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In re Patent of:	Itzhak Gurantz et al.	
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Title:	NETWORK INTERFACE DEVICE AND BROADBAND LOCAL AREA NETWORK USING COAXIAL CABLE	

DECLARATION OF SCOTT ACTON IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 7,594,249

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DECLARATION OF SCOTT ACTON

I, Scott Acton, of Charlottesville, Virginia, declare that:

I. QUALIFICATIONS AND BACKGROUND INFORMATION

1. I am currently the Lawrence R. Quarles Professor of Engineering and Applied Science at the University of Virginia. I am also Chair of the C.L. Brown Department of Electrical and Computer Engineering.

2. I earned a Bachelor of Science Degree (1988) in Electrical Engineering from Virginia Tech. I also earned both a Master of Science Degree (1990) and a Ph.D. (1993) in Electrical and Computer Engineering from The University of Texas at Austin. My Ph.D. research was in the field of signal and image processing.

3. From 1993 to present I have held a variety of professional and academic positions. I was a postdoctoral research associate at the Center for Space Research in 1994. From 1994-2000, I was assistant professor and then associate professor at Oklahoma State University. From 2000-present, I have been associate professor and then professor at the University of Virginia. I am Director of the Virginia Image and Video Analysis laboratory.

4. Between 2019 and 2022, I worked for the federal government as a Program Director in the Computer and Information Science and Engineering directorate of the National Science Foundation (NSF). In 2021-2022, I was

promoted to acting Deputy Division Director of the Computing and Communication Foundations division. At NSF, I contributed to programs in Communications and Information Foundations, Smart Health, Foundational Research in Robotics, the AI Institutes, and Predictive Intelligence for Pandemic Prevention. As a Program Director (and later Deputy Division Director) in the Communications and Information Foundations portion of the Computing and Communication Foundations division, I was in charge of evaluating proposals in the communications, wireless communications, network theory, information theory, and signal processing areas.

5. I am a member of numerous professional societies and organizations. For example, I served a four-year term as the Editor in Chief of the *IEEE Transactions on Image Processing* (2014-2018).

6. For over 30 years, I have conducted research and taught classes in the field of signal processing and analysis. My research in the signal processing area began with work in the Laboratory for Vision Systems (starting in 1988) and applied research with Motorola Semiconductor Products Sector (starting in 1990). At Motorola, I helped develop inspection systems for cellular and satellite based communication products.

7. At the University of Virginia, I teach a variety of courses, including Digital Image Processing, Digital Signal Processing, Signals and Systems, the

Science of Information and "How the iPhone works." I have received several teaching awards such as the All University Teaching Award (2009) and the Educational Innovation Award (2017).

8. I have over 300 publications related to signal processing and analysis. In 1996, I was named the Outstanding Young Electrical Engineer by Eta Kappa Nu and IEEE (national award). In 2013, I was named an IEEE Fellow. I have several best paper awards and have led several international conferences, such as the IEEE International Symposium on Biomedical Imaging that I co-chaired in 2018 (Washington, D.C.). In 2021, I was given the Director's Award for Superior Accomplishment from the National Science Foundation.

9. My research in signal and image processing and analysis has been funded by a variety of government agencies, foundations and companies. The agencies include the National Institutes of Health, NSF, Defense Advanced Research Project Agency (DARPA), Army Research Office (ARO) and the U.S. Department of Transportation (USDOT). The Foundations include Robertson Foundation, Hobby Foundation, Whitaker Foundation and Swortzel Foundation. Companies that have funded my research include Lucent, PocketSonics, Zimmer, Motorola and SVS.

10. My current curriculum vitae (DISH-1004) further sets out my academic and professional background and qualifications.

11. In writing this Declaration, I have considered the following: my own knowledge and experience, including my work experience in the fields of communications and electrical engineering; my experience in teaching those subjects; and my experience in working with others involved in those fields. In addition, I have analyzed the following publications and materials, in addition to other materials I cite in my declaration:

- U.S. Patent No. 7,594,249 (DISH-1001), and its accompanying prosecution history (DISH-1002)
- U.S. Patent 7,127,734 to Amit ("Amit") (DISH-1005)
- "ADSL/VDSL Principles: A Practical and Precise Study of Asymmetric Digital Subscriber Lines and Very High Speed Digital Subscriber Lines." ("ADSL/VDSL") (DISH-1006)
- "An Efficient Digital Modulation Scheme for Multimedia Transmission on the Cable Television Network" ("Jacobsen") (DISH-1007)
- "DSL: Simulation Techniques and Standards Development for Digital Subscriber Line Systems" ("DSL-Book") (DISH-1008)

II. LEGAL PRINCIPLES

A. Anticipation

12. I have been informed that a patent claim is invalid as anticipated

under 35 U.S.C. § 102 if each and every element of a claim, as properly construed, is found either explicitly or inherently in a single prior art reference. Under the principles of inherency, if the prior art necessarily functions in accordance with, or includes the claimed limitations, it anticipates.

