function as signal combiners, which sum the power from multiple ports into a single output. The ports used as outputs in a splitter configuration become inputs ports for the combining configuration. The common port becomes the output port.

Splitters can be designed with power dividing ratios that are not equal. Instead of a 3 dB loss to each port, one port can have, for example 1.15 dB loss, and the other 6 dB. This corresponds to 75%/25% coupling. This type of splitter could be used to balance signal power at all terminal devices when there are multiple levels of signal splitters. A branch that terminates directly to a terminal device would be connected to a higher loss tap port. A branch that contains additional splitters would be connected to a lower loss tap port, which provides extra power to compensate for the loss of additional splitters.

Another characteristic of interest in signal splitters is the isolation between output ports. The isolation is typically between 10 dB and 40 dB. This isolation attenuates signals communicating between tap ports. The signal splitter/combiner is therefore directional, power flows to and from the common port to the tap ports, but power is attenuated between tap ports.

In a conventional cable TV or cable modem use, this isolation is of no concern because terminal devices do not communicate with each other, they only communicate through the POE with the cable head-end. In a LAN system, terminal devices communicate directly with each other, therefore

attenuation between tap ports in the signal splitters results in an undesirable signal loss.

Another approach to the splitter inter-port isolation is to replace the main splitter at the building POE with a symmetric power splitter/combiner. In a symmetric splitter, power entering any port is divided among the other ports. A symmetric splitter/combiner is not directional. This type of splitter has 3 dB additional loss compared to a directional signal splitter. The additional loss is greater depending on the number of tap ports. A power amplifier may be required to boost the signal to compensate for this loss. A bi-directional device, such as a cable modem, requires a reverse path so the amplifier needs to be bi-directional. Another disadvantage to this approach is that installation is required; each coax connected to the existing N-way directional splitter must be disconnected and moved to the new splitter. Another disadvantage of this approach is that power must be available for the amplifier, which is not generally present in the area a typical main splitter is located.

The tap port isolation of splitters used in a typical cable TV distribution configuration presents a problem to shared usage of the cable for a LAN system.

Broadband networks are described in U.S. patent 5,889,765 Bi-directional communications Network issued to Gibbs, U.S. patents 5,940,387 and 6,005,861 Home Multimedia Network Architecture issued to Humpleman, U.S. patent 5,870,513 Bi-directional Cable Network with a Mixing Tap or Suppressing

Undesirable Noise in Signals From a Remote End of the Network issued to Williams, U.S. patent 5,805,591 Subscriber Network Interface issued to Naboulsi, U.S. patent 6,008,368 Ethernet Transport Facility Over Digital Subscriber Lines issued to Rubinstain, U.S. patent 6,137,793 Reverse Path Multiplexer for Use in High Speed Data Transmissions issued to Gorman, and U.S. patent 6,091,932 Bidirectional Point to Multipoint Network Using Multicarrier Modulation issued to Langlais, each of which is incorporated herein by reference.

Gibbs disclosed a broadband network overlaid with the cable service frequencies using dynamically allocated TDMA protocols. Humpleman patents disclose a home network using an active network interface unit to couple the home network to the external network. Williams discloses a method of reducing noise accumulated in the frequency bands used by an upstream signal. Naboulsi discloses an active network interface for an asynchronous transfer mode (ATM) network. Rubinstain discloses a method of transporting Ethernet over twisted pair lines. Gorman discloses an active reverse path multiplexer for communication between the cable head-end and subscriber cable modems. Langlais discloses a two-way data transmission system for communicating between an upstream and downstream unit using OFDM. None of these references addresses the problem of tap port-to-port isolation and providing a suitable signal path for terminal-to-terminal communication in a coaxial cable wired building.

SUMMARY OF THE INVENTION

The present invention uses a frequency selective network interface device placed at the building point of entry (POE) to reflect upstream signals transmitted by terminal devices back into the building distribution whereby the signals may be received by other terminal devices. By reflecting upstream signals back into the building as downstream signals, the network interface device provides a path for terminal devices to transmit to and receive from other terminal devices. This overcomes the problem of port-to-port isolation in the signal splitter/combiners. A bidirectional signal distribution network is create from existing building wiring intended only for headend to terminal device communication. Another function of the network interface device is to isolate signals generated within the building and prevent the transmission outside the building. Due to the frequency selectivity of the network interface, upstream and downstream signals for cable TV and cable modem service are not disturbed. The network interface device can be implemented as a passive device. The network interface device can alternatively be an active device that derives power from the cable or an external power source.

The network interface device can be placed further into the customer premises, instead of at the POE. The network interface device is installed with a first port connected in the direction of the POE and a second port connected in the direction of the terminal devices. Installation of the network interface device produces a reflected signal in the direction of the terminal devices.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing a prior art coaxial signal distribution plan.

Fig. 2 is a diagram showing a signal distribution plan according to the present invention.

Fig. 3 shows embodiments of network interface devices in accordance with the present invention.

Fig. 4 shows a representative frequency allocation between cable service upstream/downstream signals and an overlaid local area network in accordance with the present invention.

Fig. 5 shows a network using direct broadcast satellite wiring with a coupler according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION AND BEST MODE FOR CARRYING OUT THE INVENTION

Referring to Fig 2, amplifiers 222 and 224 are part of the cable plant and provide a signal to the street and tap 220. A frequency selective network interface device 210 is located at the point of entry (POE) to the building LAN wiring. Alternatively, the frequency selective network interface can be located further inside the building, or at a point external to the building, for example at the street tap 220. The network interface 210 produces a reflection

of upstream signals back into the LAN wiring so that terminal devices, such as LAN modem 270, can receive a signal transmitted by another terminal device connected to the LAN wiring forming the network. The invention intentionally introduces a reflection into the LAN wiring and exploits the reflected signal to provide communication path in a system that has high isolation between terminal devices due to splitters 230, 231, and 232 installed in the wiring. LAN modem 270 provides modulation and demodulation of the waveform transmitted over the cable. LAN modem 270 has an interface to communicate with a LAN device 280, which is the source or destination of data transmitted over the LAN. LAN device 280 can be, for example, a personal computer (PC). LAN device 282 can be, for example, a modulator to produce a signal for driving a TV through a signal combiner.

Existing devices, such as TV 240 and cable modem 250 connected to PC 260, use frequency bands distinct from the frequency band used by the LAN and therefore operate in a normal manner.

Referring to Fig 3, in one embodiment, the network interface device comprises a signal splitter 300 with an impedance mismatch 310 to create a reflected signal at one port, a frequency selective filter 320 coupled to the same port, and a frequency selective filter 330 coupled to a different port. The frequency selective filter 330 provides isolation of the building LAN signal from the cable plant and passes standard cable service signals through with minimal disturbance. This filter would typically be a low pass filter. Network signals at high

frequencies originating in the building pass through the splitter and are blocked by filter 330. Filter 320 passes the network signal and mismatched termination 310 reflects the signal back through the splitter 300 to the building wiring. The signal is distributed through the building wiring to all nodes.

Impedance mismatch 310 functions as a signal reflecting element. An impedance matched termination will have an impedance equal to the characteristic impedance of the transmission line, the splitter port, or filter port to which the termination is connected. For example, 75 Ohms is the characteristic impedance of a typical RG59 or RG6 system. A 75 Ohm termination will not produce a reflected signal. Terminations different from a matched termination will produce a reflected signal. The magnitude of the reflected signal will be a function of the termination impedance relative to the characteristic impedance.

Impedance mismatch 310 can be implemented in a number of ways. A short circuit of approximately 0 Ohms attached to the signal line will produce a reflected wave of approximately equal magnitude to the incident wave with an inversion in the signal polarity. An open circuit, which is an impedance approaching infinite Ohms, will produce a reflected wave of approximately equal magnitude to the incident wave with the same signal polarity. Other impedances in between 0 and infinite Ohms may be used. The magnitude of the reflected signal will vary in relation to the degree of mismatch. The reflection coefficient will be

(Z.sub.l-Z.sub.0)/(Z.sub.l+Z.sub.0),

where Z.sub.l is the termination impedance and Z.sub.0 is the impedance of the port to which the termination is connected. See generally, Microwave Circuit Design Using Linear and Nonlinear Techniques by George D. Vendelin, et al, Wiley-Interscience Publication 1990, incorporated herein by reference.

Impedance mismatch 310 can also be implemented by introducing any impairment into an element, for example a cable, component, or connector, that changes the impedance of the element. Since impedance is determined by, among other factors, the cross sectional and longitudinal geometry of a transmission line, the impairment may be introduced by altering the geometry at one point or along a region of a transmission line. Impedance is also determined by the dielectric properties of the transmission line, so changing the dielectric at one point or in a region will also affect the impedance, creating a mismatch, and therefore a reflection.

Impedance mismatch 310 can also be implemented by altering the input or output impedance of the frequency selective filter used in the network interface device. The filter provides the termination at the point of connection, and therefore a mismatch will produce a reflection.

The level of reflection produced can be adapted to the needs of the system, based on, for example, the number of splitters in the building wiring or in a branch of the wiring, or the signal loss known to exist in the building wiring or in a branch of the wiring.

Petitioner's Exhibit 1003

Splitters 300 and diplexer 302 are well known devices. Filters 320 and 330 can be constructed using lumped element inductors, capacitors, and resistors, using microstrip and strip line techniques, or using other active and passive filter implementations. The selection of components to produce a filter with particular frequency characteristics is done using well known filter design techniques, including the use of computer aided design (CAD) tools. Splitter 300 is designed to have a specific amount of coupling between the common port and the tap ports to create a desired level of signal reflection.

The frequencies used by the LAN can be located above the standard cable use frequencies, which extend to 550 MHz or 750 MHz. Other frequency plans can be used, for example where a block of frequencies is available in the middle of the cable band. The filter cut-off frequencies are selected according to the frequencies bands used.

Another embodiment of the network interface device uses a filter placed in between the POE and the customer premises. This filter can be implemented as a passive filter using an inductor 350, resistor 352, and capacitor 354. These filter components can be discrete components or formed using strip line or microstrip techniques. Inductor 350 resistor 352, and capacitor 354 determine the frequency response of the filter. In one embodiment, as shown in Fig. 3, the filter is a series notch filter that uses a parallel resonator. This filter presents an open condition to the series circuit at the resonance frequency, thereby reflecting the signal energy. The same filter can be

implemented using a series resonator connected in a shunt configuration. In other embodiments, the filter can be a lowpass, highpass, or bandpass filter. More complex filter topologies may be employed for pass band shaping and impedance matching outside the filter notch frequency.

Filters with frequency characteristics determined primarily by reactive elements, such as highpass, bandpass, lowpass, and bandstop filters implemented with inductors and capacitors, have a different impedance value in the pass band and stop band. This property may be exploited in the present invention where the filter has approximately matched impedance in the frequency of the signals to pass through the filter and a mismatch in the frequency range where reflection of signals is desired.

Other techniques which can be used to implement the filters employed in the present invention include coaxial resonators, combline filters, interdigital filters, wave guide resonators, dielectric resonators, helical resonators, tubular bandpass filters, series resonators, parallel resonators, and other known filter techniques.

The present invention operates by introducing a reflection in the LAN electrical wiring. A reflection anywhere in the wiring produces a multipath signal in some or all wiring branches that creates inter-symbol interference (ISI). The multipath signal has a delay and amplitude difference relative to the main signal. In the frequency domain, a reflection produces ripples in the response of the channel, creating amplitude variations across the pass band. In the time domain, ISI is seen as an impairment to the shape of

the digital signal pulses. ISI will degrade the bit error rate (BER) performance of the communication channel. The effects of ISI can be overcome by applying modulation techniques or receiver processing techniques. An adaptive equalizer in the terminal device receiver creates a filter response that restores a flat frequency response impaired by the multipath signal. The adaptive filter can also be seen as a coherent summer of a main signal and reflected signals.

Other methods of overcoming multipath effects include using multi-carrier techniques such as discrete multi-tone (DMT) or orthogonal frequency division multiplexing (OFDM). Another modulation technique that exploits the existence of a multipath signal is spread spectrum modulation such as direct sequence spread spectrum (DS-SS). A DS-SS receiver can employ a rake receiver in which each reflected path is received, demodulated, and coherently combined to produce a single data stream.

A variation of the DS-SS approach is to use code division multiplex (CDM), which uses data spreading of user data wherein a single user utilizes multiple spreading codes that are all transmitted on the same frequency band. User data is multiplexed between the several spreading codes to form multiple communication channels. A CDM receiver de-spreads each code and combines the data, typically into a single data stream.

A time domain equalizer (TEQ) or frequency domain equalizer (FEQ) can be used with any of the above described modulation techniques.

Petitioner's Exhibit 1004

With any form of modulation, the present invention could use a time division duplex (TDD) protocol for communications. In a TDD system, the receive and transmit data are communicated during different time intervals, generally using the same frequency. The advantage of using TDD is that the transceiver design is simplified. Different users share a common frequency channel through the use of time division multiple access (TDMA). In a TDMA system each user transmits during a different time interval. Users are assigned one or more slots of predetermined length in a framing structure that contains multiple slots. All users are synchronized by a beacon message broadcast on the network. The beacon message provides a common time reference to the users and can include other network management information.

In an alternate embodiment of the invention, a signal coupling element may be introduced at one or more splitters in the building wiring. At each splitter junction, frequency selective coupling is created whereby the upstream signal at one splitter output port is coupled to other splitter output ports. Additionally, the LAN frequency band will couple through to the splitter input port. A conventional splitter can be replaced with a new splitter that has frequency selective inter-port coupling, or an additional device can be added to existing splitters to perform this function. Alternatively, a device added to a splitter in-line with the input connection and would produce a reflection in a manner similar to the network interface device placed at the POE. In this embodiment the

interface device would be configured so a portion of the signal is reflected and a portion is passed through.

In another alternative embodiment of the invnetion, the main splitter can be constructed to introduce a reflecting circuit at each tap port along with some signal coupling between tap ports. This configuration allows some signal to reflect down the originating wiring branch to other devices in that branch and also couple to other wiring branches in the building.

In addition to coaxial wiring used for cable TV service, many homes and buildings are wired for satellite TV service. In another alternative embodiment of the present invention, a coupling path is provided to satellite television wiring system. Referring to Fig 5, a satellite receiver outdoor unit 510 typically comprises a dish antenna 520, one or more low noise block-converters (LNB) 540, and a multiport crosspoint switch 550. The crosspoint switch 550 allows connection of the outdoor unit 510 to more than one integrated receiver decoder (IRD) located inside the building. The LNB 540 converts the signal transmitted by the satellite transponder, for example C band, Ku band or another frequency band, to a lower intermediate frequency (IF) suitable for transmission through coax. For example, L band IF (950 to 1450 MHZ) with RG6 coax cable is commonly used. The IRD demodulates the IF signal from the LNB down to baseband, provides channel selection, decodes the digital data to produce a video signal, provides conditionally access, and generates an RF output to drive a television.

According to the present invention, frequency or directional selective coupling is added after the LNB, for example in or after the crosspoint switch. This device provides coupling between coax cables connected to the outdoor unit. In this embodiment, the network signal would not use the same frequency band as the satellite signal. Referring to Fig. 5, conventional splitters 562, which have interport isolation, are used to couple the cable signals to a symmetric power summer 564. Conventional splitter 562 can be, for example, a 1.25 dB/6dB splitter or some other ratio that provides an acceptable level of attenuation of the satellite signal wile providing an acceptable level of signal power for the network. The splitter may need to pass direct current (DC) to the LNB, which can be done by the inclusion of an inductor connecting the tap port to the common port. The L-band signal from the multiport switch 550 passes through the splitter and is combined with the signal output of the summer 564. Due to the directional nature of the splitter, which provides interport isolation, neither the summer signal nor the satellite signal passes through directly to the other tap port. A good quality splitter can achieve 20 dB or more of isolation between ports. Additional isolation between the satellite L-band signal and the network signals is achieved due to the non-overlapping frequency bands occupied by the respective signals.

According to the present invention, another implementation of the satellite system coupler uses frequency selective coupling to prevent interference with the L-band satellite signals. The frequency selective coupling, for example, comprises a low-pass filter to pass the band below L-band

through the coupler. The coupling is provided by a symmetric combiner that distributes the energy from any port to the other ports.

In another alternative embodiment, summer 564 can be replaced with a directional splitter with an impedance mismatch connected to the common port. In this configuration, energy from each cable drop connected to an IRD is reflected back to the other cable drops.

Application of DMT and OFDM to the present invention

Multitone modulation uses a set of modulating carriers that are integer multiples of a common frequency and the symbol period is the inverse of the common frequency. Multitone modulation is also called discrete multitone (DMT) and orthogonal frequency division multiplexing (OFDM). OFDM utilizes quadrature phase shift keying (QPSK) and multi-level quadrature amplitude modulation (QAM) wherein each OFDM carrier can be modulated by an amplitude/phase varying signal. To modulate, data bits are encoded into a number of m-ary PSK constellations, which then modulate the respective carriers. The carriers are summed together for transmission over the channel. Each carrier is independent and can be independently decoded in the receiver.

OFDM provides a mechanism to overcome the frequency selective channel impairments present in coaxial building wiring when employing a network interface device according to the present invention.

QPSK is composed a sine and a cosine wave of identical frequency with phase modulation applied to each carrier independently. QAM is composed of sine and cosine waves with phase modulation and amplitude modulation. Both of these signals can be represented using complex numbers. The OFDM waveform is generated by applying an inverse discrete Fourier transform (IDFT) to a complex vector that results in a real valued time domain sequence. The time domain sequence is applied to an up converter to place the waveform at the proper RF frequency.

Higher SNR channels can support higher data capacity. Frequency bins occupying parts of the channel where the SNR is high can be used to transmit more bits. Each carrier may be modulated with a different order constellation, where higher SNR frequencies can bear a higher order constellation, and the resulting closer spacing of the constellation points. Frequencies with the lower SNR use lower order constellations such as QPSK.

The power in individual frequency bins can be adjusted to compensate for insertion loss that varies as a function of frequency. The power level in regions of the channel can be altered by scaling the complex valued vector for the bins where power adjustment is needed before applying the inverse Fourier transform. In order to avoid interference with certain bands in the RF spectrum, the power level of certain bins can be reduced to zero.

An OFDM receiver uses a discrete Fourier transform (DFT) to convert the modulated signal back into data. The OFDM receiver receives all the carriers at once and performs the

transform on a block of data points. Drawing from terminology used in Fourier transforms, the frequency channels in OFDM may be called frequency bins or simply bins.

Various types of forward error correction can be applied to transmitted data blocks, such as Reed-Solomon and convolutional coding. Interleaving can be applied to data blocks to increase the robustness of the error correction. De-interleaving and error correction coding are applied in the receiver to recover the transmitted data without errors.

An OFDM receiver may also employ time domain equalization (TEQ), frequency domain equalization (FEQ), or both. Generally the equalizers are adaptive. Equalizers may be of the decision feedback (DFE) type or decision directed type such as least mean square (LMS) algorithm.

OFDM system architecture is covered in ADSL/VDSL Principles by DR. Dennis J. Rauchmayer, Macmillan Technical Publishing, 1999 and DSL Simulation Techniques and Standards Development for Digital Subscriber Line Systems by Dr. Walter Y. Chen, Macmillan Technology Publishing, 1998.

CLAIMS

What is claimed is:

1. A network interface device connected to building wiring, the building wiring comprising a point of entry and a plurality of branches connected to terminal devices, for creating a signal distribution system comprising

a first port connected to the point of entry side of a branch of the building wiring;

a second port connected to the terminal device side of a branch of the building wiring; and

a signal reflecting circuit connected between the first and second port.

2. The network interface device of claim 1, wherein the signal reflecting circuit comprises a parallel resonant circuit.

3. The network interface device of claim 1, wherein the signal reflecting circuit comprises a series resonant circuit.

4. The network interface device of claim 1, wherein the signal reflecting circuit comprises

a splitter/combiner with a first tap port, a second tap port and a common port, wherein the power at the first and

second tap ports is coupled bi-directionally to the common port;

the common port connected to a branch of building wiring;

a first filter for separating bands of frequencies connected to the first tap port;

means for reflecting signal energy connected to the first filter; and

a second filter for separating band of frequencies connected between the second tap port and the point of entry.

5. A signal distribution network for transmitting modulated signals using building wiring containing a plurality of branches comprising

a network interface device that couples network signals originating in the building wiring back into the building wiring;

at least one signal splitter; and

a plurality of terminal devices.

6. The signal distribution network of claim 5, wherein the signal modulation is orthogonal frequency division multiplexing.

7. The signal distribution network of claim 5, wherein the building wiring is coaxial cable.

8. The signal distribution network of claim 5, wherein the network interface device is located at the point of entry of the building wiring.

9. The signal distribution network of claim 5, wherein the network interface device is frequency dependent and couples signals by reflecting a predetermined frequency band of signals.

10. The signal distribution network of claim 5, wherein the network interface device is direction dependent and couples signals by power summing signals from at least two branches.

11. A signal distribution network for transmitting modulated signals using building wiring comprising

at least one signal splitter; and

at least one frequency dependent signal coupling element connected to a signal splitter; and

a plurality of terminal devices connected to signal splitters.

12. The signal distribution network of claim 11, wherein the frequency dependent signal coupling element reflects a predetermined frequency band of signals.

13. The signal distribution network of claim 11, wherein the signal distribution network is orthogonal frequency division multiplexing.

14. The signal distribution network of claim 12, wherein the building wiring is coaxial cable.

15. The signal distribution network of claim 12, wherein the frequency dependent signal coupling element is located at the point of entry of the building wiring.

16. The signal distribution network of claim 12, wherein the signal modulation is orthogonal frequency division multiplexing.

17. The signal distribution network of claim 12, wherein the signal modulation is code division multiplex.

18. The signal distribution network of claim 16, further comprising a method of sharing the communication medium between terminal devices using time division duplex protocol.

ABSTRACT

A local area network uses coaxial cable wiring for interconnection of terminal devices. A frequency selective network interface device is placed at the building point of entry or another point in the wiring to reflect network signals transmitted by terminal devices back into the building distribution to be received by other terminal devices. By reflecting network upstream signals back into the building as downstream signals, the network interface provides a path for terminal devices to transmit to and receive from other terminal devices.

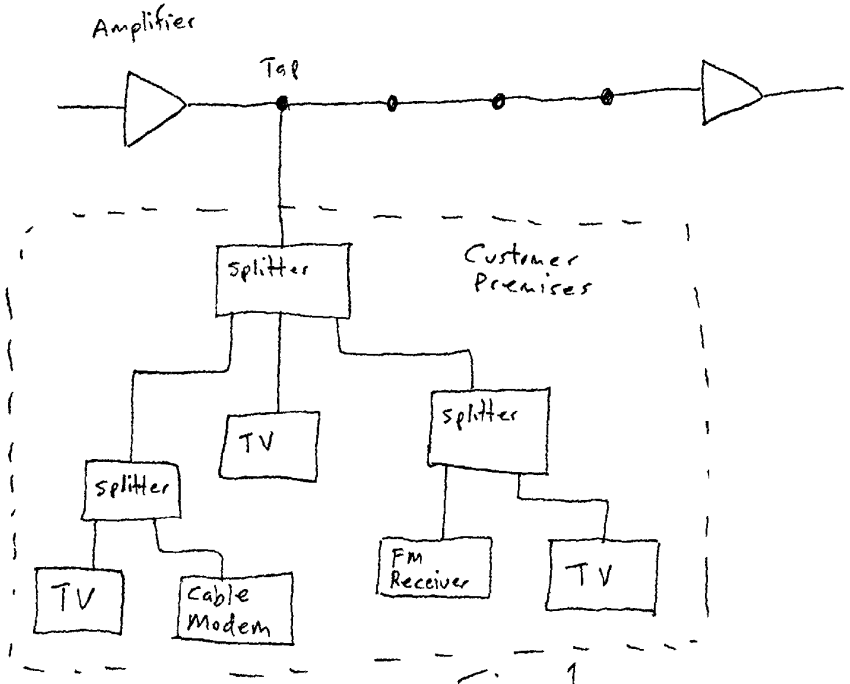
Amplifier
Tap
Customer Premises
splitter
TV
splitter
splitter
TV
Cable Modem
FM Receiver
TV

Fig. 1

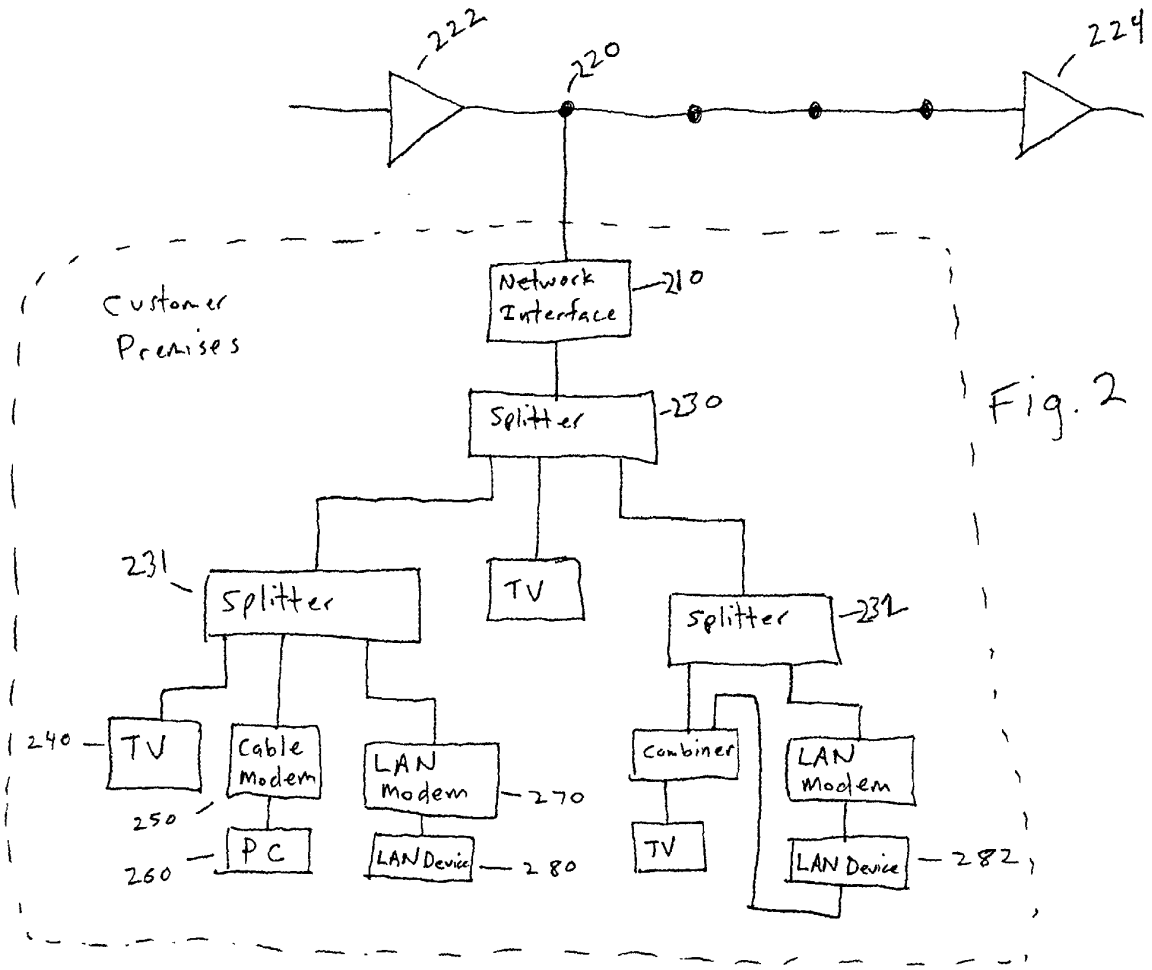
222
220
224
Customer Premises
Network Interface
210
Splitter
230
231
Splitter
TV
Splitter
232
240
TV
Cable Modem
250
LAN Modem
270
Combiner
LAN Modem
260
PC
LAN Device
280
TV
LAN Device
282

Fig. 2

TOT220:2TH0T660

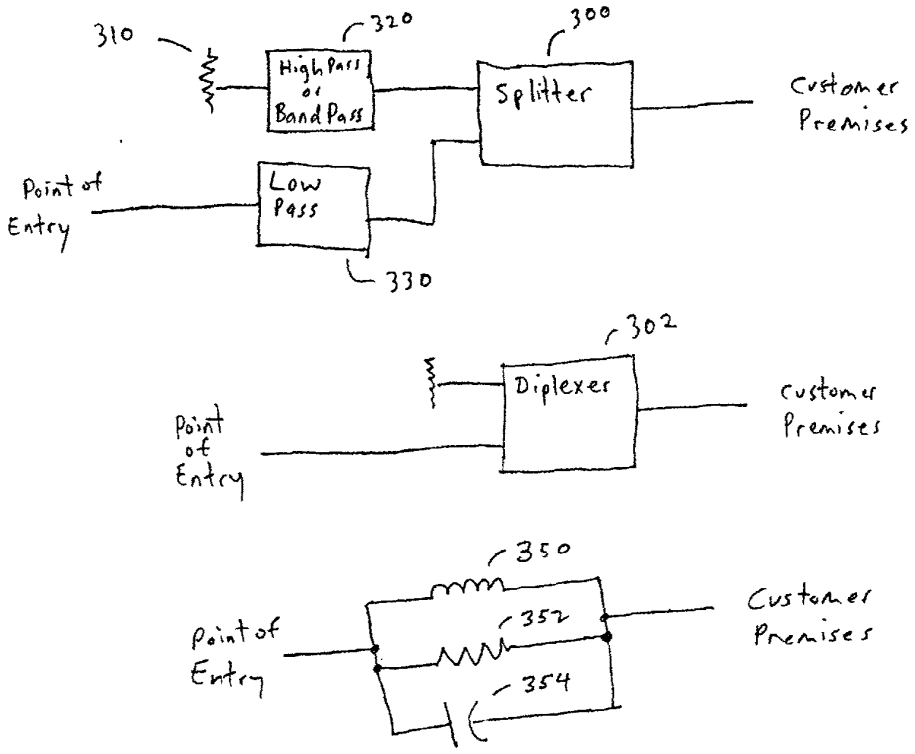

Fig 3

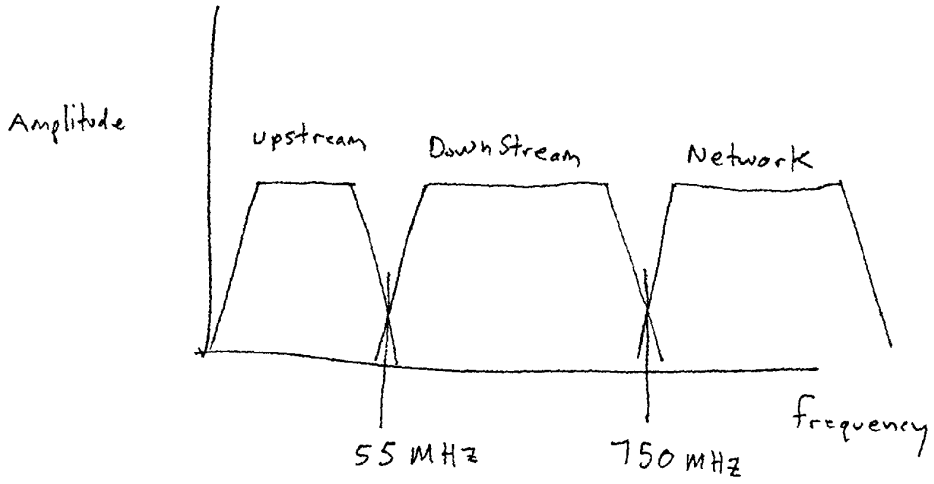
Amplitude
upstream
Down Stream
Network
frequency
55 MHz
750 MHz

Fig 4

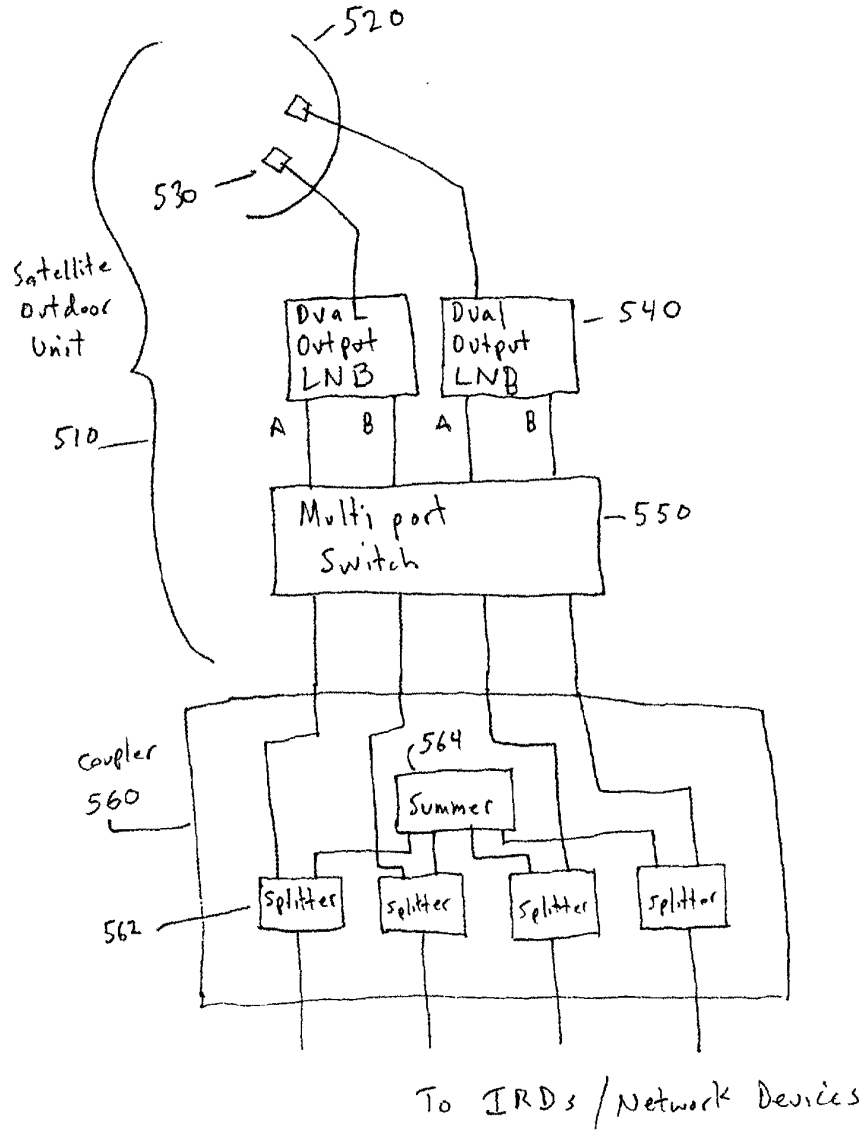
520
530
Satellite Outdoor Unit
510
Dual Output LNB
Dual Output LNB
540
A
B
A
B
Multi port Switch
550
Coupler
560
564
Summer
Splitter
Splitter
Splitter
Splitter
562
To IRDs / Network Devices

Fig. 5

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

[X] Declaration Submitted with Initial Filing OR [ ] Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	9202
First Named Inventor	Gurantz
COMPLETE IF KNOWN	
Application Number	/
Filing Date	
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Network interface device and broadband local area network using coaxial cable

(Title of the Invention)

the specification of which

[X] is attached hereto

OR

[ ] was filed on (MM/DD/YYYY) [ ] as United States Application Number or PCT International Application Number [ ] and was amended on (MM/DD/YYYY) [ ] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			[ ]	[ ]	[ ]
			[ ]	[ ]	[ ]
			[ ]	[ ]	[ ]
			[ ]	[ ]	[ ]

[ ] Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	
60/288967	5/4/2001	[ ] Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

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Address 5098 Seachase st.

Address

City San Diego | State CA | ZIP 92130

Country USA | Telephone 619-518-6979 | Fax 858-509-0184

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 so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR : [ ] A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]) Itzhak | Family Name or Surname Gurantz

Inventor's Signature [signature] Date 7/18/01

Residence: City San Diego | State CA | Country USA | Citizenship USA

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Mailing Address

City San Diego | State CA | ZIP 92130 | Country USA

NAME OF SECOND INVENTOR: [ ] A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]) Ladd | Family Name or Surname ElWardani

Inventor's Signature Ladd ElWardani Date 7-18-01

Residence: City La Jolla | State CA | Country USA | Citizenship USA

Mailing Address 6416 La Jolla Scenic Dr. South

Mailing Address

City La Jolla | State CA | ZIP 92037 | Country USA

[3] Additional inventors are being named on the 1 supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.

[Page 2 of 2]

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DECLARATION

ADDITIONAL INVENTOR(S)
Supplemental Sheet
Page 1 of 1

Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor		
Given Name (first and middle [if any])	Family Name or Surname		
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Inventor's Signature A. Monk			**Date** 7/18/01
Residence: City San Diego	**State** CA	**Country** USA	**Citizenship** USA
Mailing Address 10618 Amberglades Ln			
Mailing Address			
City San Diego	**State** CA	**ZIP** 92130	**Country** USA

Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor		
Given Name (first and middle [if any])	Family Name or Surname		
Brett	Bernath		
Inventor's Signature B K			**Date** 7/18/01
Residence: City San Diego	**State** CA	**Country** USA	**Citizenship** USA
Mailing Address 4167 Calle Mar De Ballenas			
Mailing Address			
City San Diego	**State** CA	**ZIP** 92130	**Country** USA

Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor		
Given Name (first and middle [if any])	Family Name or Surname		
Magnus	Berggren		
Inventor's Signature Magnus Berggren			**Date** 6/27/07
Residence: City San Diego	**State** CA	**Country** USA	**Citizenship** Sweden
Mailing Address 3850 Riviera Dr. #1D			
Mailing Address			
City San Diego	**State** CA	**ZIP** 92109	**Country** USA

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Docket No. 21304-2010

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POWER OF ATTORNEY OR AUTHORIZATION OF AGENT

Application Number	
Filing Date	
First Named Inventor	Gurantz
Title	Network interface device ...
Group Art Unit	
Examiner Name	
Attorney Docket Number	9202

I hereby appoint:

[X] Practitioners at Customer Number 24244 → Place Customer Number Bar Code Label here: 24244 PATENT TRADEMARK OFFICE

OR

[ ] Practitioner(s) named below:

Name	Registration Number
Michael W. Landry	38,216

as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith.

Please change the correspondence address for the above-identified application to:

[X] The above-mentioned Customer Number.

OR

[ ] Practitioners at Customer Number 24244 → *Place Customer Number Bar Code Label here*

OR

[ ] Firm *or* Individual Name	Michael W. Landry				
Address	5098 Seachase St.				
Address					
City	San Diego	State	CA	Zip	92130
Country					
Telephone	619-518-6979	Fax	858-509-0184		

I am the:

[ ] Applicant/Inventor.

[X] Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

SIGNATURE of Applicant or Assignee of Record

Name	Itzhak Gurantz, CEO Entropic Communications Inc.
Signature	
Date	7/18/01

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

☐ *Total of ____ forms are submitted.

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Patent App. Serial No. 09/855,179

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WASHINGTON, D.C. 20231
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Bib Data Sheet

CONFIRMATION NO. 2398

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/910,412	07/21/2001 RULE	725	2611	9202

APPLICANTS

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Ladd Eiwardani, La Jolla, CA;
Anton Monk, San Diego, CA;
Brett Bernath, San Diego, CA;
Magnus Berggren, San Diego, CA;

**** CONTINUING DATA ***************************

THIS APPLN CLAIMS BENEFIT OF 60/288,967 05/04/2001

**** FOREIGN APPLICATIONS *********************

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** SMALL ENTITY **
** 09/06/2001

Foreign Priority claimed	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ yes ☐ no	CA	5	18	3
35 USC 119 (a-d) conditions met ☐ yes ☐ no ☐ Met after Allowance				
Verified and Acknowledged Examiner's Signature Initials				

ADDRESS

24244

TITLE

Network interface device and broadband local area network using coaxial cable

FILING FEE RECEIVED	FEES: Authority has been given in Paper	
355	No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

07/25/2001 MLAKEW1 00000034 09910412
01 FC:201 355.00 OP

PTO-1556
(5/87)

*U.S. GPO: 2000-468-987/39595

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PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number
09/104,12

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	18	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	18 minus 20=	* 0
INDEPENDENT CLAIMS	3 minus 3 =	* 0
MULTIPLE DEPENDENT CLAIM PRESENT		☐

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

SMALL ENTITY TYPE ☐ OR OTHER THAN SMALL ENTITY

RATE	FEE	OR	RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL	355	OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY OR OTHER THAN SMALL ENTITY

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

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

FORM PTO-875
(Rev. 8/00)

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CLAIMS ONLY

SERIAL NO.	FILING DATE
APPLICANT(S)	

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
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TOTAL IND.	3					
TOTAL DEP.	15					
TOTAL CLAIMS	18					

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TOTAL IND.						
TOTAL DEP.						
TOTAL CLAIMS						

* *MAY BE USED FOR ADDITIONAL CLAIMS OR ADMENDMENTS*

FORM PTO-2022 (1-98)

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Patent and Trademark Office

*U.S. GPO: 1998-443-593/89152

Exhibit 1004

U.S. Patent 6,795,450 to Andrew Mills et al.

Customer No.: 000027683

Haynes and Boone, LLP
IP Section
2323 Victory Avenue, Suite 700
Dallas, Texas 75219
Telephone [214] 651.5000
Fax [214] 200.0853

US006795450B1

(12) **United States Patent**
Mills et al.

(10) **Patent No.: US 6,795,450 B1**
(45) **Date of Patent: Sep. 21, 2004**

(54) **METHOD AND APPARATUS FOR SUPPORTING PHYSICAL LAYER LINK-SUSPEND OPERATION BETWEEN NETWORK NODES**

(75) Inventors: **Andrew Mills**, Coto De Caza, CA (US); **Ralph Andersson**, Grass Valley, CA (US)

(73) Assignee: **TDK Semiconductor Corporation**, Tustin, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 791 days.

(21) Appl. No.: **09/676,040**

(22) Filed: **Sep. 28, 2000**

(51) **Int. Cl.**[7] **H04L 12/66**

(52) **U.S. Cl.** **370/463**; 370/419; 370/503; 713/300

(58) **Field of Search** 370/463, 503, 370/509, 318, 401, 465, 466, 459, 458, 450, 229, 311, 231, 394, 419, 420, 522; 713/300, 320, 323, 324, 330, 340

(56) **References Cited**

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(List continued on next page.)

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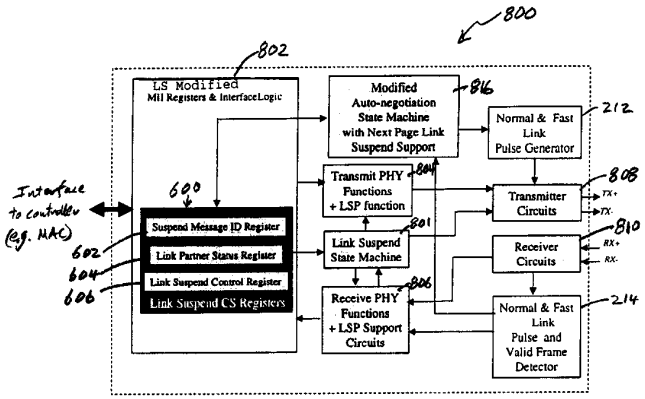
(57) **ABSTRACT**

A link-suspend operation between network nodes in a point-to-point data communications link is presented. Individual network links will have a full power operational mode for supporting full high-bandwidth communication, and a low power "link-suspend" (LS) operational mode for temporary operation when only limited communication is occurring. The communications link is maintained, while cycling transmitter power on and off during idle periods with a duty cycle that substantially reduces physical layer device (PHY) power, using LSPs. LS mode may be negotiated by advertising capabilities between two network devices. Thus, PHYs at either end of a link can notify the other of the capability to support a LS mode of operation and can negotiate parameters for communications using the LS mode. Further, transmitting and receiving continuous idles, valid data frames, and Wake-on LAN (WOL) packets is supported. Similarly, notification of "wake-up" schemes and detection of suspended WOL network device is supported.

47 Claims, 10 Drawing Sheets



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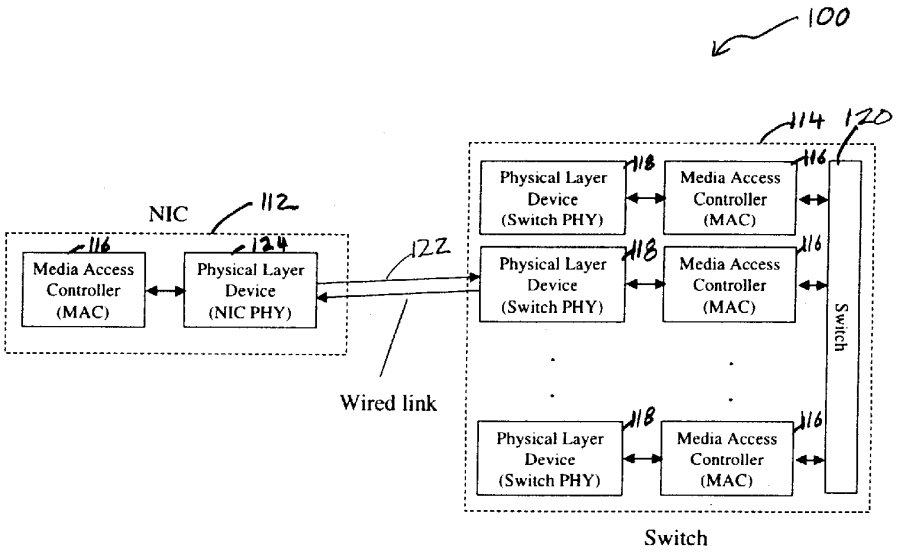

Fig 1: Typical Prior LAN System, Showing Key Functional Components

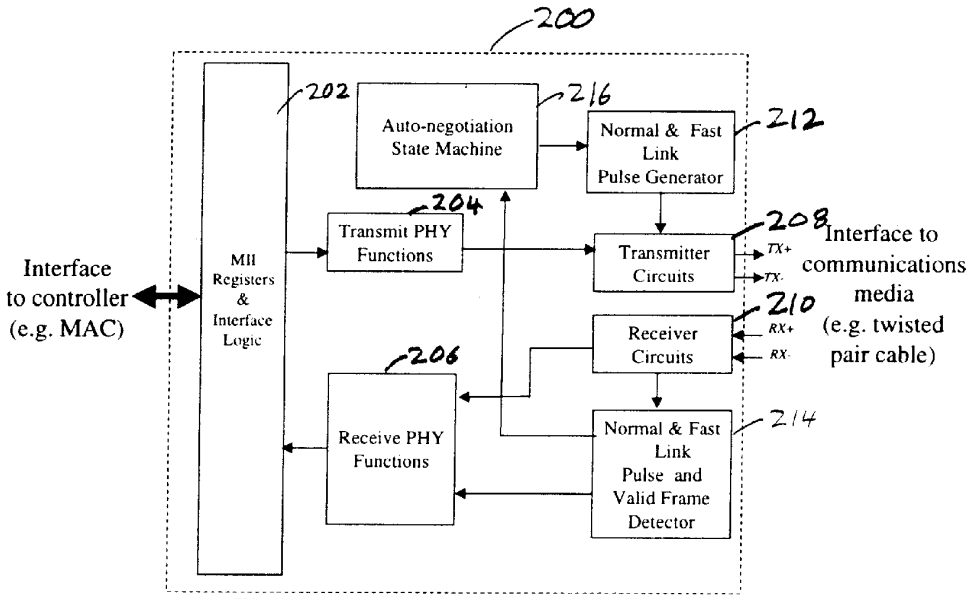

Fig 2: Typical Prior PHY Device and Main Functions

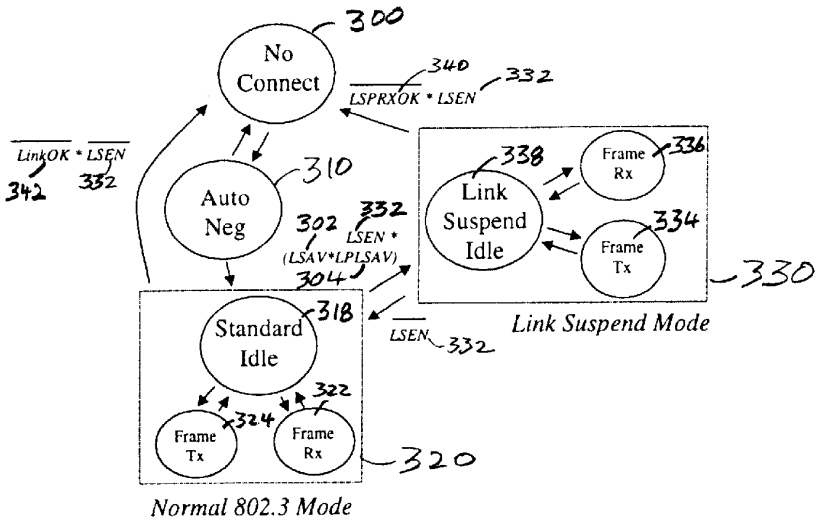

Figure 3: Example High Level Operational States of a Link-suspend PHY (Half Duplex Case)

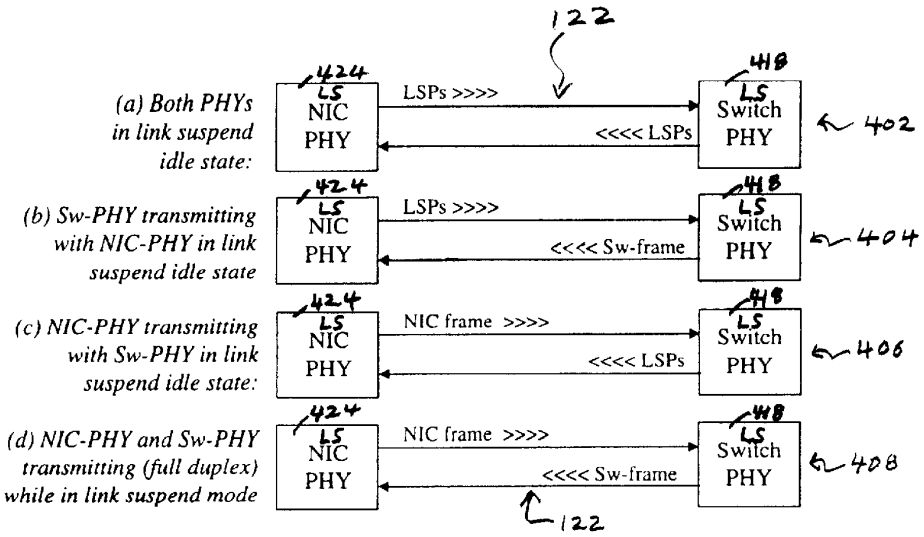

Figure 4: Example Operational States While in Link-suspend Mode

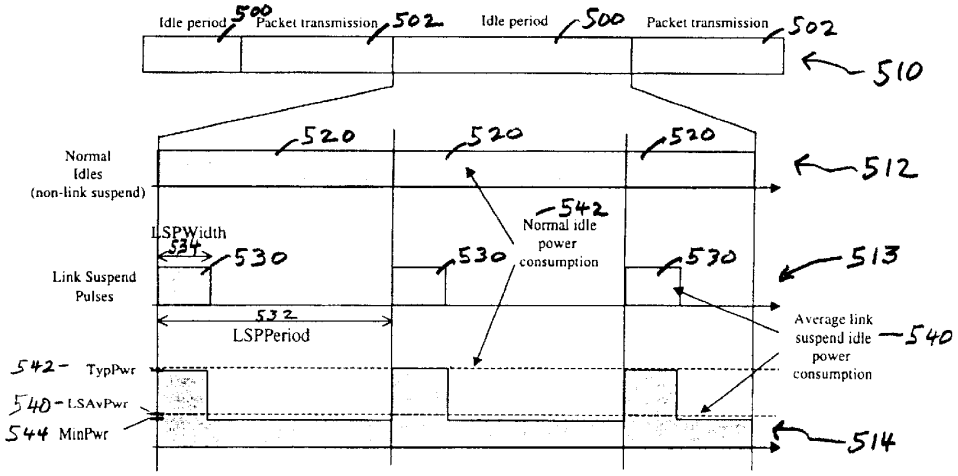

Figure 5: Link Suspend Pulse (LSP) Characteristics

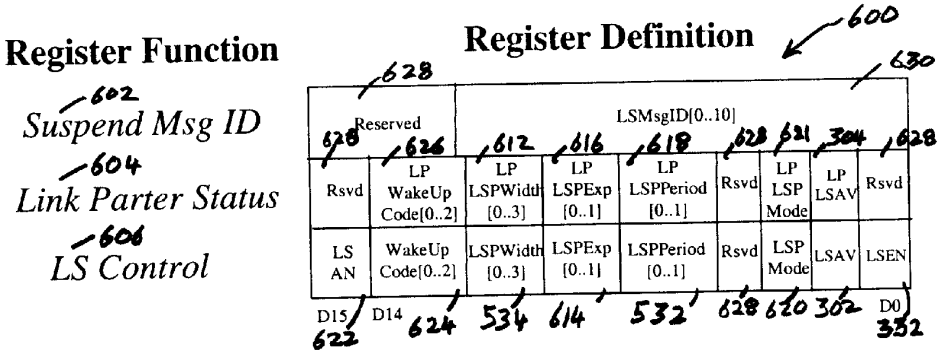

Figure 6: Example LS Modified MII Register Definition for Link Suspend Parameters

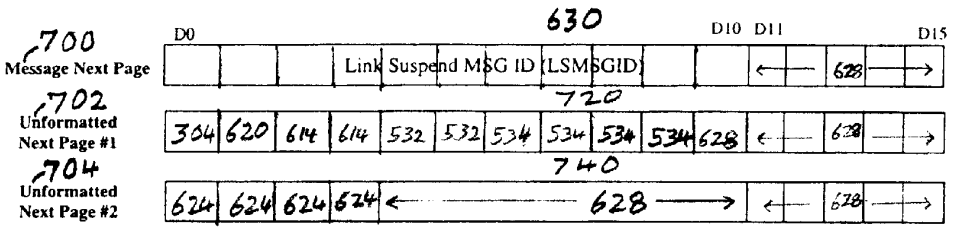

Figure 7: Auto-negotiation Next Page Message and Link-suspend Next Page Code Word

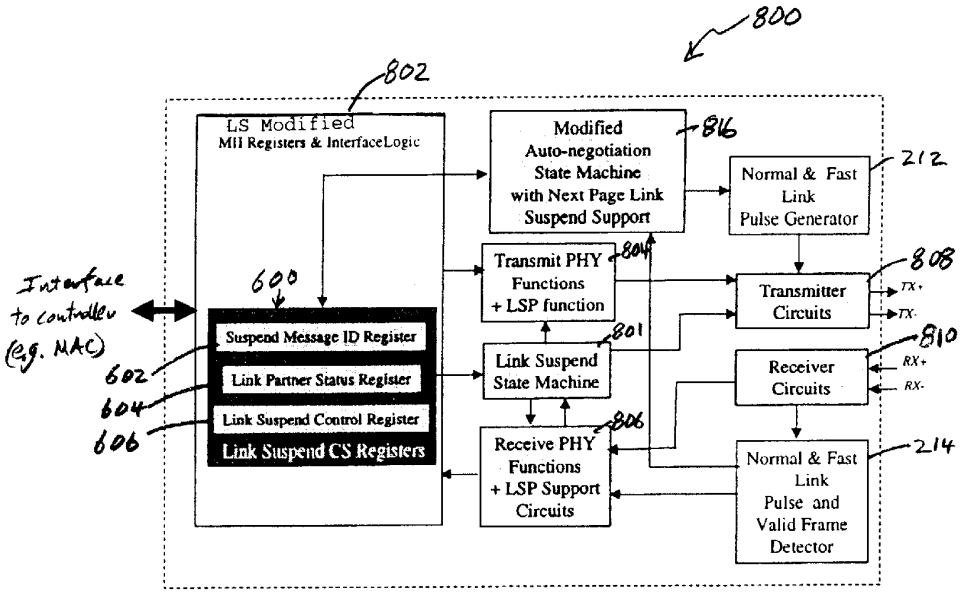

Fig8: Modified PHY With Invention Implemented

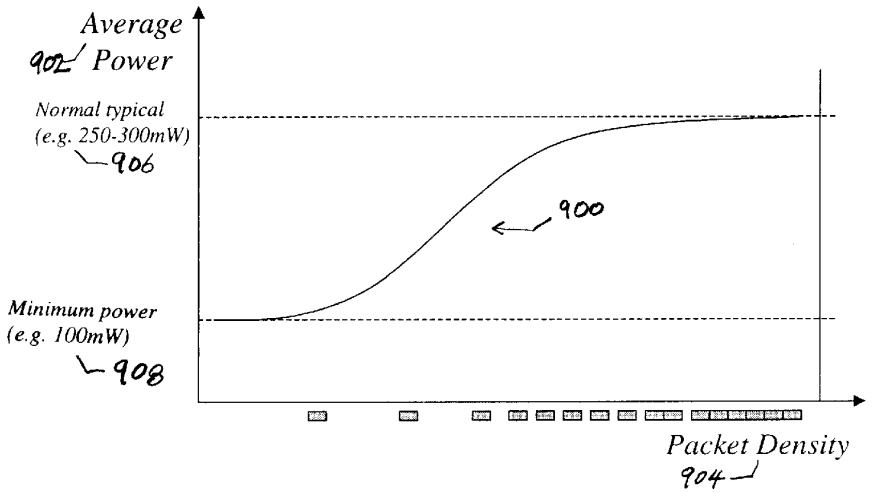

Figure 9: Average PHY Power Consumption vs. Packet Density

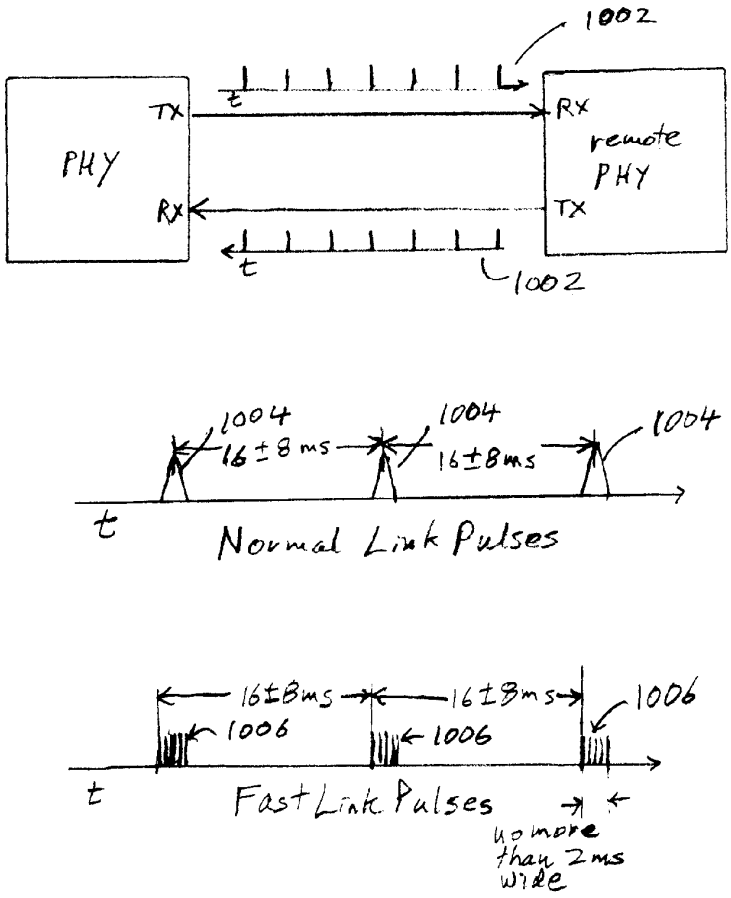
1002
TX
RX
PHY
remote
PHY
RX
TX
t
t
1002
1004
16±8 ms
1004
16±8ms
1004
t
Normal Link Pulses
16±8ms
16±8ms
1006
1006
1006
1006
t
Fast Link Pulses
no more
than 2ms
wide

Figure 10

METHOD AND APPARATUS FOR SUPPORTING PHYSICAL LAYER LINK-SUSPEND OPERATION BETWEEN NETWORK NODES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the field of computer network point to point data communications, and more particularly to communications links that normally use constant idle bit streams between packet transmissions.