B. Obviousness

13. I have been informed that a patent claim is invalid as "obvious" under 35 U.S.C. § 103 in light of one or more prior art references if it would have been obvious to a POSITA, taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called "secondary considerations" of non-obviousness, which include: (i) "long felt need" for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results of the claimed invention, and (iv) "copying" of the claimed invention by others.

14. For purposes of my analysis above and because I know of no indication from the patent owner to the contrary, I have applied a date of May 4, 2001, as the date of invention in my obviousness analyses, although in many cases the same analysis would hold true even at an earlier time than May 4, 2001. Likewise, my opinions would not change if the priority date were later, *e.g.*, in July 2001, when the application that issued as the '249 patent was filed. In other words, my opinions do not change regardless of whether the priority date is in May 2001

or July 2001. I currently hold no opinion regarding whether the '249 patent is entitled to claim priority to the May 4, 2001 provisional application, and I understand that DISH reserves its right to challenge this claim of priority.

15. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason to modify the single prior art reference, or combine two or more references, in order to achieve the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, or may come from the reference or references themselves, the knowledge or "common sense" of one skilled in the art, or from the nature of the problem to be solved, and may be explicit or implicit from the prior art as a whole. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

III. OVERVIEW OF CONCLUSIONS FORMED

16. This expert Declaration explains the conclusions that I have formed based on my analysis. To summarize those conclusions:

- Based upon my knowledge and experience and my review of the materials listed above, I believe that Claims 1-17 are rendered

obvious by the references listed above.

- Specifically, it is my opinion that Claims 1-2 of the ’249 patent are rendered obvious by Amit, Claims 1-17 are rendered obvious by Amit in view of ADSL/VDSL, Claims 1-2, 4-6, 8-10, 12-14, 16-17 are rendered obvious by Amit in view of Jacobsen, and Claims 2-3, 7, 9-13, 15, 17 are rendered obvious by Amit, in view of Jacobsen and DSL-Book.

IV. BACKGROUND KNOWLEDGE ONE OF ORDINARY SKILL IN THE ART WOULD HAVE HAD PRIOR TO THE EARLIEST POSSIBLE PRIORITY DATE OF THE ’249 PATENT

17. Based on the foregoing and upon my experience in this area, a person of ordinary skill in the art (“POSITA”) relating to the subject matter of the ’249 Patent as of May 4, 2001 would have held a Bachelor’s Degree in Electrical Engineering or Computer Engineering or a related field (or equivalent understanding through actual work experience), and had at least two to three years of experience related to the design or development of signal processing and communication systems or networks. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education.

18. For at least the reasons I explained in the paragraphs about my qualifications, I would consider myself to have qualified as a POSITA as of the

earliest possible priority date for the ’249 patent of May 4, 2001.

V. INTERPRETATIONS OF THE ’249 PATENT CLAIMS AT ISSUE

19. I understand that, for purposes of my analysis in this *inter partes* review proceeding, the terms appearing in the patent claims should be interpreted under the *Phillips* standard. In that regard, I understand that the best indicator of claim meaning is its usage in the context of the patent specification as understood by a POSITA. I further understand that the words of the claims should be given their plain meaning unless that meaning is inconsistent with the patent specification or the patent’s history of examination before the Patent Office. I also understand that the words of the claims should be interpreted as they would have been interpreted by a POSITA at the time of the invention was made (not today).

20. Because I do not know at what date the invention as claimed was made, I have used the earliest possible priority date of the ’249 patent as the point in time for claim interpretation purposes. That date is May 4, 2001.

VI. OVERVIEW OF THE ’249 PATENT

A. Brief Description

21. The technology in the ’249 patent relates to “broadband communication networks and specifically to network interface devices and network wiring.” DISH-1001, 1:14-16. The patent explains that, in “[a] local area network [that] 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." *Id.*, Abstract. "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 device." *Id.*

22. It is my opinion that before the claimed priority date of the '249 patent, there were many patents and publications that implemented or described the functionality claimed in the '249 patent. As a result, the system and methods of the '249 patent were well-known in the art. Moreover, to the extent there was any problem to be solved in the '249 patent, it had already been solved in the prior art before the priority date of the '249 patent.

23. The title of the '249 patent is "Network interface device and broadband local area network using coaxial cable." DISH-1001, cover. The '249 patent describes using a frequency selective network interface device that is placed at the point of entry of a building to reflect upstream signals transmitted by terminal devices back into the building. By reflecting these signals back into the building, the network interface device provides a path for terminal devices in the building to communicate with other terminal devices in the building.