2. Background

a. Communications Networks

There are many different types of networks, network systems, and network devices for sharing files and resources or for otherwise enabling communication between two or more computers, PCs (personal computers), workstations, telephones, etc. The term "network device", "network node" or "network component" generally refers to a computer linked to a network via a network interface card (NIC), or refers to other devices or apparatus that perform specialized functions in the network, such as repeaters, bridges, switches, routers, brouters, to name a few examples. Networks may be categorized based on various features and functions. For example, the range of a network refers to the distance over which nodes are distributed, such as local-area networks (LANs) within an office or floor of a building, wide-area networks (WANs) spanning across a college campus, or a city or a state, and global-area networks (GANs) spanning across national boundaries.

In designing a network, there are a large number of possible network configurations (such as ring, tree, star, hybrid combinations of these, etc.) and communication protocols (such as analog or digital and isochronous or non-isochronous) from which to choose. For example, a star-topology network has data sources and sinks coupled to nodes and the nodes are coupled to a central hub in a star topology. Each node (which may have one or more data sources and sinks coupled thereto) assembles the data received from the one or more data sources coupled to it into the designated frame template and transmits it to the hub.

Many networks operate in accordance with the OSI (Open Systems Interconnection) Reference Model, which is a seven-layer model developed by the ISO (International Standardization Organization). The OSI Reference Model describes how to interconnect any combination of network devices in terms of seven functional layers organized in a hierarchy, and specifies the functions that must be available at each layer. From highest level of the hierarchy to lowest level of the hierarchy, the OSI Reference Model includes the Application layer, the Presentation Layer, the Session Layer, the Transport Layer, the Network Layer, the Data-Link Layer and the Physical Layer.

Network architectures (such as Ethernet, ARCnet, Token Ring, and FDDI) encompass the Data-Link and Physical Layers and represent the most common protocols used. The Data Link layer is responsible for constructing and transmitting data packets as well as receiving and deconstructing data packets, both sequences based upon the network architecture being employed. The Data-Link layer provides services for the various protocols at the Network Layer and uses the Physical Layer to transmit and receive the data packets. In a Local Area Network Carrier Sense Multiple Access with Collision Detection (LAN CSMA/CD) implementation according to the Institute of Electrical and Electronics Engineers, Inc. (IEEE) Standard 802.3 or 802.3u-1995 (IEEE Standards) (See IEEE 802.3 Standard for Carrier Sense Multiple Access with Collision Detect (CSMA/CD) Access method and Physical Layer Specifications, 1998 Edition), the Data-Link Layer is divided into two sub-layers, the Logical-Link Control (LLC) sub-layer at the top and the Media-Access Control (MAC) sub-layer at the bottom. The LLC sub-layer provides an interface for the Network Layer protocols while the MAC sub-layer provides access to a particular physical encoding and transport scheme of the Physical Layer. The MAC sub-layer is typically executed by a MAC device that operates at one of several standard clock frequencies. Similarly, the Physical Layer is typically executed by a Physical Layer Device (PHY) that is responsible for transmitting and receiving digital code from a communications media or line, and converting the digital signals into higher intelligence signals for the device MAC.

Several structures and protocols are known for implementing the Data Link (e.g. a MAC) and Physical Layers (e.g. a PHY). Ethernet using coaxial, twisted pair or fiber-optic cables operates at 10 megabits per second (Mbps) (e.g. 10BASE-T, 10BASE-F) while fast Ethernet operates at 100 Mbps (e.g. 100BASE-T, 100BASE-FX). ARCnet (Attached Resource Computer Network) is a relatively inexpensive network structure using coaxial, twisted pair or fiber-optic cables operating at 2.5 or 20 Mbps. Token Ring topologies use special IBM cable or fiber-optic cable and operate between 1 and 16 Mbps. Fast Token Ring operates at 100 Mbps. A new standard is being developed called ATM (Asynchronous Transfer Mode), which operates at speeds of 25.6 or 155 Mbps, although newer versions may operate at even higher data rates. Of course, various other network structures are known and available.

Over the years, many networks have been designed to operate in 10BASE-T protocol. However, as faster and more sophisticated communication became possible through improvements in equipment and technology, it has become desirable to provide multi-service protocols which can support both older protocols, such as 10BASE-T, as well as additional communication protocols such as those listed above. This is so that it is not necessary to replace the entire network and related components with new equipment when upgrading to the newer protocol.

During network communications, the Physical Layer (e.g. a PHY) receives data packets from the Data-Link Layer (e.g. a MAC) above it and converts the contents of these packets into a series of electrical signals that represent 0 and 1 values in a digital transmission. These signals are sent across a transmission medium to a partner Physical Layer at the receiving end of the network link. At the destination, the partner Physical Layer (e.g. a PHY) converts the electrical signals into a series of bit values, which are grouped into packets and passed up to the Data-Link Layer (e.g. a MAC) of the destination device by the Physical Layer (e.g. a PHY) of the destination partner network device.

b. Prior LAN Systems

FIG. **1** is a block diagram of a typical prior LAN system **100** showing key functional components. It illustrates one of the most common IEEE 802.3 Ethernet communications links, which requires two PHY layer devices (e.g. a network interface card (NIC) **112** and a Switch device **114**) in order to communicate. The Switch device comprises a switch **120** connected to media access controllers (MACs) **116**, which are in turn connected to switch physical layer devices (Switch PHYs) **118**, which are connected to a wired link **122**. Similarly, the NIC **112** comprises a media access

controller (MACs) **116** connected to a NIC physical layer device (NIC PHYs) **124**, which is also connected to the wired link **122**.

The switch device media access controllers (MACs) **116** provide data media to the switch device physical layer devices (Switch PHYs) **118**, which in turn transmit and receive data from the wired link **122**. Similarly, the NIC **112** media access controller (MACs) **116** providing data media to the NIC physical layer device (NIC PHYs) **124**, which in turn transmits and receives data from the wired link **122**. Thus, by using a communications language, mode, or protocol that the other "partner" understands, the switch and NIC are able to "talk" to each other over the "link".

The wired link **122**, or media connecting two PHYs normally consists of two twisted-pair cables, with one pair utilized for receiving data and the other for transmitting data. However, various other appropriate wired link **122** media may be used to connect PHYs, such as coax cable, fiber optic cable, satellite links, cell links, radio waves, etc.

c. Physical Layer Devices (PHYs)

FIG. **2** is a block diagram of a typical prior physical layer device (PHY) **200** showing key functional components. The same basic PHY circuits can be utilized in both a network interface card (NIC), a Switch PHY circuit, as well as other network devices using various media as discussed above. Similarly, a PHY may be implemented either as a standalone single or multi-channel (e.g. 4 PHYs on a chip) device, or an integral component within a higher integrated controller that has PHY devices. The PHY function may also be implemented using a variety of an integrated circuit technology. For example, PHY functionality may be provided through a predominantly analog circuit approach or through use of a digital signal processor.

As shown in FIG. **2**, a Media Independent Interface (MII) Registers and Interface Logic component **202** is connected to a transmit PHY functions component **204**, and a receiver PHY functions component **206**. In turn, the transmit PHY functions component **204** is connected to transmitter circuits **208**. The transmitter circuits **208** are connected to a wired link **122**. Likewise, the receiver PHY functions component **206** is connected to a normal and fast link pulse and valid frame detector **214**, and receiver circuits **210**. The receiver circuits **210** are in turn connected to the wired link **122**. The transmitter circuits **208** are also connected to a normal and fast link pulse generator **212**. The receiver circuits **210** are connected to a normal and fast link pulse and valid frame detector **214**. An auto-negotiation state machine **216** is attached to the normal and fast link pulse generator **212**, and the normal and fast link pulse and valid frame detector **214**.

As part of the IEEE 802.3 standard, the MII Registers and Interface Logic component **202** provides a common interface for connecting the PHY **200** with a MAC. The MII is capable of interfacing the PHY with different types of standardized MACs so that different vendors can design standardized products that will successfully interface.

The transmit PHY functions component **204** controls the transmitter circuits **208**, which transmit across the wired link **122**. Likewise, the receiver PHY functions component **206** controls the receiver circuits **210**, which receive data from the wired link **122**.

The normal and fast link pulse generator **212** provides normal link pulses (NLPs) and fast link pulses (FLPs) used to confirm PHY connection to other "partner" or "remote" PHY's. For example, the PHY normal and fast link pulse generator **212** will generate NLPs which are then transmitted across the wired link **122** to tell a remote PHY that the transmitting PHY is still connected (i.e. an "I'm here" signal). Herein, the PHY under discussion will be referred to as simply "PHY" and a PHY at the other end of a link will be referred to as a "partner PHY" or "remote PHY". Unless stated otherwise, a partner or remote PHY behaves in the same manner as the PHY described within.

Similarly, the normal and fast link pulse and valid frame detector **214** provides normal and fast link detection for confirming a valid link with another PHY. For example, when NLPs received from the wired link **122** by the PHY receiver are detected by the normal and fast link pulse and valid frame detector **214**, a valid link with the remote PHY transmitting the NLPs is confirmed. Thus, for 10-BASE-T communications, the indication to a remote PHY receiving and detecting NLP's is that all is well on the link. On the other hand, if no pulses are received by an expecting remote PHY, the link is assumed dead.

The auto-negotiation state machine **216** provides to the pulse generator **212** and recognizes from the pulse and frame detector **214**, various parameters used to set up the operational mode of the communications link. For instance, the method of communication between two PHYs can be either half-duplex (receive or transmit only) or full-duplex (receive and transmit simultaneously). In addition, the auto-negotiation block sets up other parameters such as the speed of the link (e.g. 10 Mbps, 100 Mbps or 1000 Mbps), as well as the type of signaling and encoding schemes used (e.g. 100BASE-T4, 100BASE-T2). The IEEE 802.3 Standard auto-negotiation Section (IEEE Std 802.3, 1998 Ed., Section 28) provides for negotiation between two network endpoints. For example, the IEEE specifies protocol used by a linked node and hub to select a link configuration compatible to both endpoints. Thus, the auto-negotiation block is responsible for negotiating with its remote PHY partner to achieve the desired mode of operation.

The type of pulses used by a PHY to negotiate a link vary depending on the type of PHY. For example, at power on, an old standard 10BASE-T, 10 Mbps capacity PHY will transmit Normal Link Pulses (NLPs). Thus any PHY receiving NLPs is informed that it is communicating with a 10BASE-T partner, and will continue operations in 10BASE-T mode. In 10BASE-T mode, NLPs are transmitted during link negotiation as well as when the link is idle (e.g. when no data packets are being transmitted). Consequently, the NLP is known as the "link integrity pulse" or "link test pulse".

Newer 10BASE-T PHYs and 100BASE-T PHYs use Fast Link Pulses (FLPs) during link set up. FLPs allow for the passage of auto-negotiation parameters. In addition, FLPs are designed to be interpreted as NLPs by non-FLP capable PHYs. Thus, to an old 10BASE-T PHY, FLPs used during link negotiation will look like NLPs. Conversely, a newer 10BASE-T PHY will be capable of transmitting and interpreting Fast Link Pulses (FLPs), and hence will be able to detect both 10BASE-T and 100BASE-T modes of operation.

FIG. **10** is a waveform diagram of link negotiation pulses showing NLPs and FLPs, in accordance with an embodiment of the invention. Referring to FIG. **10**, pulses **1002** are sent by both PHYs during link negotiation. NLPs, typically consist of a pulses **1004** sent every 16±8 ms. However, FLPs typically consist of bursts of pulses **1006**, no more than 2 ms in duration, sent every 16±8 ms. Generally, each FLP burst of pulses **1006** consists of a series of clock and data pulses. The data pulses usually carry link negotiation data indicating link speed, duplex mode, etc.

Hence, during auto negotiation, higher speed PHYs exchange information identifying what type of PHY they are and what their communications mode capabilities are. For

instance, at power on, a Fast Ethernet (100BASE-T) capable PHY will startup by pulsing the media line with Fast Link Pulses (FLP) to inform remote PHYs of its existence on the line. A remote PHY will operate in a similar fashion, pulsing the media line with FLPs. When a return FLP is received by the powered on PHY, that PHY will detect the FLPs, decipher the data bits encoded therein, and identify the transmitted parameters. Generally, current systems allow the PHYs to "advertise" in this manner what mode each is capable of. The highest common operational mode is then chosen. For example, if one of the PHYs advertises 10BASE-T full duplex and the other PHY advertises 100BASE-TX full duplex, the PHY advertising 100BASE-TX will reconfigure its advertisements to the lower 10BASE-T full duplex capability.

Also, auto negotiation generally only occurs following a reset, or typically following a link failure or power up. Thus, once a link has been auto negotiated, the PHYs retain the communications mode agreed upon even though other parameters or modes may change during communications. For instance, to and from a data transmission state and an idle state.

In prior systems, a first PHY must continually transmit a signal waveform in order to maintain the link with a partner PHY at the other end for two reasons. First, the partner PHY will assume the link is severed if an identifiable waveform of signal is not received for a certain length of time, and second, the partner PHY receiver may loose its "lock" on the timing of the incoming waveform's bits and thus will not be able to decipher them. Thus, when data packets are not being transmitted over the link to a remote PHY, some other type of signal or pulse must be sent.

The type of pulses used by a PHY in between data packet transmissions varies depending on the mode of operation negotiated for that link. For example, if the link operational mode is 10BASE-T, a PHY will transmit Normal Link Pulses (NLPs) in between data packets. In this case, each PHY must continually transmit NLPs between data packets (or FLPs to be interpreted as NLPs) or the partner PHY will assume the link is severed because no identifiable signal has been received for a "timeout" period.

Alternatively, if the link operational mode is 100BASE-T, a PHY will transmit a stream of "idles" in between data packets. In the 100BASE-T case, a PHY must continually transmit the "idles" in order to keep the partner PHY from assuming the link is severed due to no identifiable waveform over a "timeout" period, as well as so that the partner PHY receiver does not loose its "lock" on the timing of the incoming bits. Unlike the slower 10BASE-T mode where there is enough time for the receiving PHY's circuitry to re-align to the timing of received data pulses, in 10BASE-T mode, it is necessary to fill the "quiet" time between data packets with a signal that enables the receiving PHY to remain in synchronization with the data pulses of a received packet. Such synchronization is necessary because at 100Mbps (100BASE-T mode), there is usually not enough time for the receiving PHY's circuitry to re-align to the timing of newly received data pulses immediately following a significant "quiet" period.

For example, for 100BASE-T, the partner PHY receiver must lock onto a 125 Mbps bit stream (4 bits are encoded into 5 bits during transmission). Thus, the partner PHY receiver must distinguish within 8 Nano seconds per pulse bit, whether that bit is a "1" or a "0" (multiple voltage levels or voltage transitions may be used, for example, in this case MLT3 having three voltage levels corresponding to +1, 0, and −1 can be implemented with a transition to the next voltage level representing a "1" and no transition a "0"). In order to make this distinction, PHY receivers typically use a Phase Lock Loop (PLL) to tune to the transmitting PHY's output. The tuned PLL lets the PHY receiver sample the correct points in the received signal to determine if that location or bit in the waveform is a 1 or 0. Further, the receiver PLL is capable of "drifting" or adapting the time at which it takes a sample, with the drifting timing or "phase" of the received waveform characteristics. Thus the PLL is able to sample for 1 or 0 distinctions at optimum waveform locations, even when those locations drift.

The PLL recovers the phase or timing of the incoming clock to determine the timing information of the signal being received. For example, when digital pulses or bits (1's, and 0's) are being received from the media, the PLL is also receiving a timing pulse signal as well. The timing pulse signal lets the PLL know where the next bit will begin, so the PLL can sample the waveform at the proper point to distinguish whether a bit is a 0 or a 1. Thus the PLL knows when to expect the next digital signal bit. For example, the timing signal tells the PLL how many (e.g. 2, 3, or more) blank spots (0's) are in the signal between two high bits (1s).

Additionally, to assist the PLL, most receivers use an equalizer to adjust for the characteristics of the incoming line. Various types of equalizers (e.g. adaptive, fixed, etc.) can be used to balance out the effect the characteristics of the media have on the incoming signal. For example, a twisted pair cable typically experiences an attenuation which is a function of its length and the frequency of interest. The equalizer will compensate for the attenuation by creating a frequency dependant gain. This results in a frequency response that is as flat as possible, across the spectrum, for that cable length. Digital signal processor (DSP) based equalizers often use "coefficients" which are a numeric table of information to map the input characteristics of a link.

d. Power Consumption

In a common network environment, the transmitters and receivers at both ends of the associated network link use a cycle template to enable the exchange of data. The cycle template continues to be exchanged even when the template contains little or no data. This continuous transmittal of the template requires the continual expenditure of transmitter and receiver power.

Power consumption directly influences the cost of operating the device, limits design possibilities, and is of particular importance if the network component is battery driven. For example, if the network device is a lap top computer, the useful operating life of the device is a direct function of battery life.

Additionally, providing support for continuous transmittal of templates for an entire multi-service network requires significant individual network device power, as well as overall network power. Hence, the desire to reduce power consumption in LAN NICs, LAN switch equipment, and other LAN apparatus has resulted in many vendors producing low power PHY devices. However, as will be explained, there is a limit to the amount of power reduction that is possible with today's implementation of physical layer (PHY) devices.

For example, there are several industry schemes and specifications designed to manage or conserve power in a personal computer (PC) environment by powering certain PC components on and off as necessary during PC use. This scheme is generally referred to as Wake-on LAN (WOL), though different vendors may call their particular implementation something different.

For instance Microsoft Wake-on LAN™ and Advanced Micro Device's Magic Packet™ are classic examples of

such schemes. Likewise, the most prevalent specifications are Microsoft OnNOW™ (See OnNow Specification (www.microsoft.com)) and the ACPI (See Advanced Configuration and Power Interface Specification (ACPI), Version 1.0b, Feb. 2, 1999 (www.acpi.com)). There is a provision within these industry defacto standards that supports the ability to remotely wake up or put to sleep a networked PC/workstation using specific types of data packets. Thus, using such a scheme it is possible for a PC to enter a suspended mode, or be put to sleep upon receiving a packet over a network.

WOL wake-up and sleep packets are usually generated by a central management station that is responsible for managing all the PC/workstations and network devices in a network. WOL may be used simply to switch machines on or off, or automatically wake them up for software maintenance at night when the machines are not in use. These applications require a NIC to consume very little power, but be capable of waking up as soon as a packet is sent to that NIC over the network. Thus, a WOL capable PC that is connected to a LAN can be "woken up" from a power suspend mode by a wake-up packet received over the network by the PC's PHY, from a partner network device. Use of such technology allows network managers to wake up a sleeping PC update the software and the switch the PC back off.

However, a certain portion of the PC's network device must always stay on to allow the network device to be woken up from a remote location in order to wake the rest of the PC up. Thus, although a lower power states for the overall NIC may be entered in prior systems, in order to allow for Wake-on LAN capability, it is necessary for the PHY part of the NIC to stay fully powered. The fully powered PHY continually transmits and receives signals, so that a channel is kept open for receiving a "wake up" packet from a partner network device.

An example of an early WOL scheme is Magic Packet™ (See Magic Packet Technology White Paper, November 95 (www.amd.com)). Similar to a programmable VCR waking up at a certain time to record a show, Magic Packet allows a PC to be woken up from across a network without re-booting. A Magic Packet is defined as a standard Ethernet MAC frame that contains the address of the target PC NIC that is to be woken up, repeated 16 times within the packet itself. These 16 instances of the station's IEEE MAC address are preceded by 6 bytes of FF. The destination address field within the MAC frame can be either the address of the individual station to be woken up or a multicast/broadcast address i.e. an address that will be received by the PC's MAC controller device.

For example, Magic Packet gives the following example of a data sequence within a Magic Packet for a station with IEEE address '112233445566' as:

> DA, SA, <misc>, FF, FF, FF, FF, FF, FF, 11, 22, 33, 44, 55, 66, 11, 22, 33, 44, 55, 66, <plus 14 times 11, 22, 33, 44, 55, 66>, <misc>, CRC.

In another example, the OnNow WOL scheme utilizes a more comprehensive packet-filtering scheme to detect certain types and protocols carried within a frame. There are three basic types of wake up mechanisms defined in the OnNow specification:

- Wake up on link status change
- Wake up on Magic Packet
- Wake up on match against a predefined byte-frame mask stored within the MAC device

When in a suspend or sleep mode, the majority of the PC/workstation components are put to sleep, including the main CPU and any network software device drivers that may be interfacing to the LAN adapter. Hence, a WOL capable network device must be capable of looking at a packet and deciding if it is the correct one to wake up the PC/workstation while the rest of the machine is asleep. If the packet content is a correct match, then the adapter will produce an interrupt, which invokes the power management software. This in turn will decide if the PC/workstation is to be fully woken up, woken up just to deal with this one request with a low level device driver, or simply ignored.

In current network devices, in order to receive a wake up packet or other signal it is necessary for PHYs to stay fully powered constantly transmitting on the link between two network devices. As a result, a lower power constant idle state has been developed having Idle Symbols or Pulses that are a specific pattern of low level symbols. Thus, transmission of a continuous waveform can be accomplished in order to hold the link between two PHYs by interlacing data packets with a constant transmission of such low power idles pulses when data transmission is suspended. Nevertheless, the constant idle pulse state requires the PHY transmitter to be fully powered and the PHY is a significant contributor to the power consumption of network devices, adapters, hubs, and switches.

For example, referring to FIG. **5**, in prior systems, a PHY must transmit continuous normal idles **512** when data packets **502**s are not transmitted so that a continuous idle periods and data packet transmissions **510** waveform having stable data is sent, in order to keep a partner PHY receiver locked into the signal that the first PHY is sending. If the partner PHY receiver fails to detect normal link idles, or data bits for a specified period, the receiver will assume that the link has been broken and the partner PHY will reset. For example, referring to FIG. **3**, a Fast Ethernet 100BASE-TX partner PHY assuming the link is broken will set its Link OK flag to "not", enter the no-connect mode, and then begin auto-renegotiation by sending FLPs across the link to determine if it can adequately re-connect to the first PHY. Thus, upon receipt of the partner FLPs, the first PHY will return FLPs to link with the partner device. However, if a data packet is transmitted to either PHY prior to completion of the auto re-negotiation, the data will not be received, but instead will be "lost".

In relation to power management standards, ACPI defines three levels of power down that apply to LAN adapters:

- D0—fully operational
- D1, D2—various levels of power down (some implementations may support WOL in the D1/2 states)
- D3 hot—usually Wake-On LAN state
- D3 cold—fully powered down with all functional units non-operational Thus ACPI network devices operate in Network Device Power States D0, D1, D2, and D3.

In the D0 state, the device, including the PHY is fully powered and can freely transmit and receive data and/or idles. In the D1 and D2 or intermediate states, the device is less than fully powered, but requires the PHY to be fully powered in order to constantly transmit idle frames, even though other components of the NIC may be at less than full power. Note that some ACPI implementations support WOL in the D1 or D2 states. D3 has a "D3-hot" and a "D3-cold" state.

In D3-hot, or what prior systems call the Wake-on LAN state, the PHY is still powered up and constantly sending idle frames (symbols) because if the partner PHY fails to receive idles, it may assume that the connection has been broken (dead wire, unplugged wire, etc . . .) and will reset. To reset, the PHY will go to the reconnect state, and will

begin transmitting in full power D0 mode (FLPs for 100BASE-T, or NLPs for 10BASE-T) to determine if the link has been physically broken, or if there was some other error. While in D3-hot, because the PHY is transmitting and receiving, the NIC may be forced back to D0 status by the partner PHY sending a re-initialization "wake up" packet.

In D3-cold the PHY may be powered down, but its receiver can not then receive a "wake up" packet. Thus, the PHY is not able to be woken up in D3-cold, and hence the PHY, NIC, PC, or workstation must be re-initialized or reset locally.

Various power requirements need to be met in the D3 states. For example, in Cardbus NIC applications, the D3-hot state requires no more than 200 mA to be drawn in total by the card in the Wake-up state, whereas the D3 cold requires no more than 5 mA. The challenge to the systems designers is that typical Fast Ethernet PHY devices today can draw more than 100–150 mA when configured in WOL mode, and therefore may exceed the 200 mA limitations. This is especially so for multi-function cards, such as LAN and Modem NICs where there are several potentially high powered devices utilized.

Much of the power consumed by a PHY goes to the transmitter as it must be capable of driving up to 100-meters of category-5 cable and maintain IEEE compliance. Moreover, PHYs are usually over-designed to operate higher power to compensate for poor line conditions.

Consequently, as shown above, most point-to-point LAN links that exist today have no method or capacity to shut off their transmitter power between valid data transmissions or during a sleep or suspended state. For example, switching off a PHY's transmitter altogether would result in the remote partner PHY detecting a loss of link due to the lack of a transmitted signal, NLP, or scrambled idle stream being received by its receiver. As a result, the constant idle pulse state requires the PHY transmitter to be fully powered and the PHY is a significant contributor to the power consumption of network devices, adapters, hubs, and switches.

Fast Ethernet PHYs have already been designed for low voltage and/or low power operation. The overall power consumption of the PHY is reduced by reducing the operational power consumption by using lower voltages. However, there is a physical limit to the amount of power reductions that can be made to the PHY without losing IEEE compliance or compromising reliability.

In the case of standard Fast Ethernet PHY devices, when a NIC is the WOL mode, the PHY has to remain functioning at its full typical idling power even when little or no data is being transmitted or it will loose the link. Hence, a PHY capable of turning its transmitter off during quiet periods would save significant power.

In addition, there is no current method of notifying a remote network node via a simple PHY signaling scheme of the type of schemes a network node supports or requires when waking from a sleep or suspend state.

SUMMARY OF THE INVENTION

The invention provides a method and apparatus for supporting a link-suspend operation between network nodes. It applies to point-to-point data communications links.

Accordingly, it is an object of an embodiment of the invention to provide a network having a full power operational mode for supporting full high-bandwidth communication, and a low power "link-suspend" operational mode for temporary operation when only limited communication is occurring, such as when there are fewer data packets being transmitted across the link. The low power "link-suspend" (LS) mode is designed to reduce the power required by a LAN communications link at the physical layer by occasionally transmitting "link-suspend-pulses" (LSPs) instead of continuous idle pulses or symbols. For example, in LS mode, the invention maintains a digital communications link without causing the link to reset, while cycling transmitter power on and off, during a non-data transmission period, between valid data transmissions or LSP transmissions with a duty cycle that substantially reduces physical layer device (PHY) power.

One embodiment supports negotiation with a remote link partner to set up LS mode by advertising operational mode capabilities between the two network devices. For example, negotiation allows a PHY to easily detect whether it is connected to another LS mode capable PHY through negotiation parameters in order to initiate and monitor LS mode communications.

One aspect of the invention, in accordance with an embodiment, provides a LS mode capable of transmitting and receiving valid data frames when network nodes are in LS, sleep, WOL, or suspend mode. Thus, the invention is able to return to a full communications state, from a sleep or suspend state without missing any incoming data.

Also, an embodiment provides a LS mode capable of monitoring received signals in order to identify LSPs, low power state messages, normal idles, data frames, and incoming WOL packets without causing the link to reset.

Similarly, an embodiment allows a partner network device to detect whether it is linked to a suspended Wake-on LAN (WOL) network device, thus allowing the partner device to enter the LS lower power mode of operation for that link. For example, the invention also provides a means that a switch or hub PHY may easily detect whether it is connected to a suspended Wake-On LAN (WOL) adapter in a PC, thus allowing the switch or hub to enter a LS mode or filter out unwanted packets on the port connected to the suspended PC.

An embodiment of the present invention also contemplates a network node having a method of notifying a remote second partner network node via a simple PHY signaling scheme of the type of "wake-up" schemes the first network node supports or requires when waking from a sleep or suspend state.

Accordingly, when communication between a node and a hub on the network is limited, such as when a network nodes are either idle or have entered a sleep or suspended mode, such as a Wake-on LAN (WOL) state, power can be saved by switching from the normal, full power, multi-service protocol to a low power link suspend protocol. Here, both PHYs at each end of the link can switch off their transmitters for significant periods of time while maintaining a valid link, thus reducing the power consumption of each PHY. By choosing a duty cycle such that the transmitter is off for significant periods of time, it can be shown that the average power consumption can be reduced dramatically in between data transmissions to as much as approximately 30% of the power consumption of today's lowest power PHYs, depending on the implementation.

In addition, in an embodiment, the invention is designed in such a way that it fully inter-operates with prior devices when the new invented features are disabled and will only use the additional features from this invention with another device with similar capabilities.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a typical prior LAN system showing key functional components.

FIG. **2** is a block diagram of a typical prior physical layer device (PHY) system showing key functional components.

FIG. **3** is a state diagram of a half duplex example of the high level operational states of a modified Link Suspend capable PHY, in accordance with an embodiment of the invention.

FIG. **4** is a diagram of possible operational states while in Link Suspend mode or protocol, in accordance with an embodiment of the invention.

FIG. **5** is a waveform diagram showing packet transmissions and idle periods; normal idle transmission; Link Suspend Pulses (LSPs) and characteristics; and normal idle versus LSP power consumption; in accordance with an embodiment of the invention.

FIG. **6** is a register bit map of a LS modified Media Independent Interface (MII) link suspend control and status registers showing Link Suspend parameters, in accordance with an embodiment of the invention.

FIG. **7** is a register bit map of an auto-negotiation Next Page message and example Link Suspend Next Page code words, in accordance with an embodiment of the invention.

FIG. **8** is a general block diagram of a modified Link Suspend capable PHY network device for providing low power Link Suspend negotiation, mode, and pulses, showing key functional components, in accordance with an embodiment of the invention.

FIG. **9** is a graph of average PHY power consumption versus the density of packets being transmitted at any one time on a network link, in accordance with an embodiment of the invention.

FIG. **10** is a waveform diagram of link negotiation pulses showing NLPs and FLPs, in accordance with an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is a method and apparatus for supporting a physical layer link-suspend operation between network nodes. In the following description, numerous specific details are set forth to provide a more thorough description of the present invention. It will be apparent, however, to one skilled in the art, that the present invention may be practiced without these specific details. In other instances, well known features have not been described in detail so as not to obscure the present invention. Hereinafter, the term "system" is used to refer to a device and/or a method for performing a function. Also, hereinafter the term "network device", "network node", "physical layer device" or "PHY" is used to refer to a network apparatus, network device, network interface card (NIC), network node, network hub, a computer linked to a network via a network interface card (NIC), voice over Internet Protocol systems, LAN telephone systems, or refers to other devices that perform Internet or network communications specialized functions such as repeaters, bridges, switches, routers, brouters, or any other point to point computer communications element or portion thereof. Furthermore, the PHY function discussed comprises implementation by various appropriate integrated circuit techniques such as by using a predominantly analog circuit approach or a digital signal processor DSP based approach.

One embodiment of the invention generally applies to computer point to point data communications links that normally use constant idle bit streams between packet transmissions. Similarly, an embodiment may also apply to the situation where LAN nodes are either idle (i.e. no packets are being transmitted) or they have entered a sleep or suspended mode of operation, such as in a wake-on LAN state. For example, the invention may reduce power on a LAN communications link at the physical layer by providing a low power operational mode for temporary operation to reduce power consumed by a physical layer device (PHY). To substantially reduce PHY power, the low power mode will cycle transmitter power on and off in a power saving duty cycle when only limited communication is occurring. Here, power is saved by switching from the normal, full power, multi-service protocol to a low power link suspend (LS) protocol where lower power link suspend pulses (LSPs) are occasionally transmitted instead of continuous idle streams. Hereinafter, the terms "protocol" and the term "mode" shall be used to refer to a method, language, mode, protocol, or system of communication.

In one embodiment, the invention is for a Fast Ethernet physical layer device (PHY) in the 100BASE-TX mode of operation. Here, the invention allows a new generation of lower power Wake-on LAN (WOL) capable adapters and power efficient switch or hub equipment to be manufactured that save substantial power over prior generations.

The Link Suspend concept is expandable to other similar Local Area Network standards, such as 10BASE-T, 100BASE-T2, 100BASE-T4, 1000BASE-T or X and 802.5 networks (including High Speed Token Ring) where two communicating nodes share a common link.

Moreover, the invention may apply to various other appropriate data communications links, communications systems between two devices, point-to-point data communications links, and signal transmission and reception systems. For example, the invention can be applied to wireless networks, satellite networks, RF networks, or any other system where idle transmission periods are filled with idle non-data carrying transmissions for the purpose of maintaining a valid link. Similarly, Link suspend can also be used with various other appropriate media such as coax cable, fiber optic cable, satellite links, cell links, radio waves, etc.

According to an embodiment, to ensure compatibility with prior PHY devices, link suspend is implemented as enhancements to existing functional blocks within a PHY that normally uses constant idle bit streams between packet transmissions. Yet, the invention may be used with various other appropriate Physical Layers, PHYs, and network devices (see list above) comprising various other appropriate communications networks.

a. Power Savings

In LAN equipment that exist today most high speed point-to-point LAN links have no method of shutting off the transmitter power between valid data transmissions or during a sleep/suspended state without causing the link to reset. Hence, a low power LS mode of operation is described that reduces overall PHY power consumption at both ends of the link when network traffic intensity is reduced or one of the nodes is placed in a sleep mode.

According to an embodiment, two connected communications nodes are able to enter a low power link suspend mode of operation when either one or both nodes temporarily suspend operation during idle transmission periods on the link and can recover to full operation without losing network data. This "link suspend" (LS) state may be in response to a specific request by a host controller wishing to enter a lower power mode of operation and suspend network communications until a specific network packet or event causes the node and host to wake up. In Link Suspend state, two link partners that are both able to implement the scheme

send Link Suspend Pulses (LSPs) back and forth in a complimentary fashion in order to keep the link operational between normal data packet transmissions.

According to one embodiment, one, or both, of the link PHY partners of a 10/100 Fast Ethernet PHY device in link suspend state, will cease continuous transmission of scrambled Idle symbols in 100BASE-TX mode and instead transmit a periodic Link Suspend Pulse (LSP) that requires lower power. For 10BASE-T mode, the PHY partners may optionally cease transmitting NLPs and instead transmit LSPs based on an alternative NLP pulse shape or period that requires less power.

Thus, a benefit of the Link Suspend state is lower consumption of power by devices during the Idle state. Since the ratio of the short time when the transmitter is on versus off while in the new invented mode causes a significant reduction in the power consumption of a physical layer device, the system allows both physical layer devices at each of the link to save power in this manner.

Similarly, LS may also be employed where general power reductions are required during quiet times on the LAN. As more networks migrate to 100 Mbps at the desktop, the savings become more apparent. For instance, if the average power savings are of the order of 90 mA per network device (180 mA per link), then for 3.3V systems, this translates to approx. 300 mW per PHY. For a 1000 PC network, this translates to 300W for the PC NIC PHYs and 300W for the corresponding switch PHY port i.e. 0.6 kW total.

One embodiment vastly reduces power on a systems wide basis and improves implementation of a PC's Advanced Configuration Power management Interface (ACPI) implementation for LAN capable PCs, along with the Microsoft OnNow™ Wake-on LAN™ (WOL) network interface cards within the newer generation of networked personal computers. In addition, the lower power consumption on every link in the network (there can be many 1000s of links) reduces network operational costs and system cooling requirements.

b. Negotiation of LS Mode

According to an embodiment, LS capable network devices may recognize other LS network devices through the use of negotiation during link initialization along with specific signal characteristic that facilitates a fast recovery when data is intended to be transmitted across the link. Hence, a low power LS mode of operation may provide for negotiation or auto-negotiation to advertise low power mode capability allowing a LAN adapter or switch product to add several unique features. In the case of an ACPI/WOL capable NIC, one advantage is much lower power when the WOL scheme is in use. Thus, it is possible to offer an energy efficient or "green" switch that is capable of recognizing link-suspend capable adapters and entering a corresponding per port low power mode of operation, significantly reducing the idle power consumption of the switch.

According to an embodiment, implementing LS in either an ACPI/Wake-On LAN capable adapter or energy efficient switch is straightforward. Enabling link-suspend in the PHY may be performed by writing a logic 1 to the link-suspend enable bit (defaults to off) (see LSEN explanation below). Also, the PHY may support a means of configuring the device via hardware pin selection enabling link-suspend to default to being always enabled following a reset/power on. Similarly, a NIC may always have the mode enabled, relying on the PHY to automatically enter the mode based on the auto-negotiation result. Additionally, the mode may be enabled only when the adapter wishes to enter the link-suspend e.g. when the PC is shutting down and entering a sleep state. Hardware selection of link-suspend operation is useful for dumb switch controllers that do not have a programmable engine or CPU attached to enable or configure link-suspend via software.

In local area networking equipment that exist today there is no means by which a switch or hub PHY may easily detect whether it is connected to a suspended Wake-on LAN adapter in a PC, thus allowing it to enter a lower power mode of operation for that port. Thus an additional benefit, according to an embodiment, solves the prior difficulty by providing a simple PHY signaling scheme of notifying a remote network node of the type of schemes a network node supports or requires when waking from a sleep or suspend state, such that the remote node may behave accordingly.

Likewise, a third benefit, according to an embodiment, is that link suspend is defined to be a state which was agreed to during negotiation and is thus not lost, but merely suspended when exited from. Thus, exiting from and re-entering into the LS state does not require the two link partners to re-negotiate a link. For example, when a network device exits the LS state, it may re-enter the previous link state (e.g. IEEE 802.3 normal mode with continuous idle transmission) without resetting to a no-connect state or re-negotiating.

FIG. **3** is a state diagram of a half duplex example of the high level operational states of a link suspend PHY, in accordance with an embodiment of the invention. FIG. **3** shows the high level operational modes of an auto-negotiating PHY incorporating the invention. Note, the case where auto-negotiation **310** is not enabled is not shown to simplify the discussion. Following a reset or initial power on, a standard PHY will enter the "No Connect" state **300**. It will then proceed to auto-negotiate **310** with the partner PHY with the purpose of establishing the capabilities of the partner PHY and also advertising it's own capabilities to the partner PHY. Typical capabilities exchanged during auto-negotiation in prior PHYs are link speed, type of signaling, encoding schemes, and full or half duplex capability.

The Link OK flag **342**, in accordance with standard IEEE 802.3 Ethernet modes of operation, indicates when the link is operating properly or is fit. If error rates become unacceptable because a PHY receiver missed too many pulses or received too much noise; or upon a partner PHY becoming unstable; a cable being pulled out; or other appropriate media or receiver detected failures; then the Link OK flag will be set to the "not" state and the link will be declared unfit. When a link is lost, and the Link OK flag is not active, a PHY will reset and attempt to re-establish that link by entering the no-connect state **300** and trying to re-negotiate on that link. For example, a Fast Ethernet 100BASE-TX PHY with its Link OK flag reset will enter the no-connect mode, and then begin auto-renegotiation across the link by sending FLPs to see if another device is on the link. However, in some PHYs, if a data packet is transmitted to the partner PHY during the re-negotiation, the data will not be received, but instead will be "lost".

An embodiment of this invention includes the added ability within the auto-negotiation process **310** to exchange capabilities and parameters associated with link-suspend. Thus, when two link-suspend capable PHYs are first connected or powered on, in addition to the other typical negotiation parameters, the PHY's may exchange parameters with each other to determine if they can support link-suspend. For example, unused bits in the baseline auto-negotiation or Next Page extensions, as described in the IEEE 802.3 standard, may be used to auto-negotiate link suspend mode as well.

Referring to an embodiment, as shown in FIG. **3**, a link suspend capable PHY may control its ability to advertise

support for link-suspend via the control bit, link-suspend available (LSAV) **302**, controlled by a higher level device via the MAC. A link partner's ability to support link-suspend mode, determined during the auto negotiation process, is indicated by the link-partner link-suspend available (LPLSAV) bit (note that the "LP" prefix indicates a link partner flag). A PHY may only enable link-suspend if both of these flags are active. Auto-negotiation of Link Suspend mode will be discussed further below.

According to an embodiment of the invention, a PHY enables and disables LS mode or operation via a link-suspend enable bit (LSEN) **332**. Link-suspend operation may then be enabled once the link-suspend enable (LSEN) bit is set. Setting LSEN, **332**, inactive causes the device to leave link-suspend mode and re-enter IEEE 802.3 standard operating mode, as illustrated in FIG. **3**.

Embodiments of the invention include various systems for negotiating link suspend mode. In one embodiment full auto-negotiation based on a Next Page scheme is used. In another, transparent negotiation using a low level signaling scheme is employed. Additional embodiments comprise combinations of schemes, such as, for example, combining a version of full Next Page auto-negotiation with a transparent negotiation backup.

According to an embodiment of the present invention, link suspend capability may be negotiated through use of full auto-negotiation based on Next Page capability. Next Page auto-negotiation may be enabled when the link suspend auto-negotiate (LSAN) control bit is set. For instance, following a reset, if LSAN is set, then the PHY will support the Next Page link suspend auto-negotiation scheme. Note that LSAN defaults to off (zero) following a power on reset, but is not affected by a soft reset to support this mode of operation. In addition, embodiments may incorporate hardware control pins to allow the default value of LSAN to be set to facilitate applications that do not wish to use software to change the LSAN setting (e.g. multi-port PHYs in switch applications).

For example, in an embodiment, unused bits in the baseline auto-negotiation or Next Page extensions, as described in the IEEE 802.3 standard, may be used to auto-negotiate link suspend mode. For instance, after a Fast Ethernet PHY transmits an FLP, if there is a return pulse, the PHY will then pass information identifying what type of PHY it is and what modes it is capable of supporting. Referring to the embodiment illustrated in FIG. **3**, the PHY would send capability to support Fast Ethernet communications in Normal 802.3 Mode (including Idle mode), and Link Suspend Mode (including Link Suspend idle mode). Next page auto detection of link suspend will be explained further below.

c. Transparent Negotiation of Link Suspend Mode

Additionally, according to an embodiment of the present invention, link suspend capability may be negotiated through transparent auto-detect via low level signaling. Transparent auto-detect is simple to implement and offers a basic indication to a remote PHY that a first PHY is capable of link-suspend. Low level signaling (compatible with the existing Ethernet standards) from the first PHY takes place following a PHY reset or power on. This scheme provides a simple method for advertising link suspend ability without the need for modification to the current auto-negotiation standards as discussed for full auto-negotiation of link suspend mode above.

For an embodiment having an auto-negotiation system using both a Next Page scheme and a transparent scheme, transparent mode may still be active during Next Page auto-negotiation mode, however, any common parameters setup as a result of the transparent negotiation may be over-ridden by those exchanged during the Next Page auto-negotiation mode. In one such example, transparent auto-detection of link suspend is enabled when the link suspend auto-negotiate (LSAN) control bit is false (default) and auto-negotiation Next Page is also disabled (see below). In this mode, a LS capable PHY will employ a simple transparent signaling method embedded within the standard FLP or 10BASE-T templates to signal link-suspend ability to a remote partner. This process will only occur if the link-suspend available (LSAV) control bit in the LS capable PHY is set. Upon recognizing the embedded LSAV signal from a partner PHY, the LS capable PHY will set its own link partner link-suspend available (LPLSAV) bit in order to allow for entry into LS mode.

Link-suspend operation is then enabled once the link-suspend enable (LSEN) bit is set, indicating that the higher layer device wishes to enter the link-suspend mode. Setting LSEN inactive causes the device to leave link-suspend mode and re-enter IEEE 802.3 standard operating mode as illustrated in FIG. **3**.

The benefit of the low level detect mode is that it can work within the framework of the existing IEEE 802.3 auto-negotiation standards without the need for changes to the standard. For example, the low level detect method for certain existing series of Fast Ethernet PHY devices and cores will inter-operate fully with existing legacy PHYs in the market place today. Thus, systems using current auto-negotiation standards may comprise LS capable devices that will recognize another LS PHY device as the remote PHY and enable the link-suspend capability. Furthermore, in an embodiment, the LSAV AND LPLSAV flags are used internally by the PHY and are also made available to the MAC or Switch.

Although auto-negotiation according to one embodiment is illustrated in FIG. **3**, other appropriate methods and/or devices for allowing network devices to communicate in link suspend mode may also be used. For example, a hardware configuration that causes connected PHYs that are LS mode capable to automatically try link suspend mode after the no connect mode, by sending a link suspend pulse and listening for a return link suspend pulse in order to identify partner LS capability may be used. Similarly, although according to the embodiment of FIG. **3**, negotiation of LS capability is done during initial link negotiation or after no-connect state, negotiation, identification, or entry of LS mode may also be performed at various other appropriate times. In addition, an embodiment of the invention provides for backwards compatibility, so that the LS PHY can interface with non LS PHY's.

d. Link Suspend Mode

According to an embodiment, after negotiation of LS mode capability, a LS PHY or device has two options or modes of operation. The LS PHY may enter a Normal mode (e.g. mode of prior devices), or may enter LS mode. For example, a PC NIC, 100 Mb Fast Ethernet mode (100BASE-T), may enter Normal IEEE 802.3 mode having its PHY is fully powered, and continually transmitting and receiving normal Idles and data. Alternatively, the PC NIC may enter a low power LS mode.

Referring to FIG. **3**, an embodiment comprises a no connect state **300**, an auto-negotiation state **310**, a Normal IEEE 802.3 Mode **320**, and a Link Suspend Mode **330**. In turn, the Normal IEEE 802.3 Mode **320**, has a standard idle state **318**, a receive data frames state **322**, and a transmit data frames state **324**. The Link Suspend Mode **330**, has a Link

Suspend Idle state **338**, a receive data frames state **336**, and a transmit data frames state **334**.

Thus, as shown in FIG. **3**, once the auto-negotiation process **310** is complete, the PHY may enter a standard idle state **318** that is part of a normal operating mode of an IEEE 802.3 PHY **320**. While in standard idle **318**, the PHY receives standard idles and/or transmits standard idles as per the IEEE 802.3 standard. In full duplex mode, both receive and transmit of standard Idles can occur simultaneously. Alternatively, data frames are transmitted in the transmit data frames state **324**, and data frames are received in the receive data frames state **322**.

The invention modifies the standard PHY's modes by adding a further mode of operation, called Link-Suspend (LS) mode **330**. LS mode is enabled provided that a control signal, link-suspend enable (LSEN) **332**, is active, in addition to LSAV **302** and LPLSAV **304** being active as discussed earlier. The LSEN **332** may be implemented as a control register bit that is set either by a higher layer device, or configured using other means such as hardware mode configuration pins on the PHY device. Also, LSEN may default following a reset or power on of the PHY to either active or inactive, depending on the preference of the higher layer devices or hardware pins.

In an embodiment, LS mode has a Link Suspend Idle state **338** where Link Suspend Pulses (LSP) are transmitted, a receive data frames state **336** where normal data frames can be received, and a transmit data frames state **334** where normal data frames can be transmitted. In the LS Idle state **338**, the LS network device is able to instantly transition to the second receive/transmit data state in order to send or receive data frames, while still staying in LS mode. The LS network device is also capable of returning from the receive data frames state **336** or transmit data frames state **334**, to the Link Suspend Idle state **338**, while staying in LS mode. Further, the device can switch between the receive data frames state **336** and transmit data frames state **334**, without returning to the LS idle state. Thus, while in LS mode, the PHY may be able to send and receive LSPs and data frames; as well as be able to accept that the partner PHY may not continually send frames or idle symbols in return.

For example, when in the LS idle state **338**, standard 100BASE-TX scrambled idle symbol transmissions on the media are replaced with link suspend pulses (LSPs) designed to reduce PHY power consumption to a minimum level between data packets and during link idle times. In addition, the LSPs are used to indicate to each remote PHY partner that there is still an active PHY link. Thus, LSPs received by a partner LS PHY will prevent the partner LS PHY from entering the no-connect state **300** or attempting to re-auto-negotiate **310** the link.

Moreover, when in the link suspend mode **330**, normal data frames may be received **336** or transmitted **334** in half or full duplex with the difference from normal 802.3 mode being that the PHY returns to LS idle state **338**, instead of the standard idle state **318**, when data is not being received or transmitted.

Additionally, embodiments allow LS mode to be applied as permanent operating mode, or in conjunction with various other network device modes, as appropriate. For example, LS mode may be entered, not just during D3 or WOL power states, but also to reduce power consumption during intermediate low power modes such as D1 or D2.

Prior PHYs send constant idles pulses or symbols to a partner PHY when data communications are attenuated, when in any D0–D3 state, or when in any WOL state, in order to tell the partner not to drop the link just because no data is being received. Similarly, in an embodiment, a LS network device must be able to "hold" the link by using occasional LSPs comprising data, idle pulses, or idle symbols, as will be further explained below. However, various other appropriate systems for holding the link between LS network devices may also be used.

In an embodiment, in order to detect a removed cable, unplugged cable, broken cable, non-functional partner PHY, or powered-off partner PHY, an LSP receive timer may be implemented that detects if LSPs are being received. If no LSPs are received from the partner PHY within the period defined by the parameter LSPExp (LSP Expiration), the link is assumed to be broken. When the link is assumed broken, the PHY will fall back to the no connect state **300**, as shown in FIG. **3**. Furthermore, the internal flag, LSP received ok (LSPRXOK) **340** is active while LSPs are received and the timer has not timed out, and set false when no LSPs are received for a period exceeding the allowed time set by LSPExp (i.e. timer has timed out).

For instance, the timer-reload value, referred to as LSPExp, may default to 2× the value of the current LSP-Period value. In addition, LSPExp may be reset to an alternative value if appropriate based on multiples of LSP-Period or turned off for diagnostic purposes. The value of LSPExp may be advertised during auto-negotiation to a link partner using the Link-suspend Code Word.

According to one embodiment of the invention, the general rules followed by a LS PHY and a partner LS PHY may be summarized as follows:

1. A LS PHY enters the link-suspend mode **330** when both itself and a partner LS PHY have indicated via auto-negotiation **310** that they both support link-suspend mode (LSAV*LPLSAV is true) AND link-suspend mode has been enabled (LSEN=1).
2. A LS PHY remains in link-suspend mode **330**, receiving and transmitting LSPs or valid data frames, under the following conditions:
   a. Valid LSPs are received from the link partner LS PHY such that the LSP receive timer (loaded with the LSPExp value every time a valid LSP is received) does not expire;
   b. Valid data frames are received in the same format as those prior to entering link-suspend mode; and
   c. Valid data frames are presented to the LS PHY at the LS modified MII transmit interface for transmitting onto the media.
3. A LS PHY exits link-suspend mode **330** and resets to the no connect state **300**, under the following conditions:
   a. No LSPs or data frame activities are detected or received for a timeout period of time, indicating a cable has been unplugged or the remote link partner is non functional or has been switched off (LSPRXOK flag is reset). This timeout value is set by the LSP expiration parameter (LSPExp) within a LS PHY; or
   b. Normal data frame link pulses are detected or received by the LS PHY, indicating that the link partner LS PHY wishes to restart the auto-negotiation **310** process or go to the no connect state **300**.
4. A LS PHY exits the link-suspend mode **330** and resumes its prior operational state (for example normal IEEE 802.3 mode, **320**) without resetting (e.g. returning to the no connect state **300**) or causing a re-auto-negotiation **310** of the link when LSEN **332** is set inactive by the LS PHY's associated software device driver or MAC.

5. While in the link-suspend mode **330**, a LS PHY may:
   a. Transmit LSPs during periods when the link would normally be idle (e.g. during link suspend idle state **338**);
   b. Receive LSPs, or normal scrambled idle stream (continuous idles) depending on the setting of the LSPMode bit (see below) (e.g. during link suspend idle state **338**);
   c. Have sufficient minimal receive circuitry powered up to receive, recognize, and pass valid data frame messages or activity to the LS modified receive interface (e.g. during receive data frames state **336**); or
   d. Permit data to be transmitted without delay, from the LS modified transmit interface, onto the media (e.g. during transmit data frames state **334**).

Furthermore, referring to FIG. **3**, according to one embodiment, if both PHYs are link-suspend capable (i.e. LSAV **302**, and LPLSAV **304** are both true) but a LS PHY is in the normal IEEE 802.3 mode **320**, because LSEN **332** is inactive, that PHY must continue to receive LSPs without causing the link to reset (e.g. enter the no connect state **300**). Under such circumstance, that PHY will remain in the standard idle mode **318**, transmitting standard scrambled idles (e.g. 100BASE-TX), but receiving LSPs. Thus, the receive state machine **206**, may be modified from the current IEEE 802.3 standard so that that PHY does not cause the link to reset back to the no-connect state **300**. Here, the default power-on state of the PHYs may be with LSAV **302** set and LSEN **332** reset.

According to one embodiment, a LS PHY (say a Switch PHY) may be configured such that it enters link-suspend mode **330**, from the standard 802.3 mode **320**, only when that PHY receives LSPs (dependant on LSEN **332** being set by that switch PHY so that the partner LS PHY knows that the switch PHY is link suspend mode **330** capable). In this case, the Switch PHY would have to ensure that it can be forced into the link-suspend idle state **338**, as indication that LSPs are transmitted by the far end. Thus, the switch PHY going into link suspend mode is verification that the partner PHY is sending LSPs and they are being received by the Switch PHY. Here, whenever the Switch PHY is in link suspend mode, it is assumed that LSPs are being sent by both PHYs.

Such operation allows one of the PHYs (the Switch PHY here) to have control over whether the entire link (i.e. both PHYs) enters or exits link suspend mode. Here, the Switch PHY sends LSEN **332**, enabling the partner PHY to send LSPs in LS mode, thus causing the Switch PHY to enter LS mode and send LSPs based on detection of the partner's LSPs.

FIG. **4** is a diagram of possible operational states while in link suspend mode or protocol, in accordance with an embodiment of the invention. It shows the various operational states that a LS capable Switch PHY **418** and a LS capable NIC PHY **424** can be in while both enabled in the link-suspend mode **330**.

(a) When both PHYs are in LS idle state **402**, each PHY is periodically transmitting LSPs. Thus, both PHYs (Switch **418** and NIC **424**) are saving power.

(b) When the Switch PHY is transmitting a data frame with the NIC PHY in LS idle state **404**, each PHY is still in LS mode. Thus, the LS capable Switch PHY **418** draws higher power while transmitting one or more data frames (e.g. wake-up frames), reducing power between data frames, with its transmitter periodically transmitting LSPs and not continually transmitting standard idles. Moreover, the LS capable NIC PHY **424** is saving power because it is only periodically transmitting LSPs.

(c) When the NIC PHY is transmitting a data frame with the Switch PHY in LS idle state **406**, each PHY is still in LS mode. The Switch-PHY **418** has finished transmitting a data frame and the NIC PHY **424** is transmitting a data frame back to the receiving switch. Thus, the LS capable NIC PHY **424** draws higher power while transmitting while transmitting the one or more return data frames (e.g. wake-up confirmed frames), reducing power consumption between data frames with its transmitter periodically transmitting LSPs and not continually transmitting standard idles. Moreover, the LS capable Switch PHY **418** is saving power because it is only periodically transmitting LSPs.

(d) When the NIC PHY and Switch PHY are both transmitting (full duplex) data frames while in LS mode **408**, each PHY is still in LS mode. Data transmission is in a full duplex mode with each PHY receiving and transmitting simultaneously, as they would normally, with the exception that between data frames, instead of continually transmitting standard idles, each PHY is periodically transmitting LSPs. Thus, the LS capable NIC PHY **424** and Switch PHY **418** draw higher power while transmitting the data frames, and reduced power then the PHYs' transmitters are periodically transmitting LSPs as opposed to not continually transmitting standard idles. Overall power is reduced depending on the density of data frames as illustrated in FIG. **9**. Note, there are cases discussed later where a PHY may not be able to receive LSPs (See LSP transmit only mode below.)

e. Link Suspend Pulses

In prior systems, in order to allow for any future communications, it is necessary for a PHY to stay fully powered, continually transmitting data frames interlaced with idle symbols or pulses. These idle pulses typically contain a specific pattern of low level symbols, that require less power to transmit across the media or wire, but are enough to keep the receiver of a partner PHY locked on. Hence in link suspend mode it is still necessary to keep some type of link relationship between the PHY transmitter and the partner PHY receiver. The relationship is maintained by Link Suspend Pulses (LSPs) that cause the partner PHY receiver into holding onto the link, so that the partner is capable of sending return LSPs, normal idle pulses, data frames, or a WOL or a "D3-hot" state PHY a wake up packet. Thus, LSPs are sent periodically to keep the link ready and in "standby" state for further communication, and to keep the link from resetting (e.g. resetting before receiving a data packet).

FIG. **9** is a graph of average PHY power consumption versus the density of packets being transmitted at any one time on a network link, in accordance with an embodiment of the invention. The graph is a power curve **900**, showing the average PHY power consumed, **902**, increasing with increasing packet density, **904**. The power curve is at its lowest or minimum PHY power consumption, **908**, (e.g. 50 mW), when no packets are being transmitted. At the opposite extreme, during continuous packet transmission, the power curve reaches the saturation point of normal typical average PHY power consumption, **902**, (e.g. 250–300 mW).

FIG. **5** is a waveform diagram showing packet transmissions and idle periods; normal idle transmission; Link Suspend Pulses (LSPs) and characteristics; and normal idle versus LSP power consumption; in accordance with an

embodiment of the invention. The first waveform of FIG. **5** shows continuous idle periods and data packets transmissions **510**, having Idle Periods **500** interspersed between data Packet Transmissions **502** during normal network interface communications. The second waveform shows continuous normal idles **512** of a non-LS prior idle state where normal idles **520** are continuously transmitted to keep a partner receiver "locked on". The third waveform shows Idle Periods **500** comprising periodic Link Suspend Pulses (LSPs) **513**, as opposed to the continuous normal idles **512** of a non-LS prior idle state. The LSPs **530**, occur at a LSP period (e.g. LSPPeriod) and occur for a LSP width (e.g. LSPWidth **534**). The fourth waveform shows periodic LSP power consumption **514**.

Referring to FIG.**5**, as described earlier, link-suspend pulses (LSPs) **530**, are used to replace standard idles **520** or normal idle transmissions, while in the link-suspend mode **330**. The purpose of the LSPs **530** is to indicate the presence of a valid link and remote link partner as an alternative to the standard scrambled idle stream **520**, while conserving power within the PHY device and on the physical media.

FIG. **5** shows the effect of using LSPs **530**, as compared to transmission of continuous standard idles **520** in standard idle mode, on the consumption of transmitter power and corresponding PHY power. By plotting normal idles with the LSPs the periodic LSP power consumption **514** is illustrated. Here, the average link suspend power consumed by the PHY during the link suspend idle state (e.g. LSAvPwr **540**) can be calculated by comparing the typical power consumption of a PHY during normal idle state (e.g. TypPwr **542**), and the minimal power consumption of a PHY between link suspend idle pulses (e.g. MinPwr **544** during LSP Period **532**, less LSP Width **534**). Hence, using the definitions for LSAvPwr, TypPwr, MinPwr, LSPWidth, and LSPPeriod given thus far, the power consumption for the LSP steady state condition **338** is described by the following equation:

$$LSAvPwr=((TypPwr)*(LSPWidth/LSPPeriod))+((MinPwr)*((LSPPeriod-LSPWidth)/LSPPeriod))$$

Using the values for the LSPWidth **534** and LSPPeriod **532** from the equation given above, LSAvPwr can be calculated as follows:

$$LSAvPwr=((TypPwr)*(0.96/51200))+((MinPwr)*((51200-0.96)/51200))$$

$$LSAvPwr=((TypPwr)*(0.00002))+((MinPwr)*(0.99998))$$

$$LSAvPwr\sim MinPwr$$

Thus, LSAvPwr is roughly equal to the MinPwr consumption of the PHY when its transmitter is turned off. For example, a typical PHY consumes roughly 330 mW during standard idle **320**. During link suspend idle **330**, from present estimates, the PHY could consume as little as 50–70 mW, i.e. an 80–85% reduction in power.

According to one embodiment, in 10BASE-T mode, a special link-suspend pulse may not be required if the PHY has been designed to reduce its power between normal link pulses (NLPs). The argument is similar to the above case for 100BASE-TX link suspend, where the average power consumption of the PHY when transmitting NLPs can be designed to be close to the equivalent MinPwr for 10BASE-T, the power consumed in-between the pulse.

Moreover, for network devices having numerous LS capable PHYs, such as a switch for example, the power savings will be multiplied by the number of LS PHYs linked to other partner LS capable PHYs. Thus, for a switch having multiple LS PHYs interfaced to multiple other LS network devices (NICs for example, each having only a single PHY), the NICs and the switch benefit in an 80–85% power savings for each PHY-PHY link which enjoys the low power LS mode.

f. LSP Composition

Moreover, in an embodiment, an LSP indicates the presence of a link partner in link suspend mode to facilitate a lower power mode of operation for either one or both link partner PHYs. The frequency of an LSP can be set to any specific value that can be designed into a PHY. The frequency is allowed to be fixed or programmable. LSPs may be sent uni-directionally or bi-directionally between a PHY and its link partner. Specific implementations might require LSPs, for example, to be only sent from the PHY on the NIC to the PHY on the switch and not in the other direction. On the other hand, some implementations might require LSPs to be sent from both the NIC's PHY and the switch or hub PHY.

In an embodiment of the invention, LSPs **530** can be implemented a number of ways, from single electrical pulses to bursts of standard idles, and/or specially coded symbols. For example, the LSP may comprise of some of the unused symbols of a particular coding scheme (for example unused symbols in a standard IEEE 802.3 coding scheme) in order to distinguish the LSP from data frames or standard idle patterns, making LSP detection easier. Also, in one embodiment, it may be desirable to replace 10BASE-T mode normal link pulses (NLPs) with LSPs that uses the same pulse type as NLPs but with a longer period.

In an embodiment, for 1000BASE-T, where each of four pairs of signal links employs a duplex transmission approach, four simultaneously transmitted LSPs may be used. Also, an embodiment, may shut down one or more of the four duplex transmissions links during link-suspend idle and use a fewer number of LSP pairs, or even a single pair if possible, to transmit LSPs and assure resynchronization of partner LS network device receivers.

In an embodiment for a 100BASE-TX link, when link-suspend mode is enabled and active, a LS Switch PHY transmitter will start sending LSPs **530** within the timeframe LSPPeriod **532**, following the end of transmitting a valid frame **502**. LSPs may be made up of a series of scrambled idle symbol bursts, consisting typically of 32 symbols. The number of symbols in an idle burst may be altered via the parameter LSPWidth **534**, allowing a range of 32 up to 512 symbols (default **32**). The LSPPeriod period parameter may be programmed as multiples of a base value of 512 ms, for example. In this case, LSPPeriod **532** may be equal to "0", causing an LSP pulse to occur every 512 ms, or "**3**" (e.g. binary 11, as shown in FIG. **7**) extending the period to 2048 ms. In addition, the PHY may transmit a normal data frame **502**, when TXEN (Transmit Enable) is asserted at the LS modified MII transmit interface, and ceases sending LSPs until the frame is completely transmitted **502**. Further embodiments include LSPs having fixed non-programmable LSP Width and LSP Period.

According to an embodiment, a LS capable PHY receiver (e.g. receiver circuits **210**, receiver PHY functions component **206**, and normal and fast link pulse and valid frame detector **214**), when in the link-suspend state and receiving LSPs **530**, must be capable of resuming full data operations when a data frame is received. Thus, the PHY must implement an appropriate means of restarting the receiver within the frame pre-amble period without losing any of the received frame data.

For example, according to one embodiment, the PHY may send an LSP comprising of 20 normal idle pulses, and then

switch off its transmitter for a period three times as long as it takes to transmit the 20 pulses. Entering such a duty cycle assures that the transmitter is off for most of the time, substantially reducing PHY power consumption, thus saving most of the power expended by the NIC.

According to one embodiment, the type of signaling used by the LSP is such that it facilitates a fast recovery of the receiver upon reception of an LSP or data packet while in LS mode, and maybe used to resynchronize the receiver clock and data recovery circuits while the link is in the link-suspend idle state **330**. The LSP should cause resynchronization of the receiver circuits to allow them to recover a LSP or a transmitted data frame from the remote partner PHY within the standard preamble time of the incoming data frame.

For instance, according to an embodiment, LSPs may have characteristics to assure both PHY receivers stay synchronized to each other's transmitter outputs. In other words, each LS network device must assure that it has the capability to remember certain receiver Phase Lock Loop information (e.g. timing cycle) and filter coefficients.

According to an embodiment, in order to distinguish incoming signal bits and type, a PHY's receiver PLL must be able to lock onto the timing of an incoming signal in LS mode, even if the signal is unexpected, or arrives when the transmitting PHY is supposed to have its transmitter powered down. In other words, the receiver PLL must keep the timing rhythm, or be capable of fast locking onto the incoming signal, even without the idle timing pulses. Since typical prior PHY PLLs rely on receiving a continuous signal containing either data frames or idle pulses to hold a lock, these devices do not have capacity to remember timing or signal information during transmitter powered down period of LS mode. Examples of such signal information are link phase, link timing, and PLL phase period (the timing between clock pulses). Hence, such a prior PHY must be adapted to be able to keep timing rhythm in order to estimate where the bits of an incoming signal will be. Then, even 100 clock ticks down the road, the PLL will be able to tune in with received data bits to distinguish 1s and 0s.

Similarly, in an embodiment, an adaptive receiver PHY equalizer is designed to remember the input characteristics of the link, as last determined. For example, storage of the equalizer coefficients, which contain information that maps the input characteristics, will enable the receiver to quickly adapt to the received signal.

However, embodiments comprising various appropriate LSPs may be used to ensure that link suspend capable network devices can recognize, distinguish, and interpret LSPs, standard idles, data frames, wake up packets, or other communications during entry to, departure from, or existence in any communications condition, protocol, or mode. For example, embodiments having various other appropriate systems or electronic signals for receiving and/or transmitting data while in LS mode, or by transitioning to another mode or state, may be used.

g. LS Modified MII Control and Registers

FIG. **6** is an example of a register bit map of a LS modified Media Independent Interface (MII) link suspend control and status registers **600** showing link suspend parameters, in accordance with an embodiment of the invention. The LS modified MII, comprises a link suspend message identification (ID) register **602**, link partner status register **604**, and link suspend control register **606**. Each of the three registers has 16 bits. The bits in the words are identified by a "D", followed by the bit number, beginning with "0", as illustrated in FIG. **6**. The link suspend message identification register **602**, comprises the Link Suspend Message Identification **630** in bits D**0–10**, and reserved bits **628** in bits D**11–15**. The link partner status register **604**, comprises reserved bit **628** in bit D**0**, LPLSAV **304** in bit D**1**, LPLSPMode **621** in bit D**2**, reserved bit **628** in bit D**3**, LPLSPPeriod **618** in bits D**4–5**, LPLSPExp **616** in bits D**6–7**, LPLSPWidth **612** in bits D**8–11**, LPWakeUpCode **626** in bits D**12–14**, and reserved bit **628** in bit D**15** (note that the "LP" prefix indicates a link partner flag). Parameters that are received during auto-negotiation are stored in the link partner status register. For example LSAV, LPLSPExp, LPWakeUpCode, LPLSPWidth and LPLSMode. The link suspend control register **606**, comprises LSEN **332** in bit D**0**, LSAV **302** in bit D**1**, LSPMode **620** in bit D**2**, reserved bit **628** in bit D**3**, LSPPeriod **532** in bits D**4–5**, LSPExp **614** in bits D**6–7**, LSPWidth **534** in bits D**8–11**, WakeUpCode **624** in bits D**12–14**, and LSAN **622** in bit D**15**. Reserved bits **628** may support redundant codes or data or perform other valid functions such as providing message protocol or control information as necessary.

In accordance with one embodiment of the invention, during system operation, a PHY in LS mode must ensure that it observes the Link Partner LSPWidth (LPLSPWidth) parameter **612** received and sets its transmitted LSP pulse width, LSPWidth **534**, accordingly. The timer-reload value, referred to as LSPExp **614**, is set by the received parameters from the remote partner PHY. For instance, the link partner LSPExp (LPLSPExp) **616** and link partner LSPPeriod (LPLSPPeriod) **618** values received by a PHY ensure that the LSP receive timer functions correctly in accordance with the timing of partner PHYs transmitter functions.

In the invention, according to an embodiment, the LSP-Period and LSPWidth values are advertised to the link partner during auto-negotiation when LSAN is set. For PHYs that implement the transparent detect method described earlier without using the Next Page auto-negotiation, the default LSP parameter values are assumed (indicated in the Link Suspend Code Word earlier). The link partner must ensure that it observes the LSPWidth parameter received and sets its LSP pulse width accordingly. The same applies to the LSPMode parameter. Thus, the remote PHY upon receiving LSPMode must set its LSP transmit mode accordingly.

In an embodiment of the invention, in order to ensure a valid link is still present, each PHY must implement a counter for timing the arrival rate of LSPs **530** when link-suspend mode **330** is active. If the timer expires, the flag LSPRXOK **340** is reset and the PHY will reset back to the no-connect state **300** as shown in FIG. **3**. It may be reset to an alternative value if appropriate based on multiples of LSPPeriod **532** or turned off for diagnostic purposes. Both the LSPPeriod **532** and LSPWidth **534** values are advertised during auto-negotiation to a link partner as described later.

h. LSP Transmit Only Mode

In an embodiment, it may be desirable or necessary to only have one of the PHYs generate LSPs **530**s, and the other continue in a non-LS transmit mode. For instance, a PHY generating LSPs may wish to receive 100BASE-TX scrambled idles **520**s. Consequently, the receive circuits of the PHY receiving the standard idles remain in normal IEEE 802.3 operation and are able to instantly receive a Wake-on Lan (WOL) frame. In order to implement LSP transmit only mode, the LSPMode Control Flag or bit **620** may be used in auto-negotiation Next Page (explained below) to allow a PHY to advertise to its link partner that it requires the link partner to always transmit standard idles **520**s as opposed to LSPs **530**s. Likewise, the LPLSPMode Control Flag **621**,

allows the link partner to advertise the same requirement in return, if necessary.

According to an embodiment, transmitting LSPs while requesting normal continuous idle streams can be used by the LS capable NIC PHY **424** communicating with a LS capable Switch PHY **418**, so that an incoming WOL packet received by the NIC PHY is not missed in 100BASE-TX transmit due to the receiver circuits (PLL and equalizer) not being able to lock onto the incoming packet and resynchronize the scrambler. Note that lower power consumption is still realized in the LSP transmitting NIC PHY **424**, but not in the normal idle transmitting LS capable Switch PHY **418**.

For typical WOL applications, it is not expected that the LS Switch PHY in transmit only mode will experience 100BASE-TX transmit re-synchronization problems upon waking the NIC PHY because there will be a reasonable timeframe between when the Switch wakes the NIC PHY **124** out of LS mode **330** (LSEN=0) and when the workstation having the NIC PHY is able to transmit a meaningful operating system level packet back to the Switch PHY **418**. Here, the NIC PHY will restart transmitting a continuous scrambled idle sequence once it is woken. Thus, the delay between when the switch sends the wake-up and when the 1st data packet is returned to the switch from the NIC PHY, should give the Switch PHY **418** adequate time to recover receiver operation if required, as scrambled idles **520** will have been received by the Switch PHY for a reasonable period of time before the data packet is received.

i. Next Page Auto-Negotiation of Link Suspend

In an embodiment, during the auto-negotiation state **310**, the PHY and partner PHY may indicate their ability to support link-suspend mode **330** by employing auto-negotiation Next Page. Auto-negotiation Next Page permits additional parameters to be exchanged with the remote PHY, allowing reconfiguration of those parameters along with indications of the higher layer wake-up modes employed within the node. Use of Next Page requires a simple extension to the IEEE auto-negotiation standard to recognize the link-suspend Next Page message ID. For example, the message ID may be temporarily set to #20hex, although other appropriate values may also be used (e.g. as a result of any standardization efforts). Further, a control bit may be present to enable or disable the link-suspend auto-negotiation capability described within. As illustrated in FIG. **6**, a control bit, link-suspend auto-negotiation (LSAN) **622**, is identified for this purpose. Moreover, PHY Wake Up Code **624** and link partner Wake Up Code **626** can be contained in the registers allowing either PHY to notify the other PHY of the type of packet the PHY needs to be sent to be woken up (for instance out of a WOL suspended mode).

According to an embodiment, following a reset, if LSAN **622** is set, then the PHY will support the Next Page Link Suspend Auto-Negotiation scheme. Here, LSAN defaults to off (zero) following a power on reset, but is not affected by a soft reset to support Next Page auto-renegotiation of LS mode. Hardware control pins may be implemented that allow the default value of LSAN to be set to facilitate applications that do not wish to use higher layer software to change this setting (e.g. multi-port PHYs in switch applications).

As mentioned above, a mechanism, referred to as Next Page, may be used for passing operational parameters between PHYs during link negotiation. The IEEE 802.3 auto-negotiation standard, as described in IEEE 802.3 Standard for CSMA/CD Access method and Physical Layer Specifications, Section 28.2.3.4, is one example of such a mechanism, but other valid ones may also be implemented. As governed by the exiting IEEE standard, support of a link-suspend parameter exchange requires the assignment of a link-suspend Next Page message ID. A control register, link-suspend message ID (LSMSGID) **630** is identified for setting the Next Page message ID parameter. This may either be a hardwired value within the PHY or a programmable register that may be setup by the controller interfacing to the PHY (e.g. see the LS modified MII registers above).

FIG. **7** is a register bit map of an auto-negotiation message Next Page **700** and example link suspend Next Page code words, in accordance with an embodiment of the invention. In this example, an unformatted Next Page #**1 702**, and unformatted Next Page #**2 704**, are shown following the message Next Page **700**. Here, using the IEEE standard, the Next Page scheme provides a means of transmitting 16-bit Next Page words (**700**, **702**, and **704**, either message or unformatted Next Pages) to a partner PHY. Although the Next Page scheme is described here, various other appropriate combinations of registers may be used for link negotiation.

The auto-negotiation message Next Page **700**, comprises of a Link Suspend message ID (LSMsgID **630**) in bits D**0**–**10**, and reserved bits **628** in bits D**11**–**15** for providing message parameters and control (e.g. Next Page flags). The 11 bit Link Suspend message ID indicates that further pages to follow provide additional link-suspend code words in the unformatted code word format.

The unformatted Next Page #**1 702**, comprises 11 bit code word link suspend code word #**1 720**, and reserved bits **628** in bits D**11**–**15** for providing message parameters and control (e.g. Next Page flags). Similarly, the unformatted Next Page #**2 704**, comprises link suspend code word #**2 740**, and reserved bits **628** in bits D**11**–**15** for providing message parameters and control (e.g. Next Page flags).

The link-suspend code word #**1 720**, provides the basic parameters to set up link suspend operation **330**. Link-suspend code word #**2 740**, is optionally sent, only if a bit field of the first link-suspend code word is set, indicating there is further information to be sent. Examples of parameters sent in the two code words, according to an embodiment, are described below. The bits in the words are recognized by a "D", followed by the bit number, beginning with "0", as illustrated in FIG. **7**.

Link-suspend Code Word #**1 720** (D**0**–D**10**) bit D**0**=LSAV **302**
- =0 Link-suspend Not Enabled (but PHY is capable)
- =1 Link-suspend Capable (enabled if both link partners are capable)

bit D**1**=LSPMode **620** (required by this PHY—remote PHY must support request)
- =0 PHY transmits LSPs and receives LSPs during link-suspend operation
- =1 PHY transmits LSPs but requires standard idles during link-suspend mode in order for the receiver to operate correctly (remote PHY must ensure that when it sees this it does not transmit LSPs during link-suspend idle state).

bits D**2**–D**3**=LSPExp **614** (LSP receive timeout)
- value 0=2×LSPPeriod value (default)
- value I=3×LSPPeriod value
- value 2=4×LSPPeriod value
- value 3=off (never times out)

bits D**4**–D**5**=LSPPeriod **532** (LSP pulse spacing)
- value 0=512 ms (default)
- value I=2×512 ms

value 2=3×512 ms

value 3=4×512 ms

bits D6–D9=LSPWidth **534** (minimum pulses required by this PHY to operate)

value 0=16 symbols (default)

value n=(n−1)×16 symbols (where n=2–15)

(Optional) Link-suspend Code Word #**2 740** (D**0**–D**10**)

bits D**0**–D**2**=WakeUpCode **624** (see examples below)

bits D**3**–D**10**=reserved **628**

Note that these are example assignments, and various other appropriate message, word, and bit combinations may be used for varying implementations of link-suspend.

j. Wake-up Codes

In an embodiment, a PHY may use a second link-suspend code word **740**, during auto-negotiation **310**, to advertise additional parameters to remote partner PHYs. For example, three bits of Link Suspend Code Word #**2 740** may be reserved for indicating the packet required by the node to "wake up" from a sleep state or to perform Wake-on LAN (WOL) operations. The network operating system driver is required in this case to write a meaningful value to the WakeUpCode field **624** of a register within the PHY device. This capability permits a LS Switch PHY **418** to recognize, which end stations or attached partner LS NIC PHYs **424** are sleep capable, along with what packet types or link conditions can be used to wake up each sleep capable node, without the need or intervention of higher layer protocols. The switch may use the codes to employ additional filtering schemes (that recognize the appropriate packet required by a sleeping node) thereby preventing unscreened packets from reaching the end station unless they meet the WOL criteria (i.e. are the appropriate wake up packet).

For an embodiment, example Wake-up codes **624** may be as follows:

=000 Not defined (NIC—default)

=001 Originator of wake up packet (normally a switch port)

=010 Wakeup using Link Status change

=011 Wakeup using Magic Packet

=100 Wakeup using Masked Packet (e.g. OnNow)

=101–110—User defined

=111—Reserved for future use (e.g. Wake up code expansion control word in a further link suspend code word)

For this embodiment, a code value of zero simply means the software has left the Wake-up code undefined. Thus, none-zero values are advertised by a NIC supporting a form of sleep mode that requires a wakeup packet to resume operation. Note that a switch is usually the originator or forwarder of the wake up packet, with WakeUpCode=001. Also, note that where both PHY's WakeUpCodes are non-zero, either node may be woken up or originate wake-up frames (e.g. switch-to-switch connections). Thus, the link-suspend scheme is programmable and facilitates adjustment of key operational parameters, such as wake-up codes, to enable fine-tuning to match an application's particular needs and intensity of data traffic.

According to an embodiment, an additional benefit of the invention is that a network manager may poll the switches in a network and determine which PC/workstations are currently sleeping, awake or turned off completely, by interrogating the switch management information base (MIB), independent of the PC/workstations being awake or not. Here, the LSAV and LPLSAV flags, which are used internally by the PHY, can also made available to the MAC or Switch after link negotiation. Thus, the MAC level controller can determine if a link is link suspend-capable by polling a link-suspend available (LSAV) status bit via the LS modified MII register, and store the result in a MIB register for system level access.

Similarly, an embodiment allows more intelligent and power sensitive network devices (e.g. switch/hub devices) to be manufactured that can recognize a sleep capable attached node without the need for higher-level protocol support. The recognition is supported through a low-level mechanism for passing link power management parameters and WOL operational modes between WOL capable network devices. In the example of a PC LAN adapter and a LAN switch or hub device, the switch can simply read a PHY register (LPLSAV in the LS modified MII) to determine if a remote partner PHY (and NIC's) has sleep or WOL capability. Moreover, an embodiment allows a switch receiving enough LSPs to indicate that its remote partner is asleep, to poll the switch manager to determine what type of wake up packet to send to wake up the sleeping partner node, by reading the sleeping partner's wake up code register.

k. Invention Construction

FIG. **8** is a general block diagram of a modified LS capable PHY network device **800** for providing low power Link Suspend pulses and protocol, showing key functional components, in accordance with an embodiment of the invention. As illustrated, a standard PHY requires several changes in order to support the additional LS negotiation, mode, and states. Also, implementing the invention as an enhancement to a standard PHY facilitates backwards compatibility. Thus, FIG. **8** illustrates the high level PHY functions that may be modified to create a LS capable PHY from a current PHY (e.g. from a typical prior PHY **200** as shown in FIG. **2**, to a LS capable PHY **800** as shown in FIG. **8**).

FIG. **8** illustrates an embodiment comprising a LS modified MII registers and interface logic component **802**, connected to a Link Suspend state machine **801**, a transmit PHY functions and LSP function component **804**, a receive PHY functions and LSP support circuits component **806**, and a modified auto-negotiation state machine with Next Page link suspend support **816**. In turn, the Link Suspend state machine **801** is also connected to the transmit PHY functions and LSP function component **804**, a modified LS capable transmitter circuits **808**, and the receive PHY functions and LSP support circuits component **806**. The transmit PHY functions and LSP function component **804**, is also connected to modified LS capable transmitter circuits **808**. Likewise, the receive PHY functions and LSP support circuits component **806**, is also connected to a normal and fast link pulse and valid frame detector **214**, and a modified LS capable receiver circuits **810**. The modified LS capable transmitter circuits **808**, is also connected to a normal and fast link pulse generator **212**. The modified LS capable receiver circuits **810**, is also connected to the normal and fast link pulse and valid frame detector **214**. The modified auto-negotiation state machine with Next Page link suspend support **816**, is also attached to the normal and fast link pulse generator **212**, and the normal and fast link pulse and valid frame detector **214**.

In an embodiment, the link suspend state machine **801** provides overall control of the PHY link suspend functions of the system. The state machine may be a standalone state machine as shown in FIG. **8**, or integral to the receive or transmit PHY function components, which may be state machines too.

Likewise, according to an embodiment, the LS modified MII Registers and Interface Logic component **802**, provides a common interface for connecting the LS capable PHY **800**

with different types of standardized MACs so that different vendors can design standardized products that will successfully interface with the LS PHY. For example, devices supporting the link suspend modes may be pin compatible with the existing PHY chip devices, allowing products with the existing chip devices to later upgrade in hardware, or migrate in design to a low power LS version in order to support the LS mode without hardware or board level changes. However, various other appropriate PHY interfaces, such as RMII, SMII, GMII, for example, may also be used.

Additional control and status registers **600**, may be located in the LS modified MII registers and interface logic component **802** to monitor and control link suspend operation. For example, a Link Suspend Control **606**, Link Suspend Partner Status **604**, and Link Suspend Message ID **602** registers may be employed having bit significance as shown in FIG. **6**.

Further, in the invention according to one embodiment, the modified auto-negotiation state machine and associated logic **816**, may support recognition of and provision of various parameters of a link suspend partner PHY. For example, the modified auto-negotiation state machine may use Next Page link suspend support to provide to the pulse generator **212** and recognize from the frame detector **214**, various parameters used to initiate and control communications and link suspend operations. Thus, the modified auto-negotiation block is responsible for negotiating with its remote LS capable PHY partner to achieve the desired communications modes.

For instance, the modified negotiation state machine may transfer and/or receive parameters that alter the behavior of a LS PHY's receiver in order to match the characteristics of a partner LS PHY's transmitter; or to dictate a specific link-suspend mode necessary for the a LS PHY's receiver circuits to operate correctly, as illustrated in FIGS. **4**, **6**, and **7**.

The transmit PHY functions and LSP function component **804**, controls the modified LS capable transmitter circuits **808**, which transmit across the wired link **122**. Likewise, the receive PHY functions and LSP support circuits component **806**, controls the modified LS capable receiver circuits **810**, which receive data from the wired link **122**. The normal and fast link pulse generator **212** provides the timing pulses for the modified LS capable transmitter circuits **808**. Similarly, the normal and fast link pulse and valid frame detector **214** provides receipt triggering for the modified LS capable receiver circuits **810**.

Moreover, the modified transmitter function **804** and associated circuits **808**: (1) support the generation of link suspend pulses **530** and (2) consume less power when transmitting a series of link suspend pulses **530** as compared to prior standard link idle state transmissions **520**, and (3) switch the majority of the powered up circuits off between link-suspend pulses **530** in order to reduce the average power consumption of the PHY to a minimum, as illustrated in FIG. **5**.

Additionally, the modified receiver function **806** and associated circuits **810**: (1) support detection of valid link suspend pulses **530**, (2) detects loss of link suspend pulses by timing the interval between valid link suspend pulses, and (3) recover from the link-suspend idle state **338**, upon receipt of a valid packet or frame without the loss of the incoming data, as shown in FIG. **5**.

Although certain embodiments have been described, the invention may be designed in such a way that it fully inter-operates with prior network devices when the link suspend features are disabled and will only use link suspend features with another network device having some of the similar capabilities.

The physical layer link suspend operation system described above is for purposes of example only. An embodiment of the invention may be implemented in any type of network method, apparatus, device, mode, state, in any network environment, or across any network media. For example, it may be used as a stand-alone system, or the apparatus may be coupled to other similar apparatus, PHYs, or network device across any type of network (e.g., LAN, WAN, PSTN, Internet, Cable TV, cellular, satellite, etc.), or any combination thereof.

Thus, a method and apparatus for supporting a physical layer link-suspend operation between network nodes has been described. Particular embodiments described herein are illustrative only and should not limit the present invention thereby. The invention is defined by the claims and their full scope of equivalents.

What is claimed is:

1. An apparatus comprising:

a link suspend device comprising a low power communications mode, said low power communications mode comprising transmission of at least one link suspend pulse;

a plurality of link suspend registers for monitoring and controlling said low power communications mode, said plurality of link suspend registers maintaining characteristics of said link suspend pulse; and

a transmitter comprising a plurality of circuit elements coupled to said link suspend device, said transmitter configured to transmit said link suspend pulses and to power down at least one of said plurality of circuit elements between said transmissions of said link suspend pulses.

2. The apparatus of claim **1**, further comprising a generator coupled to said transmitter, said generator configured to provide timing pulses to said transmitter.

3. The apparatus of claim **1**, further comprising a transmit functions controller coupled to said transmitter, said transmit functions controller configured to provide control of said transmitter.

4. The apparatus of claim **1**, further comprising a receiver coupled to said link suspend device.

5. The apparatus of claim **4**, wherein said receiver is configured to detect valid ones of said link suspend pulses.

6. The apparatus of claim **5**, wherein said receiver is configured to detect the absence of said link suspend pulses.

7. The apparatus of claim **4**, wherein said receiver is configured to detect a valid data frame template while in said low power communications mode.

8. The apparatus of claim **7**, wherein said link suspend device is configured to continue said low power communications mode upon receipt of a valid data frame template and process data contained in said valid data frame template.

9. The apparatus of claim **7**, wherein upon receipt of a valid data frame template said link suspend device is configured to:

bring a host device coupled to said link suspend device out of a sleep state;

process data contained in said valid data frame template; and

continue said low power communications mode.

10. The apparatus of claim **4**, further comprising a detector coupled to said receiver, said detector configured to detect normal and fast link pulses.

11. The apparatus of claim **10**, wherein said detector is configured to detect valid data frame templates.

12. The apparatus of claim 10, further comprising a receive functions controller coupled to said receiver, said receive functions controller configured to provide control of said receiver.

13. The apparatus of claim 4, further comprising a negotiation device coupled to said transmitter, said negotiation device configured to negotiate a communications link.

14. The apparatus of claim 13, wherein said negotiation device is further configured to provide at least one first link parameter to at least one link partner, and receive at least one second link parameter from said at least one link partner.

15. The apparatus of claim 14, wherein said first and said second link parameters comprise information for initiating and controlling said low power communications mode.

16. The apparatus of claim 14, wherein said parameters comprise a wake-up code for identifying a data packet that upon receipt will bringing a host device attached to said link suspend device out of a sleep state.

17. The apparatus of claim 16, wherein said wake-up codes are transmitted and received, using Next Page messages.

18. The apparatus of claim 14, further comprising:

a mode control parameter for transmitting to said link partner, said mode control parameter configured to cause said partner to suspend transmission of link suspend pulses and continue to receive link suspend pulses.

19. The apparatus of claim 13, wherein said negotiation device comprises an auto negotiation device.

20. The apparatus of claim 1, wherein said transmitter is further configured to power down at least one of said plurality of circuit elements between transmissions of valid data templates.

21. The apparatus of claim 1, further comprising an interface coupled to said link suspend device, said interface configured to interface with a media controller.

22. The apparatus of claim 21, wherein said interface further comprises at least one register and interface logic for initiating and controlling said low power communications mode.

23. The apparatus of claim 22, further comprising:

a register for providing a link partner with a wake-up code, said wake-up code configured to notify a host device attached to said link suspend device of a wake up mode employed by said link suspend device; and

a register for receiving and recording a partner wake-up code, said partner wake-up code configured to notify a host device attached to a link partner of said wake up mode employed by said link suspend device.

24. The apparatus of claim 21, wherein said interface is configured to receive a first set of data from said media controller for transmitting onto a link, and is configured to provide a second set of data received from said link to said media controller.

25. The apparatus of claim 21, wherein said plurality of link suspend registers comprises an identification register, said identification register configured to provide to a link partner, information used to define operational parameters for link partner operation related to said suspend pulses.

26. The apparatus of claim 25, wherein said plurality of link suspend registers comprises a control register, said control register configured to provide to a link partner, information used to initiate and control said low power communications mode.

27. The apparatus of claim 26, wherein said plurality of link suspend registers comprises a status register, said status register configured to receive and retain from a link partner, information used to initiate and control said low power communications mode.

28. An apparatus comprising:

a link suspend device comprising a low power communications mode, said low power communications mode comprising transmission of at least one link suspend pulse;

a transmitter comprising a plurality of circuit elements coupled to said link suspend device, said transmitter configured to transmit said link suspend pulses and to power down at least one of said plurality of circuit elements between said transmissions of said link suspend pulses;

a receiver coupled to said link suspend device, said receiver configured to detect said link suspend pulses and data frame templates while in said low power communications mode;

a detector coupled to said receiver, said detector configured to detect normal link pulses, fast link pulses, and valid data frame templates;

a plurality of link suspend registers for monitoring and controlling said low power communications mode;

a negotiation device coupled to said link suspend device, said negotiation device configured to negotiate a communications link; and

an interface coupled to said link suspend device, said interface configured to interface with a media controller.

29. The apparatus of claim 28, wherein said apparatus comprises a computer network physical layer device.

30. The apparatus of claim 28, wherein said transmitter is further configured to power down at least one of said plurality of circuit elements between transmissions of valid data templates.

31. The apparatus of claim 28, wherein said plurality of link suspend registers comprises:

an identification register coupled to said link suspend device, said identification register configured to provide to a link partner, a first set of information used to define operational parameters for link partner operation related to said link suspend pulses;

a control register coupled to said link suspend device, said control register configured to provide a second set of information used to initiate and control said low power communications mode with a link partner; and

a status register coupled to said link suspend device, said status register configured to receive and retain a third set of information used to initiate and control said low power communications mode with a link partner.

32. A method for providing a low power communications mode, comprising:

negotiating a link with a link partner, wherein said negotiating comprises:

transmitting to said link partner parameters identifying available communications modes;

receiving from said link partner parameters identifying available link partner communications modes;

receiving from said partner parameters identifying a low power communications mode as one of said available link partner communications modes;

entering said low power communications mode;

transmitting at least one link suspend pulse;

powering down at least one of a plurality of transmitter circuit elements between transmission of said link suspend pulses;

receiving a signal from said link partner;

detecting a receive link suspend pulse in said signal;

detecting a receive data frame template in said signal;

supporting said link during detection of said receive data frame template;

interpreting receive data contained in said receive data frame templates;

providing said receive data to a media controller;

obtaining transmit data from said media controller;

transmitting said transmit data in a transmit data frame template onto said link.

33. A method for providing a low power communications mode, comprising:

negotiating a link with a link partner;

receiving a first set of parameters identifying a low power communications mode as one of available communications modes of said link partner, and storing said first set of parameters in a first link suspend register;

transmitting a second set of parameters from a second link suspend register identifying said low power communications mode as one of available communications modes;

entering said low power communications mode;

transmitting at least one link suspend pulse during said low power communications mode;

powering down at least one of a plurality of transmitter circuit elements between transmission of said link suspend pulses.

34. The method of claim **33**, wherein said negotiating comprises:

transmitting to said link partner said second set of parameters identifying available communications modes;

receiving from said link partner said first set of parameters identifying available link partner communications modes.

35. The method of claim **34**, wherein said negotiating comprises transmitting to said partner parameters identifying available communications modes, wherein said negotiating further comprises receiving from said link partner parameters identifying available link partner communications modes.

36. The method of claim **34**, further comprising the steps of:

detecting a receive link suspend pulse in a signal from said link partner;

detecting a receive data frame template in said signal;

bringing a host device coupled to a link suspend device out of a sleep state upon receipt of a valid data frame template;

processing data contained in said valid data frame template; and

continuing said low power communications mode.

37. The method of claim **36**, further comprising reentering said negotiating upon loss of said low power communications mode.

38. The method of claim **34**, wherein said negotiating further comprises:

retaining parameters for said negotiating of said link;

transmitting to said link partner parameters identifying said low power communications mode as one of said available communications modes;

receiving from said link partner link partner parameters identifying said low power communications mode as one of said available communications modes of said link partner;

transmitting to said link partner information identifying transmit link suspend pulses to be transmitted to said link partner; and

receiving from said link partner information identifying receive link suspend pulses to be received from said link partner.

39. The method of claim **33**, further comprising steps of:

receiving a signal from said link partner;

detecting a receive link suspend pulse in said signal;

detecting a receive data frame template in said signal;

detecting absence of said link suspend pulses transmitted by said link partner;

supporting said link during detection of said receive data frame template;

providing receive data in said receive data frame template to a media controller;

obtaining transmit data from said media controller; and

transmitting said transmit data in a transmit data frame template onto said link.

40. The method of claim **33**, further comprising:

transmitting at least one valid data template while in said low power communications mode; and

powering down at least one of said plurality of transmitter circuit elements between transmission of said valid data templates.

41. The method of claim **40**, further comprising the steps of:

continuing, said low power communications mode;

discontinuing said transmission of said link suspend pulses; and

transmitting data frame templates.

42. The method of claim **33**, further comprising the steps of:

controlling said low power communications mode with a link suspend controller;

discontinuing said low power communications mode upon receipt of a data frame template containing data requesting said low power communications mode to be discontinued.

43. The method claim **33**, further comprising the steps of:

continuing said low power communications mode upon receipt of a valid data frame template; and

processing data contained in said valid data frame template.

44. The method of claim **33**, further comprising:

detecting received link suspend pulses in a signal;

discontinuing said low power communications mode upon discontinuation of said detection of said link suspend pulses.

45. The method of claim **33**, further comprising:

detecting receive data frame template in a signal;

detecting timing pulses of said receive data frame template with a pulse detector; and

interpreting receive data contained in said receive data frame templates.

46. The method of claim **45**, further comprising:

discontinuing said low power communications upon discontinuation of said detection of said receive data frame template.

47. The method of claim **33**, further comprising:

transmitting a mode control parameter to said link partner, said mode control parameter configured to cause said link partner to discontinue transmitting link suspend pulses while said link partner continues receiving link suspend pulses.

* * * * *

Exhibit 1014

"A 64/256 QAM Receiver Chip for High-speed Communications, Shin et al., IEEE (2000)

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A 64/256 QAM Receiver Chip for High-speed Communications

Abstract – This paper presents the implementation of a 64/256 QAM receiver chip for high-speed multimedia data communication that supports DOCSIS (Data Over Cable Service Interface Specification) of MCNS (Multimedia Cable Network System). The implemented architecture consists of the upstream unit and the downstream unit that includes the demodulator symbol timing recovery, carrier recovery and a DFE equalizer. The equalizer uses MMA (Multi-Modulus Algorithm). The 64/256 QAM receiver can support high-speed data rate up to 64 Mbps and can also provide the symbol rate up to 8 Mbaud which is faster than that of existing QAM receivers. We have used the 0.35 □m standard cell library. The total number of gates is about 210,000 and the implemented 64/256 QAM receiver chip is currently being fabricated and will be delivered soon.

Index terms—Modem, QAM receiver, MMA, DOCSIS, CATV.

I. INTRODUCTION

As the throughput of a fixed bandwidth is constantly needed to increase for supporting high-speed multimedia data communications[1,2], such as the MCNS (Multimedia Cable Network System) standard for the CATV network, more throughput-efficient modulation schemes are required. To reduce the bandwidth of the modulated signal while maintaining the same transmission rate, QAM (Quadrature Amplitude Modulation) that decreases the symbol rate by adding more points in the constellation is widely used. Such a reduction in the bandwidth requirement allows to transmit more information in the spectrum that has been allocated. Because of its good performance, QAM is being used in many of high-speed multimedia data communications. Several QAM receivers have been developed for various high-speed applications, such as cable modem, LMDS, CATV, DSL, etc. [3-6].

However, symbol rates of existing modem architectures [3-6] have been limited to rates less than 7 Mbaud and the previous work [6] can support data rates up to 50 Mbps. In this paper, we present a 64/256 QAM receiver that consists of the demodulator, symbol timing recovery, carrier recovery, and the blind adaptive DFE (Decision Feedback Equalizer) equalizer, provides symbol rates up to 8 Mbaud and data rates up to 64Mbps. The symbol timing recovery uses the parabolic interpolator [7,8], which is heavily pipelined with high-speed multipliers and carry-save adders (CSAs) for high-speed operations. The decision-directed carrier recovery is used to remove the carrier frequency offset, phase offset and phase jitter [9]. The blind equalizer consists of FFE (FeedForward Equalizer) and FBE (FeedBack Equalizer) [10-12], 5-tap and 6-tap filters, respectively, which use MMA and LMS (Least Mean Square) tap coefficient update algorithms [13].

We have simulated the proposed 64/256 QAM receiver using VHDL models and performed logic synthesis using the 0.35 μm standard cell library. The implemented 64/256 QAM receiver contains about 210,000 gates and can accommodate symbol rate up to 8

* This work was supported in part by the IDEC (IC Design Educatio Center) and IITA (Institute of Information Technology Assessment)

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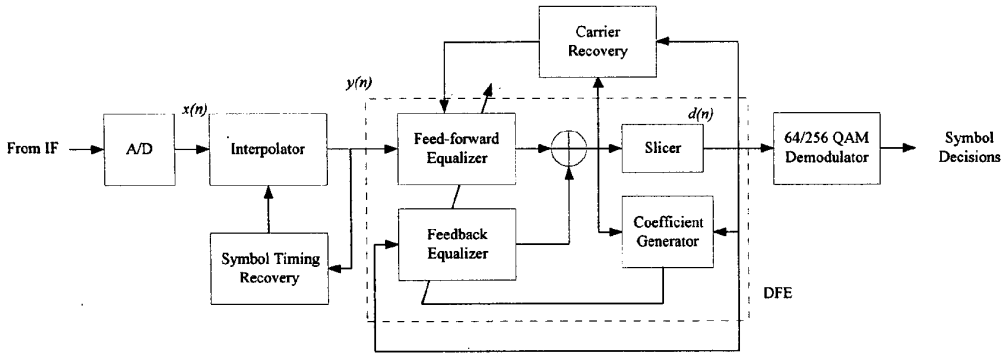

Figure 1. The proposed 64/256 QAM receiver architecture

Mbaud. This symbol rate is faster than existing QAM receivers [3-6].

The paper is organized as follows, Section II describes the architecture of 64/256 QAM receiver and section III describes the results of simulation and implementation. Finally, section IV contains concluding remarks.

II. 64/256 QAM RECEIVER ARCHITECTURE

The overall block diagram of the proposed 64/256 QAM receiver is shown in Figure 1. The A/D converter operates at a sample rate of two times the baud rate. The A/D output with a resolution of 10-bit is interpolated to adjust timing for the optimum detection of symbols. The interpolator output, produced at the baud rate, is equalized by DFE to eliminate intersymbol interference (ISI). The carrier recovery block removes the carrier frequency offset, phase offset and phase jitter from the output of the equalizer.

2.1 Symbol Timing Recovery

Figure 2 shows the block diagram of the timing recovery circuit. The symbol timing recovery uses a parabolic interpolator [7,8], which is heavily pipelined with high-speed multipliers and carry-save adders (CSA's) for high-speed operations.

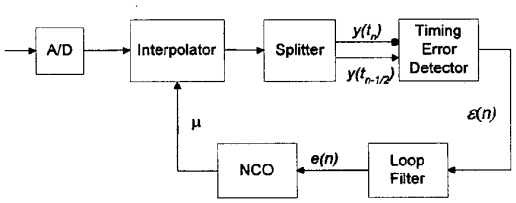

Figure 2. The timing recovery block

We have modified the interpolator architecture to reduce two registers in the Farrow structure for parabolic interpolator [8]. The critical path of the existing parabolic interpolator consists of five adders and two multipliers. We have modified the interpolator architecture to reduce critical path that consists of one adder and one multiplier.

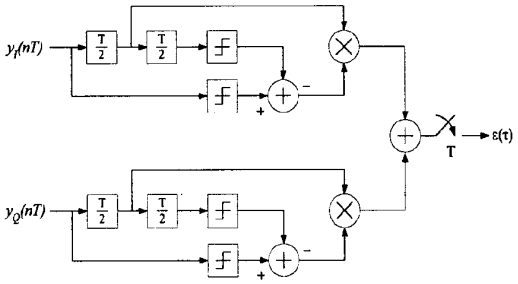

Figure 3. The timing error detector

Given two successive input samples $y(t_n)$ and $y(t_{n-1/2})$, the interpolator produces a sample $y(t_n+\mu)$, where μ is the fractional valued interpolation interval generated by the symbol timing recovery which is a second-order digital PLL. The symbol timing recovery in the implemented LMDS downstream receiver is based on the timing error detector introduced by Gardner shown in Figure 3 [7].

The Gardner algorithm requires only two samples for each data symbol. The Gardner algorithm is expressed as

$$\varepsilon(\tau) = y_I\{(n-\frac{1}{2})T+\tau\}[y_I(nT+\tau)-y_I\{(n-1)T+\tau\}] \quad (1)$$
$$+y_Q\{(n-\frac{1}{2})T+\tau\}[y_Q(nT+\tau)-y_Q\{(n-1)T+\tau\}]$$

where τ is the timing shift from the desired delay, $y_I(nT)$ and $y_Q(nT)$ is the strobe values of the nth symbol and $\varepsilon(\tau)$ is the estimatation of the timing error.

2.2 Carrier Recovery

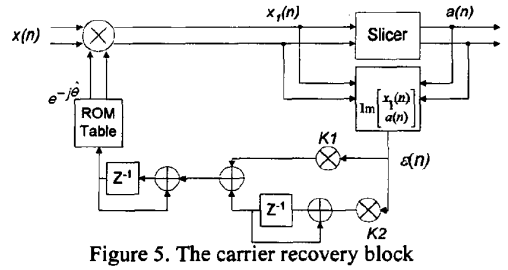

Figure 5. The carrier recovery block

A decision-directed carrier recovery loop is used to remove any residual carrier frequency offset as well as the high frequency phase noise induced by the RF tuner. The decision-directed algorithm for QAM is described in [9,14]. The details of the carrier recovery circuit that has a typical decision-directed structure are shown in Figure 5.

Referring to Figure 5, the output of a equalizer, $x(n)$ is expressed as

$$x(n) = a(n)e^{j\theta(n)} + v(n) \quad (2)$$

where $a(n)$ is the nth transmitted symbol, $v(n)$ is the AWGN (Additive White Gaussian Noise) and $\theta(n)$ is the uncompensated carrier phase at the receiver input. The carrier error $\theta(n)$ consists of three components, i.e., the phase jitter, frequency offset and phase offset. The small loop error signal $\varepsilon(n)$ which is proportional to the phase error $(\theta-\hat{\theta})$ is expressed as

$$\varepsilon(n) = \mathrm{Im}\left[\frac{x_1(n)}{a(n)}\right] = \sin(\theta-\hat{\theta}) \approx \theta-\hat{\theta} \quad (3)$$

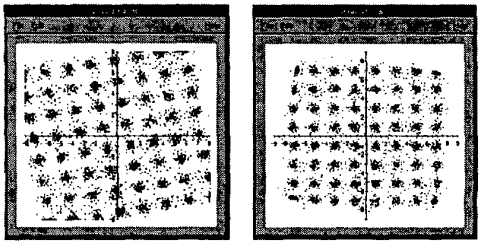
(a) input symbol (b) output symbol

Figure 6. The 64/256 QAM signal constellation of carrier recovery

Figure 6 shows the 64/256 QAM signal constellation of a carrier recovery loop. The constellation of 64/256 QAM signal with the carrier frequency offset and phase offset under the AWGN channel is shown in Figure 6(a). Figure 6(b) shows that the carrier frequency offset and phase offset have been removed from Figure 6(a).

2.3 Blind Equalizer

DFE is widely used to remove ISI in band-limited

channels because of its advantages, such as the small mean-squared-error (MSE) and low computational cost. It can easily obtain the steady state performance compared with other structures, such as transversal, lattice, etc. [2,10-12]. The DFE structure has better channel adaptive performance and lower BER than the transversal structure when the numbers of tap are the same [10-12].

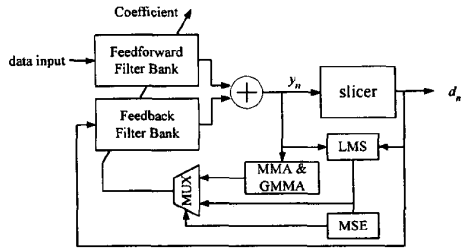

Figure 7. The proposed blind equalizer

The proposed blind equalizer shown in Figure 7 consists of a 5-tap feedforward filter bank, a 6-tap feedback filter bank and a tap weight generation block.

The proposed adaptive equalizer uses two adaptive algorithms, i.e., MMA and LMS algorithms [13]. MMA initializes the equalizer tap weights in unknown channel. The LMS algorithm is used after the equalizer reaches to the steady state. The coefficient generator consists of three main blocks, an MMA coefficient generation block, an LMS coefficient generation block and an MSE generation block.

The adaptive algorithm to update tap weights is selected by two threshold values of MSE. The MMA coefficients are selected when MSE is higher than threshold1 and the LMS algorithm coefficients are selected when MSE is lower than threshold2. When MSE is between threshold1 and threshold2, it maintains the previous values. Threshold1 and threshold2 are important parameters for the convergence of the equalizer. We have decided the optimum values of threshold1 and threshold2 by extensive performance simulations.

III. PERFORMANCE EVALUATION AND IMPLEMENTATION

The simulations of the 64/256 QAM receiver with the AWGN channel have been performed. Figure 7 shows the BER performance of the 64/256 QAM receiver. As shown in Figure 7, the implementation loss of the implemented 64/256 QAM receiver was measured to be about 1 dB in 64 QAM and about 1.5 dB in 256 QAM at a BER of 10^{-6}.

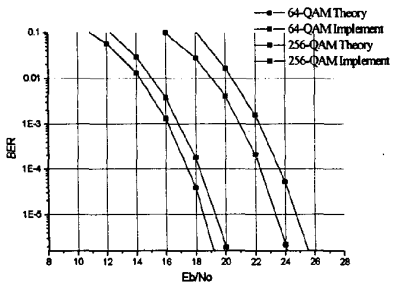

Figure 7. The BER performance of the implemented 64/256 QAM receiver

To implement the high-speed 64/256 QAM receiver, we have employed heavily pipelined structures, high-speed multipliers, carry-save adders (CSA's) and square operation logics. In addition, we have optimized the bit width of each block to reduce hardware complexity by using the SPW™ CAD tool.

We have verified the proposed 64/256 QAM receiver using the SPW™ tool and the proposed architecture has been modeled by the VHDL language and simulated using the SYNOPSYS™ tool. We have performed simulations for VHDL models and synthesized models using test-vector files that have been

generated by the SPW™ tool and have synthesized the VHDL models of the proposed 64/256 QAM receiver to gate-level logic using the SYNOPSYS™ CAD tool. The architecture of the 64/256 QAM receiver has been synthesized using the 0.35㎛ standard cell library and have performed function and timing simulations using the CADENCE™ Verilog XL. The chip is currently fabricated and it will be delivered soon.

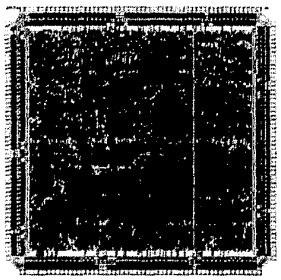

Figure 8. The Die Photograph after floorplanning and P&R

IV. CONCLUSIONS

In this paper, we implemented the 64/256 QAM receiver consists of the symbol timing recovery, the carrier recovery and the blind adaptive equalizer. The proposed 64/256 QAM receiver can support 64 Mbps and can provide symbol rates up to 8 MBaud. This symbol rate is faster than the existing QAM receivers. The implemented 64/256 QAM receiver has about 210,000 gates. The proposed 64/256 QAM receiver can be used for high-speed multimedia data communications, such as CATV network, LMDS, etc.

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Exhibit 1012

"RF and System Requirements for Cable Modem Applications," Donald G. McMullin, IEEE (2000)

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RF AND SYSTEM REQUIREMENTS FOR CABLE MODEM APPLICATIONS

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ABSTRACT

Examined in this paper are the critical RF and system requirements for high speed digital modem applications in a Hybrid Fiber Coax (HFC) environment. An overview of the basic elements and modulation formats of the system including the RF tuner, IF amplifiers, and frequency allocations for 2-way transmission on a single cable are presented. Requirements for Inter-Modulation Distortion (IMD) and Noise Figure (NF) in a digital Quadrature Amplitude Modulation (QAM) system are contrasted with the traditional analog NTSC format, which the cable systems were initially designed to support. Important RF system requirements for downstream and upstream data paths are presented.

I. INTRODUCTION

Since the inception of the Internet as a high-speed data connection between universities in the early 1970's, the search for a low-cost broadband last mile delivery system has been pursued. The fiber-optic backbone is capable of sustaining terabits of data throughput, but the last mile connection has traditionally been limited to, at best, about 28kbits and more recently 56kbits. Realizing that the needed bandwidth for these high speed data-links could be supplied by the cable plant, in the mid 1970's the FCC mandated that all new cable television trunk lines and drop lines be installed as 2-way ready. 2-way amplifiers were installed which allow both downstream and upstream data traffic to occupy selected frequency spectrums on a single cable. New head-end cable equipment was installed and the cable operators began to deploy broadband Internet access over the cable infrastructure (Figure 1).

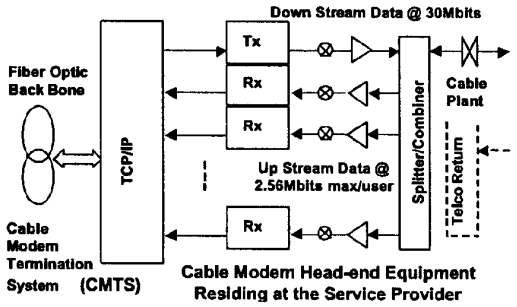

Figure 1 Block Diagram of CMTS.

In the event that a cable plant had not been upgraded for 2-way operation, the Telco modem (or cable downstream and telephone upstream) has been successfully deployed. The bandwidth requirements are such that the broadband downstream channel is necessary (users typically request large amounts of data). The return path bandwidth can be reduced since users generally do not transmit large amounts of data upstream. In fact, the limited upstream traffic has allowed for further bandwidth efficiency by utilization of a Time Division Multiple Access (TDMA) scheme for the 2-way cable modem implementation. This method allows multiple users to transmit on the same IF carrier frequency, but at different times. In contrast to the upstream burst mode operation, the subscriber modem receives the downstream data from a continuous bit stream. Payload data, which belongs to a particular user, has a unique Packet ID (PID) and Service ID (SID) embedded in the data packets. Only the data packets which correspond to the user ID, assigned during the logon registration, are processed and all others are ignored (Figure 2). The parsing of these data packets is handled by the Media Access Controller (MAC).

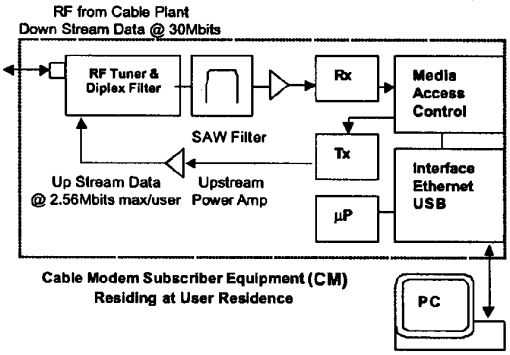

Figure 2 Block Diagram of CM.

In order for both upstream and downstream data to co-exist on a single cable, a diplex filter is used to minimize cross-talk (low-pass for upstream and high pass for downstream). The downstream data services reside with the already established downstream video channels occupying the 54MHz to 860MHz band (using 6MHz channel spacing), upstream data is placed from 5MHz to 42MHz (Figure 3). Upstream return channels are burst

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mode and symbol rates are assigned during the logon process based on required bandwidth. Thus, the head-end can allocate bandwidth in accordance with the demands as

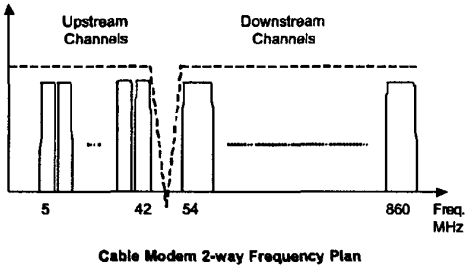

Figure 3 Cable Modem Frequency Plan.

more users logon and require more channel capacity. This results in a slow degradation in system performance, in contrast to a telephone modem whereby when no more switch ports are available, the user cannot connect at all. Additionally, when the cable system bandwidth reaches an unacceptable level of performance, a new RF frequency is assigned to some of the users, and the system data throughput is restored. Typical loading is 200 users per downstream channel.

II. MODULATION FORMAT

The transmission medium drives the choice of modulation scheme and for a 'wired' or cable system, the design constraints are very different than in a wireless system. The fundamental specification driving the choice of modulation is the obtainable system SNR, and secondary to this are the expected multi-path reflections, which can be stationary (cable) or time varying (wire-less). The well known Shannon-Hartley Capacity Theorem [1] states:

$$C = W\log_2(1 + S/N)$$

where;

C = system capacity, W=system bandwidth
S= RMS signal, N=RMS noise

Rearranging and normalization yields the channel capacity C/W in bits/Sec/Hz (Figure 4), which defines the maximum number of bits/symbol that can be transmitted for a given SNR. Although the Shannon-Hartley equation does not explicitly set a limit for the error probability, achievable SNR has a large effect in determining the Bit Error Rate (BER). This in turn will dictate the reliability and absolute data rate of the communications link. NTSC analog video requires SNR on the order of 50dB (peak signal/RMS noise) and linearity, HD2 and HD3, need to be suppressed -60dBc [2]. Achievable SNR's of 40dB (RMS power/RMS noise) allow for feasible deployment of modulation orders as high as 256QAM (8bits/sym). For a symbol rate of 5Mbaud, this would correspond to a bit rate of 40Mbits/sec. Today most cable operators deploy 64QAM at approximately 5Mbaud for a downstream data rate of 30Mbits/sec.

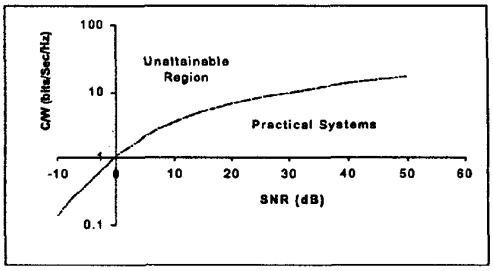

Figure 4 Channel Capacity.

III. DOWNSTREAM RF AND AFE REQUIREMENTS

The typical downstream RF front-end for a cable modem begins with a TV tuner designed to down convert the RF frequency spectrum of 54 - 860 MHz to an IF frequency of 43.75MHz for NTSC systems or 36.125MHz for European PAL systems. Traditional TV tuners, or so called single-conversion tuners, take the RF input and mix it with an LO offset by the desired IF to place the incoming RF signal at the IF desired (43.75MHz in the NTSC case). Since these tuners were designed for off-air reception, the LO leakage back into the antenna was of little concern due to the limited range of radiation. However, this LO leakage was found to be of great concern when the RF was connected to a cable plant. To circumvent the LO leakage problem, designers have increased reverse isolation of the Low Noise Amplifier (LNA) at the very front-end of the tuner. The first stage Noise Figure (NF) will dominate the obtainable receiver system SNR. To meet the Data Over Cable Service Interface Specification (DOCSIS) BER of 1E-8 at C/N of 33dB, with RF input levels of -15dBmV to + 15dBmV and 2.5dB margin, the tuner must have a NF of 10dB or less [3] (Figure 5).

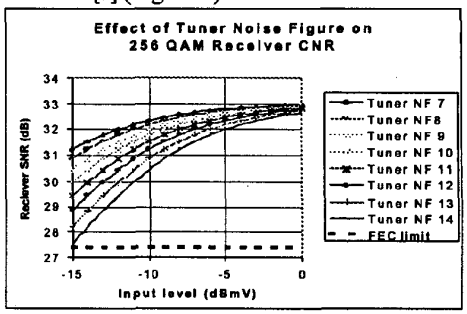

Figure 5 SNR vs Input Level for 256QAM.

In addition to the noise and input level, the QAM receiver carrier recovery loop is sensitive to the phase noise contribution of the tuner, and typical values of –85dBc/Hz at a 10kHz offset are required. Single conversion tuners have been accepted into cable plant operations due to the low phase noise, low cost and superior NF.

Following the down conversion to the 43.75MHz IF, a SAW filter is placed in the signal path to eliminate any residual power from the adjacent channels that may have not been attenuated by the tuner. Stop band attenuation, pass band ripple and group delay at the stop band corners are all important design constraints. QAM receivers employ an equalizer as part of the digital processing and this can relax some the SAW filter requirements. Equalizers cannot affect any signal that is not correlated to the input such as AGWN. However, any symbol spaced equalizer can correct for correlated distortions produced by the RF/AFE/ADC as long as they occur within 1 symbol time interval and the equalizer has enough dynamic range to compensate for them. In a typical QAM system symbol times of 200nS and equalizer dynamic ranges of 10dB allow the use of SAW filters with pass band ripples of 2dB and the group delays of 50nS. The equalizer will correct for these distortions and produce a flat channel response. A fixed gain amplifier is needed following the SAW filter due to the significant insertion loss, often as large as 20dB. The driving specification for this amplifier is low-noise. Linearity will again be compensated by the equalizer, which allows for consideration of an open loop design. An Automatic Gain Control (AGC) amplifier is included in the tuner RF front-end and is closed around this amplifier, so gain drift will be automatically compensated. A fixed gain of 34-36dB is required. This amplifier drives the input of the QAM receiver directly. An internal Programmable Gain Amplifier (PGA) provides additional AGC range and the Analog to Digital Converter (ADC) samples the 43.75MHz IF in a sub-sampled mode, i.e. the sample rate is less than the input IF frequency (typically 24-28MHz). Since the input frequency is slewing faster then than the sample clock, aperture jitter of the sample-hold is extremely important. It can be shown that this must be limited to less than 11pS for SNR better than 50dB.

Additional reduction of non-linearities and distortion can be found by examination of the QAM signal itself. In order to transmit and receive a QAM modulated signal in a robust manner, a guaranteed level of randomization must exist in the signal. That is to say, the probability distribution of the modulated symbols must appear random. The means to achieve this is done by using a Pseudo Random Bit Sequence (PRBS) logically ANDed with the data on the transmitter side, and an identical PRBS pattern on the receiver side to reverse the process. The effect this has on the original signal, and more importantly the distortion products, is to distribute them over the symbol rate bandwidth which makes them appear as additional noise components (Figure 6,7). This is a very important result for a QAM system and again illustrates how important the noise contribution is to system performance.

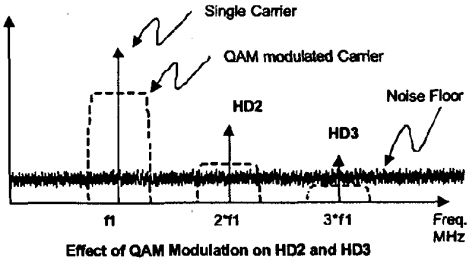

Figure 6 Distortion in a QAM modulation system.

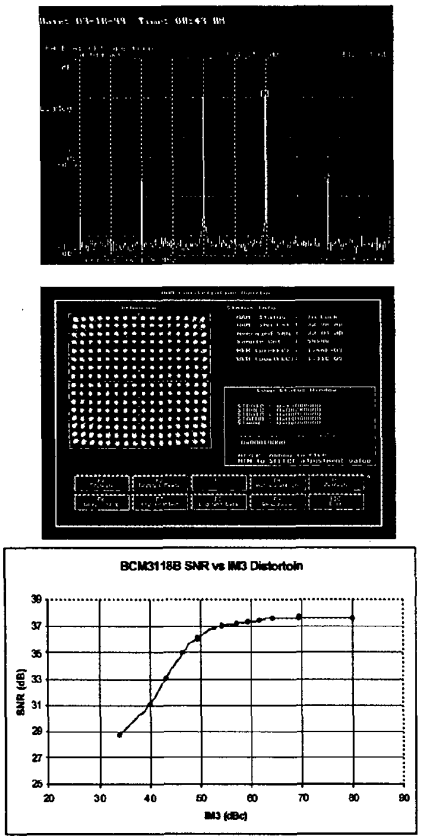

Figure 7 Effects of IM3 distortion on 256QAM.

IV. UPSTREAM IF REQUIREMENTS

The upstream burst modulator consists of a digital I/Q data stream that utilizes a Quadrature Direct Digital Frequency Synthesis (QDDFS) to up convert to the desired IF frequency. A high speed DAC (typically 200MHz Fsample) is used to convert this digital IF to an analog signal. The modulation format is either QPSK or 16QAM for all current modems. Under consideration is 64QAM for the next generation. Since the upstream data is transmitted in a burst mode, a means for packet synchronization is necessary. This is accomplished by the addition of a preamble at the beginning of each packet which allows the receiver to synchronize before the actual pay-load data is transmitted. A simple QPSK pattern of 0xCCCCC0D is appended to the data which corresponds to I/Q zero crossings (CCCCC) plus a unique word (0D) and gives a good probability of acquisition for a QPSK system (Figure 8).

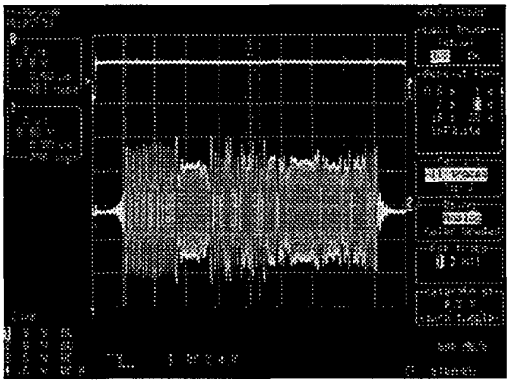

Figure 8 Burst Upstream Data Packet.

Unlike a continuous receiver, if the burst receiver is not able to lock to the preamble, then the entire packet is lost creating packet errors which are much more severe than bit errors. The analog portion of the upstream design begins with an image reject filter which follows the QDDFS and DAC. The DAC will produce an image of the desired IF at (Fsample - Fif). This image must be attenuated so as to not over drive the input to the power amplifier. Typically, a 5th order Chebyshev filter with a pass band ripple of .25dB is used for this purpose. Noise and distortion are very important for the upstream IF path, because they must not be allowed to interfere with the lower downstream channels beginning at 54MHz. With this in mind, a fully differential topology is preferred, which will allow the cancellation of HD2 leaving HD3 to contend with. There is some help from the diplex filter to attenuate the 3rd order product. The power amplifier which drives the upstream data back through the 75Ω cable must supply a variable gain of 50dB, from +8 to +58dBmV of signal level. Common practice is to design the burst modulator with an on chip PGA providing fine gain control (25dB in .4dB steps) and design the power amplifier to supply the other 25dB in coarse steps (6dB). In addition to the large signal and low distortion requirements, the amplifier must have very low noise (-59dBmV/Hz) which necessitates disabling it in between data bursts. This in turn leads to the potential turn on/off glitch which has been specified to be less than 100mV integrated over 2μS. To make matters even more difficult, the on/off impedance match must maintain a 75Ω termination insuring proper cable termination and no micro reflections, and it is desirable to use a single +5Vdc supply for the power. Taking all of this into consideration makes for a very challenging design (Figure 9).

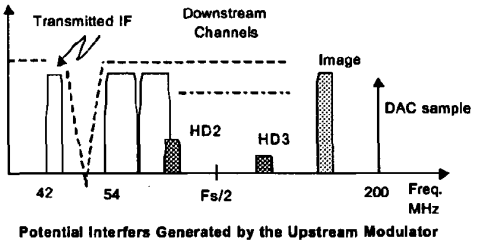

Figure 9 Burst Upstream Frequency Spectrum.

V. CONCLUSIONS

Presented in this paper are descriptions of some of the key components found in cable modem equipment. Current video delivery to most US homes is via cable, and as more interactive services are offered, there will be increasing emphasis on providing simultaneous high-speed data available to these users. The bandwidth is available from the existing cable plants to provide this growth. Cable modems have shown increases in speed of 1000X over telephone modems, and nearly all housing developments in the US have a cable infrastructure already in place. Increased levels of integration have dramatically reduced the cost of cable modems enabling explosive growth and accelerated deployment for the next several years.

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Exhibit 1001

U.S. Patent No. 7,594,249

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(12) **United States Patent**
Gurantz et al.

(10) **Patent No.: US 7,594,249 B2**
(45) **Date of Patent: Sep. 22, 2009**

(54) **NETWORK INTERFACE DEVICE AND BROADBAND LOCAL AREA NETWORK USING COAXIAL CABLE**

(75) Inventors: **Itzhak Gurantz**, San Diego, CA (US); **Ladd ElWardani**, La Jolla, CA (US); **Anton Monk**, San Diego, CA (US); **Brett Bernath**, San Diego, CA (US); **Magnus Berggren**, San Diego, CA (US)

(73) Assignee: **Entropic Communications, Inc.**, San Diego, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 816 days.

(21) Appl. No.: **09/910,412**

(22) Filed: **Jul. 21, 2001**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
H04N 7/18 (2006.01)

(52) **U.S. Cl.** **725/78**; 725/51; 725/54; 725/74; 725/80; 725/85; 725/125; 725/119; 725/127

(58) **Field of Classification Search** 725/51, 725/54, 80, 74, 78, 85, 125, 119, 127
See application file for complete search history.

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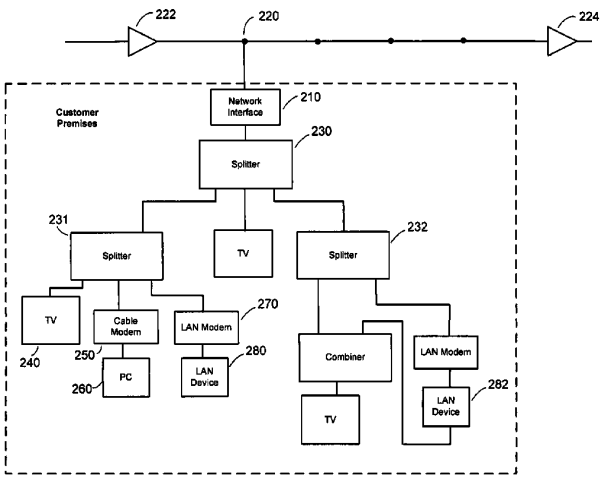
(57) **ABSTRACT**

A local area network uses coaxial cable wiring for interconnection of terminal devices. A frequency selective network interface device is placed at the building point of entry or another point in the wiring to reflect network signals transmitted by terminal devices back into the building distribution to be received by other terminal devices. By reflecting network upstream signals back into the building as downstream signals, the network interface provides a path for terminal devices to transmit to and receive from other terminal devices.

17 Claims, 5 Drawing Sheets



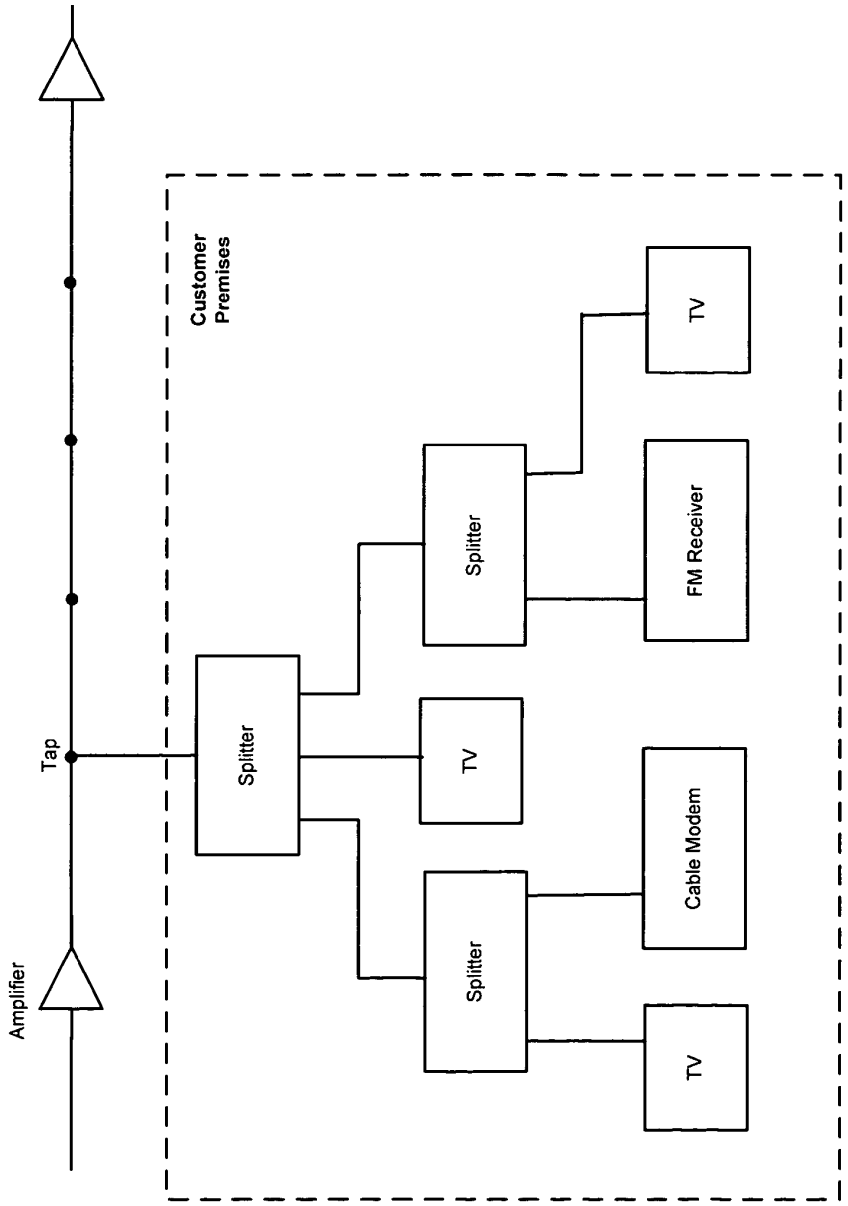
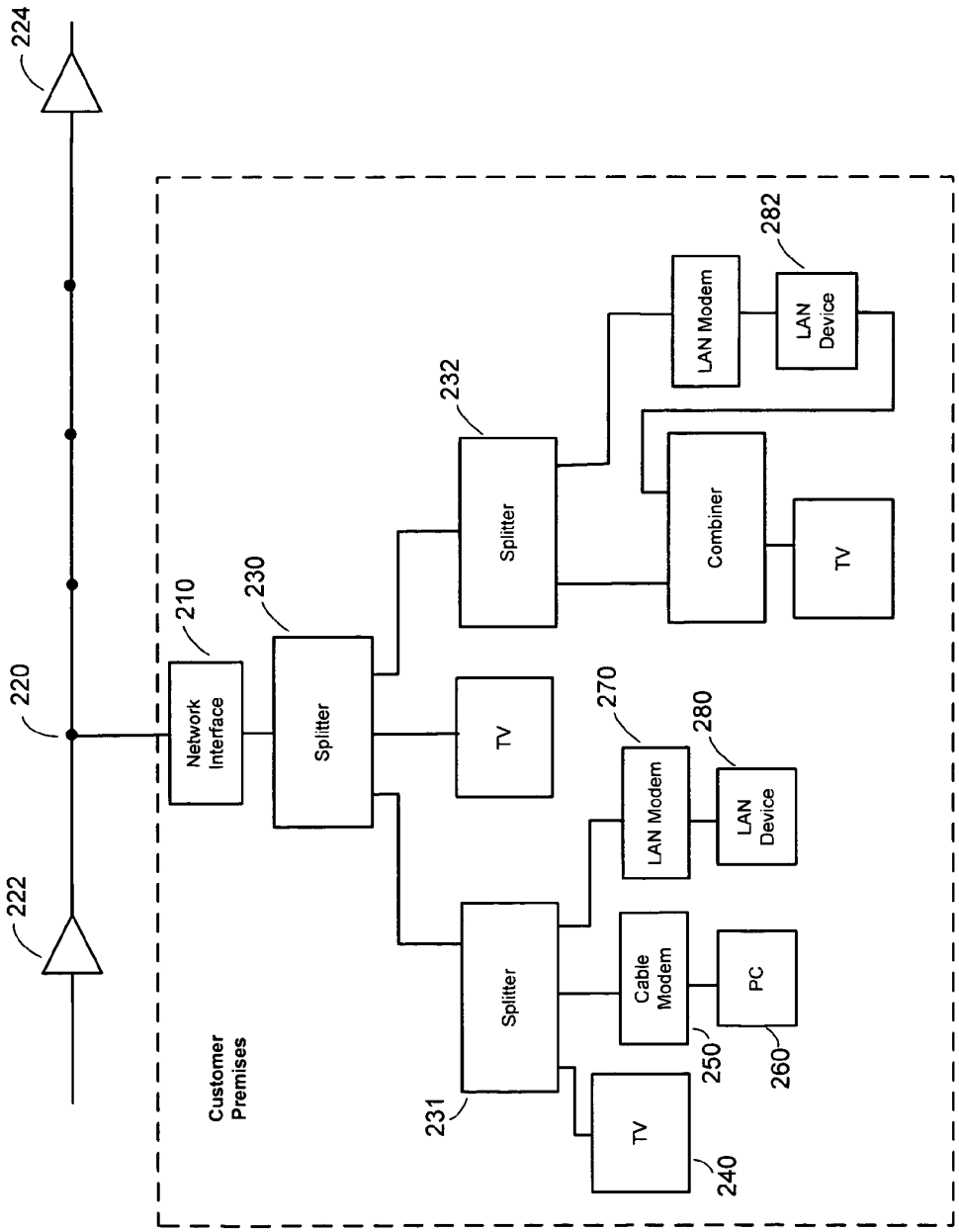


FIG. 1
Prior Art

FIG. 2


224
220
222
210
Network Interface
230
Splitter
TV
232
Splitter
LAN Modem
282
LAN Device
Combiner
TV
270
LAN Modem
280
LAN Device
231
Splitter
Cable Modem
250
PC
260
TV
240
Customer Premises

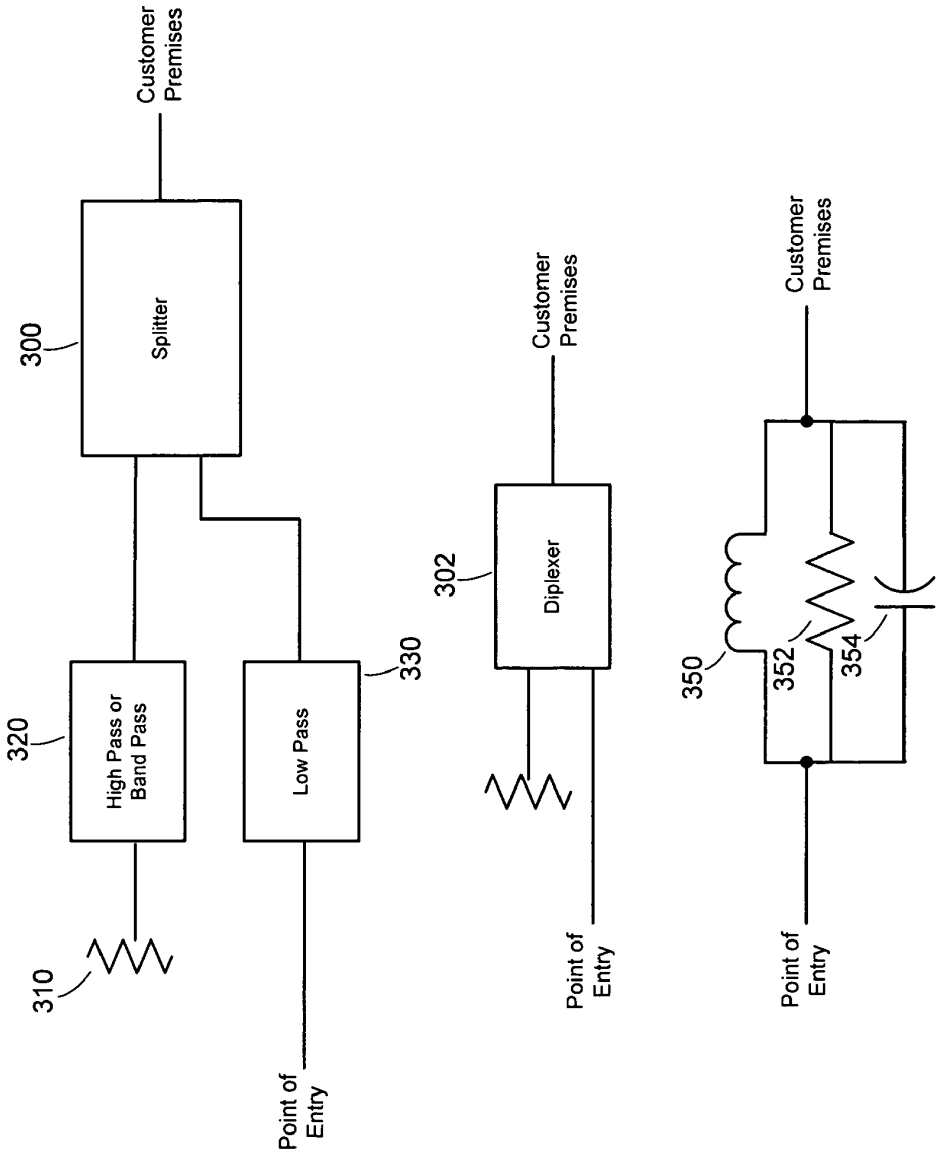

Customer Premises
Splitter
300
High Pass or Band Pass
320
Low Pass
330
310
Point of Entry
Customer Premises
Diplexer
302
Point of Entry
Customer Premises
350
352
354
Point of Entry

FIG. 3

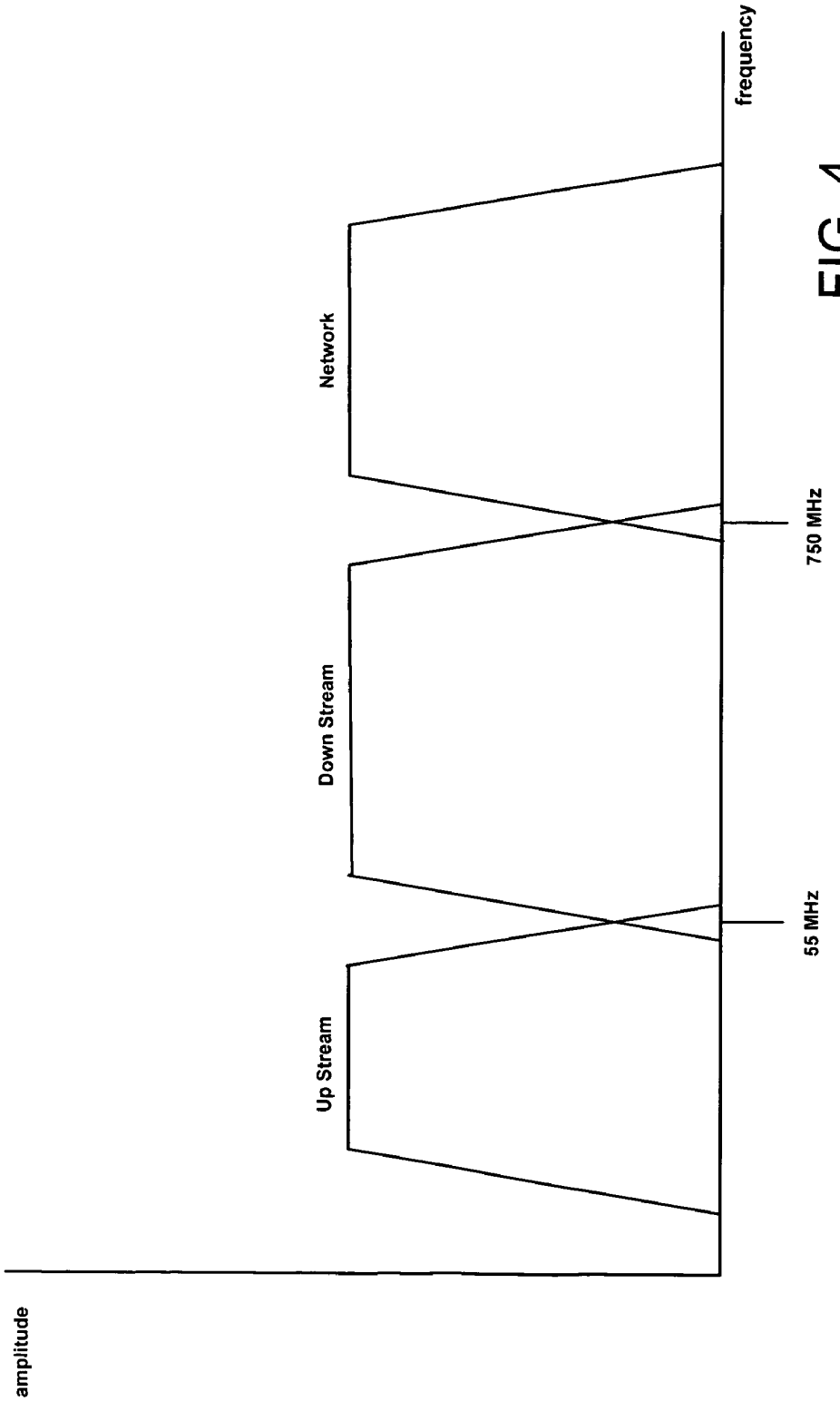

frequency
Network
750 MHz
Down Stream
55 MHz
Up Stream
amplitude

FIG. 4

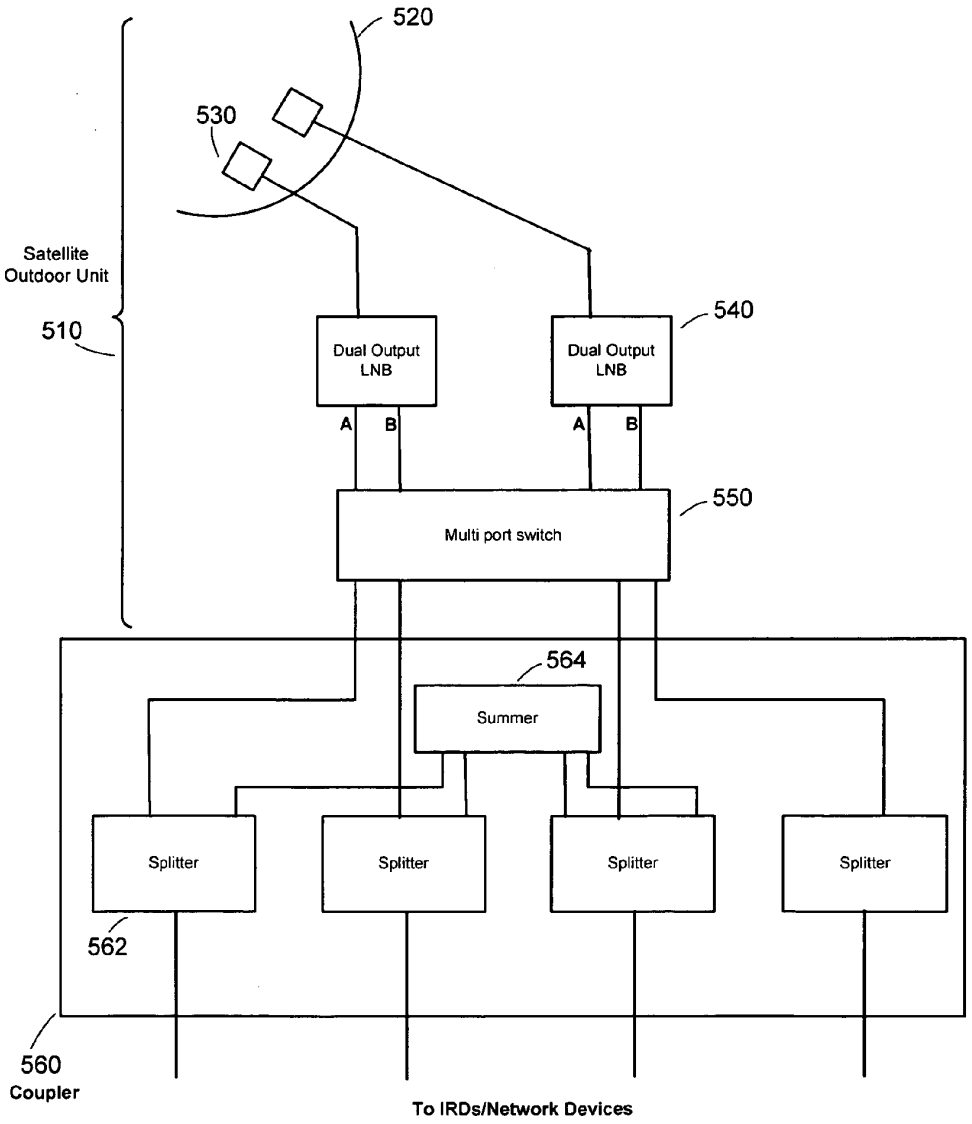

520
530
Satellite
Outdoor Unit
510
Dual Output
LNB
Dual Output
LNB
540
A
B
A
B
550
Multi port switch
564
Summer
Splitter
Splitter
Splitter
Splitter
562
560
Coupler
To IRDs/Network Devices

FIG. 5

NETWORK INTERFACE DEVICE AND BROADBAND LOCAL AREA NETWORK USING COAXIAL CABLE

RELATED APPLICATIONS

This application claims the benefit of U.S. provisional application No. 60/288,967 filed May 4, 2001 entitled: Network interface and broadband local area network using coaxial cable.

TECHNICAL FIELD

This invention relates to broadband communication networks and specifically to network interface devices and network wiring.

BACKGROUND

In a coaxial cable based local area network (LAN), communication between nodes occurs over a shared coaxial cable. When the coaxial cable used for the LAN is shared with a community aerial television (CATV) or cable TV service the signals must be separated to avoid interference. The LAN signal can use one band of frequencies and the cable TV service can use a different band. A typical cable TV configuration for a home is shown in FIG. **1**. Signal splitters are used to distribute downstream signals from the point of entry (POE) to the various terminals in the home, which can include cable converter boxes, televisions, and cable modems, generally referred to as customer premise equipment (CPE). Each terminal device may have the ability to transmit as well as receive. The upstream signal transmitted by the terminal device flows through the signal splitters back to the POE and to the cable plant. The signal splitters are functioning as signal combiners for upstream signals. Good quality splitters used in a properly wired system will provide a high level of isolation between terminal devices connected to the building wiring.

Signal splitters, shown in FIG. **2**, are commonly used in home and other building type coaxial cable wiring. They have an input port and multiple output ports. The input port can also be considered a common port. The output ports can also be considered tap ports. Splitters are generally passive devices and can be constructed using lumped element circuits with discrete transformers, inductors, capacitors, and resistors. Splitters can also be constructed using strip line or microstrip circuits. A typical two-way splitter splits the power equally between the two output ports if each port is terminated equally. Thus each output would have a power level 3 dB lower than the input. Ideally, a splitter transfers all power from the input port to the output ports. In a practical implementation there is a modest power loss in the splitter due to impedance mismatches, non-zero resistances, dissipative losses in circuit elements, and other non-ideal properties. These losses amount to approximately 0.5 dB, thus a practical two-way splitter provides −3.5 dB power level to each output. A splitter may have 3 or more tap ports. There is typically an N-way splitter at the point of entry of a building.

Splitters are generally bi-directional; they can also function as signal combiners, which sum the power from multiple ports into a single output. The ports used as outputs in a splitter configuration become inputs ports for the combining configuration. The common port becomes the output port.

Splitters can be designed with power dividing ratios that are not equal. Instead of a 3 dB loss to each port, one port can have, for example 1.15 dB loss, and the other 6 dB. This corresponds to 75%/25% coupling. This type of splitter could

be used to balance signal power at all terminal devices when there are multiple levels of signal splitters. A branch that terminates directly to a terminal device would be connected to a higher loss tap port. A branch that contains additional splitters would be connected to a lower loss tap port, which provides extra power to compensate for the loss of additional splitters.

Another characteristic of interest in signal splitters is the isolation between output ports. The isolation is typically between 10 dB and 40 dB. This isolation attenuates signals communicating between tap ports. The signal splitter/combiner is therefore directional, power flows to and from the common port to the tap ports, but power is attenuated between tap ports.

In a conventional cable TV or cable modem use, this isolation is of no concern because terminal devices do not communicate with each other, they only communicate through the POE with the cable head-end. In a LAN system, terminal devices communicate directly with each other, therefore attenuation between tap ports in the signal splitters results in an undesirable signal loss.

Another approach to the splitter inter-port isolation is to replace the main splitter at the building POE with a symmetric power splitter/combiner. In a symmetric splitter, power entering any port is divided among the other ports. A symmetric splitter/combiner is not directional. This type of splitter has 3 dB additional loss compared to a directional signal splitter. The additional loss is greater depending on the number of tap ports. A power amplifier may be required to boost the signal to compensate for this loss. A bi-directional device, such as a cable modem, requires a reverse path so the amplifier needs to be bi-directional. Another disadvantage to this approach is that installation is required; each coax connected to the existing N-way directional splitter must be disconnected and moved to the new splitter. Another disadvantage of this approach is that power must be available for the amplifier, which is not generally present in the area a typical main splitter is located.

The tap port isolation of splitters used in a typical cable TV distribution configuration presents a problem to shared usage of the cable for a LAN system.

Broadband networks are described in U.S. Pat. No. 5,889,765 Bi-directional communications Network issued to Gibbs, U.S. Pat. Nos. 5,940,387 and 6,005,861 Home Multimedia Network Architecture issued to Humpleman, U.S. Pat. No. 5,870,513 Bi-directional Cable Network with a Mixing Tap or Suppressing Undesirable Noise in Signals From a Remote End of the Network issued to Williams, U.S. Pat. No. 5,805,591 Subscriber Network Interface issued to Naboulsi, U.S. Pat. No. 6,008,368 Ethernet Transport Facility Over Digital Subscriber Lines issued to Rubinstain, U.S. Pat. No. 6,137,793 Reverse Path Multiplexer for Use in High Speed Data Transmissions issued to Gorman, and U.S. Pat. No. 6,091,932 Bidirectional Point to Multipoint Network Using Multicarrier Modulation issued to Langlais, each of which is incorporated herein by reference.

Gibbs disclosed a broadband network overlaid with the cable service frequencies using dynamically allocated TDMA protocols. Humpleman patents disclose a home network using an active network interface unit to couple the home network to the external network. Williams discloses a method of reducing noise accumulated in the frequency bands used by an upstream signal. Naboulsi discloses an active network interface for an asynchronous transfer mode (ATM) network. Rubinstain discloses a method of transporting Ethernet over twisted pair lines. Gorman discloses an active reverse path multiplexer for communication between

the cable head-end and subscriber cable modems. Langlais discloses a two-way data transmission system for communicating between an upstream and downstream unit using OFDM. None of these references addresses the problem of tap port-to-port isolation and providing a suitable signal path for terminal-to-terminal communication in a coaxial cable wired building.

SUMMARY OF THE INVENTION

The present invention uses a frequency selective network interface device placed at the building point of entry (POE) to reflect upstream signals transmitted by terminal devices back into the building distribution whereby the signals may be received by other terminal devices. By reflecting upstream signals back into the building as downstream signals, the network interface device provides a path for terminal devices to transmit to and receive from other terminal devices. This overcomes the problem of port-to-port isolation in the signal splitter/combiners. A bidirectional signal distribution network is create from existing building wiring intended only for headend to terminal device communication. Another function of the network interface device is to isolate signals generated within the building and prevent the transmission outside the building. Due to the frequency selectivity of the network interface, upstream and downstream signals for cable TV and cable modem service are not disturbed. The network interface device can be implemented as a passive device. The network interface device can alternatively be an active device that derives power from the cable or an external power source.

The network interface device can be placed further into the customer premises, instead of at the POE. The network interface device is installed with a first port connected in the direction of the POE and a second port connected in the direction of the terminal devices. Installation of the network interface device produces a reflected signal in the direction of the terminal devices.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram showing a prior art coaxial signal distribution plan.

FIG. **2** is a diagram showing a signal distribution plan according to the present invention.

FIG. **3** shows embodiments of network interface devices in accordance with the present invention.

FIG. **4** shows a representative frequency allocation between cable service upstream/downstream signals and an overlaid local area network in accordance with the present invention.

FIG. **5** shows a network using direct broadcast satellite wiring with a coupler according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION AND BEST MODE FOR CARRYING OUT THE INVENTION

Referring to FIG. **2**, amplifiers **222** and **224** are part of the cable plant and provide a signal to the street and tap **220**. A frequency selective network interface device **210** is located at the point of entry (POE) to the building LAN wiring. Alternatively, the frequency selective network interface can be located further inside the building, or at a point external to the building, for example at the street tap **220**. The network interface **210** produces a reflection of upstream signals back into the LAN wiring so that terminal devices, such as LAN modem **270**, can receive a signal transmitted by another terminal device connected to the LAN wiring forming the network. The invention intentionally introduces a reflection into the LAN wiring and exploits the reflected signal to provide communication path in a system that has high isolation between terminal devices due to splitters **230**, **231**, and **232** installed in the wiring. LAN modem **270** provides modulation and demodulation of the waveform transmitted over the cable. LAN modem **270** has an interface to communicate with a LAN device **280**, which is the source or destination of data transmitted over the LAN. LAN device **280** can be, for example, a personal computer (PC). LAN device **282** can be, for example, a modulator to produce a signal for driving a TV through a signal combiner.

Existing devices, such as TV **240** and cable modem **250** connected to PC **260**, use frequency bands distinct from the frequency band used by the LAN and therefore operate in a normal manner.

Referring to FIG. **3**, in one embodiment, the network interface device comprises a signal splitter **300** with an impedance mismatch **310** to create a reflected signal at one port, a frequency selective filter **320** coupled to the same port, and a frequency selective filter **330** coupled to a different port. The frequency selective filter **330** provides isolation of the building LAN signal from the cable plant and passes standard cable service signals through with minimal disturbance. This filter would typically be a low pass filter. Network signals at high frequencies originating in the building pass through the splitter and are blocked by filter **330**. Filter **320** passes the network signal and mismatched termination **310** reflects the signal back through the splitter **300** to the building wiring. The signal is distributed through the building wiring to all nodes.

Impedance mismatch **310** functions as a signal reflecting element. An impedance matched termination will have an impedance equal to the characteristic impedance of the transmission line, the splitter port, or filter port to which the termination is connected. For example, 75 Ohms is the characteristic impedance of a typical RG59 or RG6 system. A 75 Ohm termination will not produce a reflected signal. Terminations different from a matched termination will produce a reflected signal. The magnitude of the reflected signal will be a function of the termination impedance relative to the characteristic impedance.

Impedance mismatch **310** can be implemented in a number of ways. A short circuit of approximately 0 Ohms attached to the signal line will produce a reflected wave of approximately equal magnitude to the incident wave with an inversion in the signal polarity. An open circuit, which is an impedance approaching infinite Ohms, will produce a reflected wave of approximately equal magnitude to the incident wave with the same signal polarity. Other impedances in between 0 and infinite Ohms may be used. The magnitude of the reflected signal will vary in relation to the degree of mismatch. The reflection coefficient will be

$$(Z_l - Z_0)/(Z_l + Z_0),$$

where Z.sub.l is the termination impedance and Z.sub.0 is the impedance of the port to which the termination is connected. See generally, *Microwave Circuit Design Using Linear and Nonlinear Techniques* by George D. Vendelin, et al, Wiley-Interscience Publication 1990, incorporated herein by reference.

Impedance mismatch **310** can also be implemented by introducing any impairment into an element, for example a cable, component, or connector, that changes the impedance of the element. Since impedance is determined by, among other factors, the cross sectional and longitudinal geometry of

a transmission line, the impairment may be introduced by altering the geometry at one point or along a region of a transmission line. Impedance is also determined by the dielectric properties of the transmission line, so changing the dielectric at one point or in a region will also affect the impedance, creating a mismatch, and therefore a reflection.

Impedance mismatch **310** can also be implemented by altering the input or output impedance of the frequency selective filter used in the network interface device. The filter provides the termination at the point of connection, and therefore a mismatch will produce a reflection.

The level of reflection produced can be adapted to the needs of the system, based on, for example, the number of splitters in the building wiring or in a branch of the wiring, or the signal loss known to exist in the building wiring or in a branch of the wiring.

Splitters **300** and diplexer **302** are well known devices. Filters **320** and **330** can be constructed using lumped element inductors, capacitors, and resistors, using microstrip and strip line techniques, or using other active and passive filter implementations. The selection of components to produce a filter with particular frequency characteristics is done using well known filter design techniques, including the use of computer aided design (CAD) tools. Splitter **300** is designed to have a specific amount of coupling between the common port and the tap ports to create a desired level of signal reflection.

The frequencies used by the LAN can be located above the standard cable use frequencies, which extend to 550 MHz or 750 MHz. Other frequency plans can be used, for example where a block of frequencies is available in the middle of the cable band. The filter cut-off frequencies are selected according to the frequencies bands used.

Another embodiment of the network interface device uses a filter placed in between the POE and the customer premises. This filter can be implemented as a passive filter using an inductor **350**, resistor **352**, and capacitor **354**. These filter components can be discrete components or formed using strip line or microstrip techniques. Inductor **350** resistor **352**, and capacitor **354** determine the frequency response of the filter. In one embodiment, as shown in FIG. **3**, the filter is a series notch filter that uses a parallel resonator. This filter presents an open condition to the series circuit at the resonance frequency, thereby reflecting the signal energy. The same filter can be implemented using a series resonator connected in a shunt configuration. In other embodiments, the filter can be a lowpass, highpass, or bandpass filter. More complex filter topologies may be employed for pass band shaping and impedance matching outside the filter notch frequency.

Filters with frequency characteristics determined primarily by reactive elements, such as highpass, bandpass, lowpass, and bandstop filters implemented with inductors and capacitors, have a different impedance value in the pass band and stop band. This property may be exploited in the present invention where the filter has approximately matched impedance in the frequency of the signals to pass through the filter and a mismatch in the frequency range where reflection of signals is desired.

Other techniques which can be used to implement the filters employed in the present invention include coaxial resonators, combline filters, interdigital filters, wave guide resonators, dielectric resonators, helical resonators, tubular bandpass filters, series resonators, parallel resonators, and other known filter techniques.

The present invention operates by introducing a reflection in the LAN electrical wiring. A reflection anywhere in the wiring produces a multipath signal in some or all wiring branches that creates inter-symbol interference (ISI). The multipath signal has a delay and amplitude difference relative to the main signal. In the frequency domain, a reflection produces ripples in the response of the channel, creating amplitude variations across the pass band. In the time domain, ISI is seen as an impairment to the shape of the digital signal pulses. ISI will degrade the bit error rate (BER) performance of the communication channel. The effects of ISI can be overcome by applying modulation techniques or receiver processing techniques. An adaptive equalizer in the terminal device receiver creates a filter response that restores a flat frequency response impaired by the multipath signal. The adaptive filter can also be seen as a coherent summer of a main signal and reflected signals.

Other methods of overcoming multipath effects include using multi-carrier techniques such as discrete multi-tone (DMT) or orthogonal frequency division multiplexing (OFDM). Another modulation technique that exploits the existence of a multipath signal is spread spectrum modulation such as direct sequence spread spectrum (DS-SS). A DS-SS receiver can employ a rake receiver in which each reflected path is received, demodulated, and coherently combined to produce a single data stream.

A variation of the DS-SS approach is to use code division multiplex (CDM), which uses data spreading of user data wherein a single user utilizes multiple spreading codes that are all transmitted on the same frequency band. User data is multiplexed between the several spreading codes to form multiple communication channels. A CDM receiver de-spreads each code and combines the data, typically into a single data stream.

A time domain equalizer (TEQ) or frequency domain equalizer (FEQ) can be used with any of the above described modulation techniques.

With any form of modulation, the present invention could use a time division duplex (TDD) protocol for communications. In a TDD system, the receive and transmit data are communicated during different time intervals, generally using the same frequency. The advantage of using TDD is that the transceiver design is simplified. Different users share a common frequency channel through the use of time division multiple access (TDMA). In a TDMA system each user transmits during a different time interval. Users are assigned one or more slots of predetermined length in a framing structure that contains multiple slots. All users are synchronized by a beacon message broadcast on the network. The beacon message provides a common time reference to the users and can include other network management information.

In an alternate embodiment of the invention, a signal coupling element may be introduced at one or more splitters in the building wiring. At each splitter junction, frequency selective coupling is created whereby the upstream signal at one splitter output port is coupled to other splitter output ports. Additionally, the LAN frequency band will couple through to the splitter input port. A conventional splitter can be replaced with a new splitter that has frequency selective inter-port coupling, or an additional device can be added to existing splitters to perform this function. Alternatively, a device added to a splitter in-line with the input connection and would produce a reflection in a manner similar to the network interface device placed at the POE. In this embodiment the interface device would be configured so a portion of the signal is reflected and a portion is passed through.

In another alternative embodiment of the invention, the main splitter can be constructed to introduce a reflecting circuit at each tap port along with some signal coupling between tap ports. This configuration allows some signal to

reflect down the originating wiring branch to other devices in that branch and also couple to other wiring branches in the building.

In addition to coaxial wiring used for cable TV service, many homes and buildings are wired for satellite TV service. In another alternative embodiment of the present invention, a coupling path is provided to satellite television wiring system. Referring to FIG. **5**, a satellite receiver outdoor unit **510** typically comprises a dish antenna **520**, one or more low noise block-converters (LNB) **540**, and a multiport crosspoint switch **550**. The crosspoint switch **550** allows connection of the outdoor unit **510** to more than one integrated receiver decoder (IRD) located inside the building. The LNB **540** converts the signal transmitted by the satellite transponder, for example C band, Ku band or another frequency band, to a lower intermediate frequency (IF) suitable for transmission through coax. For example, L band IF (950 to 1450 MHZ) with RG6 coax cable is commonly used. The IRD demodulates the IF signal from the LNB down to baseband, provides channel selection, decodes the digital data to produce a video signal, provides conditionally access, and generates an RF output to drive a television.

According to the present invention, frequency or directional selective coupling is added after the LNB, for example in or after the crosspoint switch. This device provides coupling between coax cables connected to the outdoor unit. In this embodiment, the network signal would not use the same frequency band as the satellite signal. Referring to FIG. **5**, conventional splitters **562**, which have interport isolation, are used to couple the cable signals to a symmetric power summer **564**. Conventional splitter **562** can be, for example, a 1.25 dB/6 dB splitter or some other ratio that provides an acceptable level of attenuation of the satellite signal wile providing an acceptable level of signal power for the network. The splitter may need to pass direct current (DC) to the LNB, which can be done by the inclusion of an inductor connecting the tap port to the common port. The L-band signal from the multiport switch **550** passes through the splitter and is combined with the signal output of the summer **564**. Due to the directional nature of the splitter, which provides interport isolation, neither the summer signal nor the satellite signal passes through directly to the other tap port. A good quality splitter can achieve 20 dB or more of isolation between ports. Additional isolation between the satellite L-band signal and the network signals is achieved due to the non-overlapping frequency bands occupied by the respective signals.

According to the present invention, another implementation of the satellite system coupler uses frequency selective coupling to prevent interference with the L-band satellite signals. The frequency selective coupling, for example, comprises a low-pass filter to pass the band below L-band through the coupler. The coupling is provided by a symmetric combiner that distributes the energy from any port to the other ports.

In another alternative embodiment, summer **564** can be replaced with a directional splitter with an impedance mismatch connected to the common port. In this configuration, energy from each cable drop connected to an IRD is reflected back to the other cable drops.

Application of DMT and OFDM to the Present Invention

Multitone modulation uses a set of modulating carriers that are integer multiples of a common frequency and the symbol period is the inverse of the common frequency. Multitone modulation is also called discrete multitone (DMT) and orthogonal frequency division multiplexing (OFDM). OFDM utilizes quadrature phase shift keying (QPSK) and multi-level quadrature amplitude modulation (QAM) wherein each OFDM carrier can be modulated by an amplitude/phase varying signal. To modulate, data bits are encoded into a number of m-ary PSK constellations, which then modulate the respective carriers. The carriers are summed together for transmission over the channel. Each carrier is independent and can be independently decoded in the receiver.

OFDM provides a mechanism to overcome the frequency selective channel impairments present in coaxial building wiring when employing a network interface device according to the present invention.

QPSK is composed a sine and a cosine wave of identical frequency with phase modulation applied to each carrier independently. QAM is composed of sine and cosine waves with phase modulation and amplitude modulation. Both of these signals can be represented using complex numbers. The OFDM waveform is generated by applying an inverse discrete Fourier transform (IDFT) to a complex vector that results in a real valued time domain sequence. The time domain sequence is applied to an up converter to place the waveform at the proper RF frequency.

Higher SNR channels can support higher data capacity. Frequency bins occupying parts of the channel where the SNR is high can be used to transmit more bits. Each carrier may be modulated with a different order constellation, where higher SNR frequencies can bear a higher order constellation, and the resulting closer spacing of the constellation points. Frequencies with the lower SNR use lower order constellations such as QPSK.

The power in individual frequency bins can be adjusted to compensate for insertion loss that varies as a function of frequency. The power level in regions of the channel can be altered by scaling the complex valued vector for the bins where power adjustment is needed before applying the inverse Fourier transform. In order to avoid interference with certain bands in the RF spectrum, the power level of certain bins can be reduced to zero.

An OFDM receiver uses a discrete Fourier transform (DFT) to convert the modulated signal back into data. The OFDM receiver receives all the carriers at once and performs the transform on a block of data points. Drawing from terminology used in Fourier transforms, the frequency channels in OFDM may be called frequency bins or simply bins.

Various types of forward error correction can be applied to transmitted data blocks, such as Reed-Solomon and convolutional coding. Interleaving can be applied to data blocks to increase the robustness of the error correction. De-interleaving and error correction coding are applied in the receiver to recover the transmitted data without errors.

An OFDM receiver may also employ time domain equalization (TEQ), frequency domain equalization (FEQ), or both. Generally the equalizers are adaptive. Equalizers may be of the decision feedback (DFE) type or decision directed type such as least mean square (LMS) algorithm.

OFDM system architecture is covered in *ADSL/VDSL Principles* by DR. Dennis J. Rauchmayer, Macmillan Technical Publishing, 1999 and *DSL Simulation Techniques and Standards Development for Digital Subscriber Line Systems* by Dr. Walter Y. Chen, Macmillan Technology Publishing, 1998.

What is claimed is:

1. A signal distribution network comprising:

a filter located at the point of entry of a building tuned to reject network signals originating in the building, such that the network signals originating in the building do not pass through the filter, but rather are reflected back into the building;