24. The '249 patent explains that "[i]n a coaxial cable based local area

network (LAN), communication between nodes occurs over a shared coaxial cable" where "[s]ignal splitters are used to distribute downstream signals from the point of entry (POE) to the various terminals in the home." *Id.*, 1:20-29. An example of this is shown in Figure 1, reproduced below:

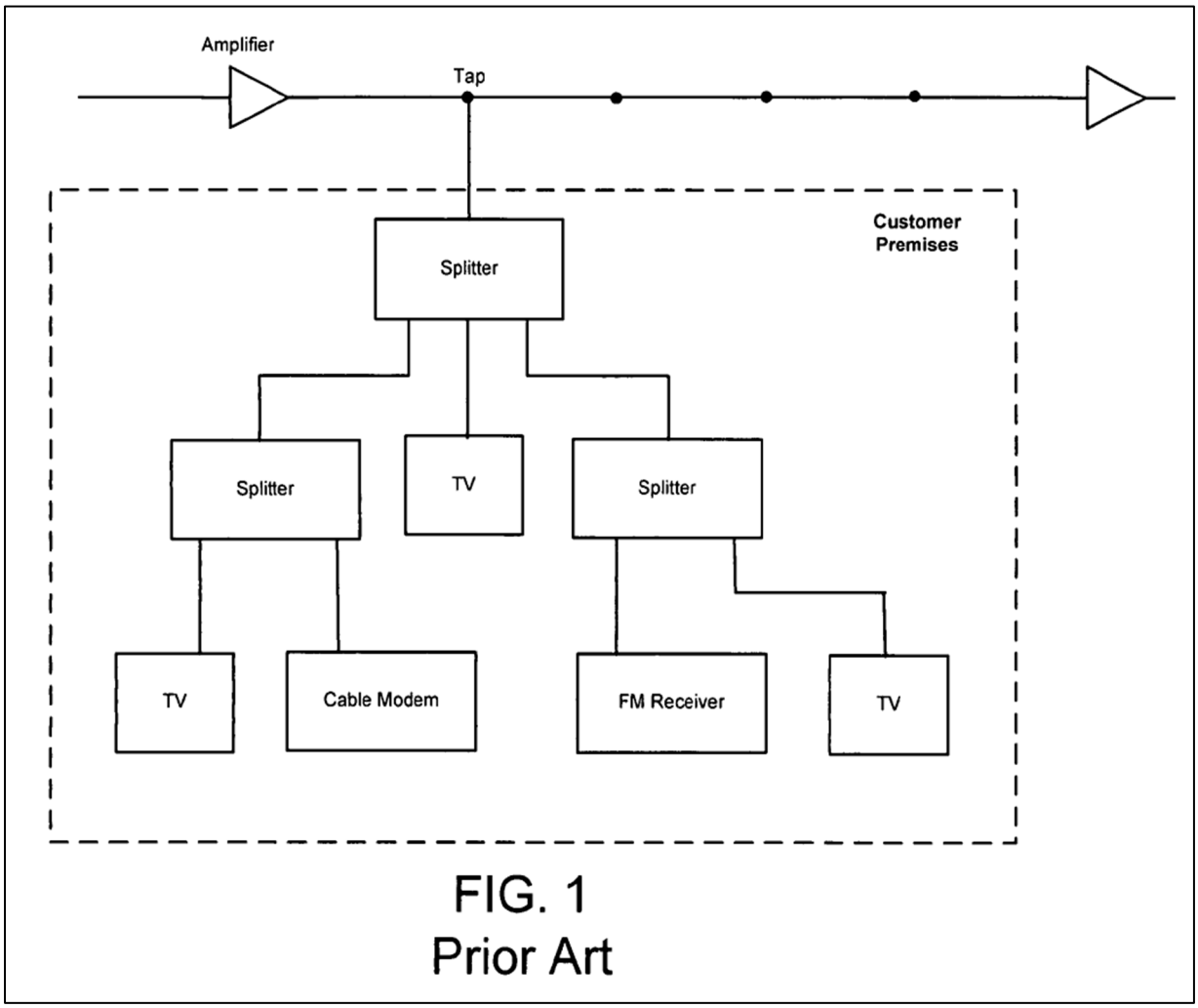


FIG. 1
Prior Art

25. The '249 patent indicates that the splitters have an input port that can also be considered a common port and output ports that can also be considered tap ports. *Id.*, 1:40-43. The "isolation between output ports … is typically between 10 dB and 40 dB" and "attenuates signals communicating between tap ports." *Id.*, 2:8-

11. When terminal devices communicate directly with each other in a LAN, the attenuation between the tap ports in the signal splitters results in undesirable signal loss. *Id.*, 2:18-21.

26. The ’249 patent uses a frequency selective network interface device placed at the point of entry of a building, where the network interface device reflects upstream signals transmitted by terminal devices back into the building so that the signals may be received by other terminal devices. *Id.*, 3:11-18. The annotated version of Figure 2 below shows an example of such a network interface device:

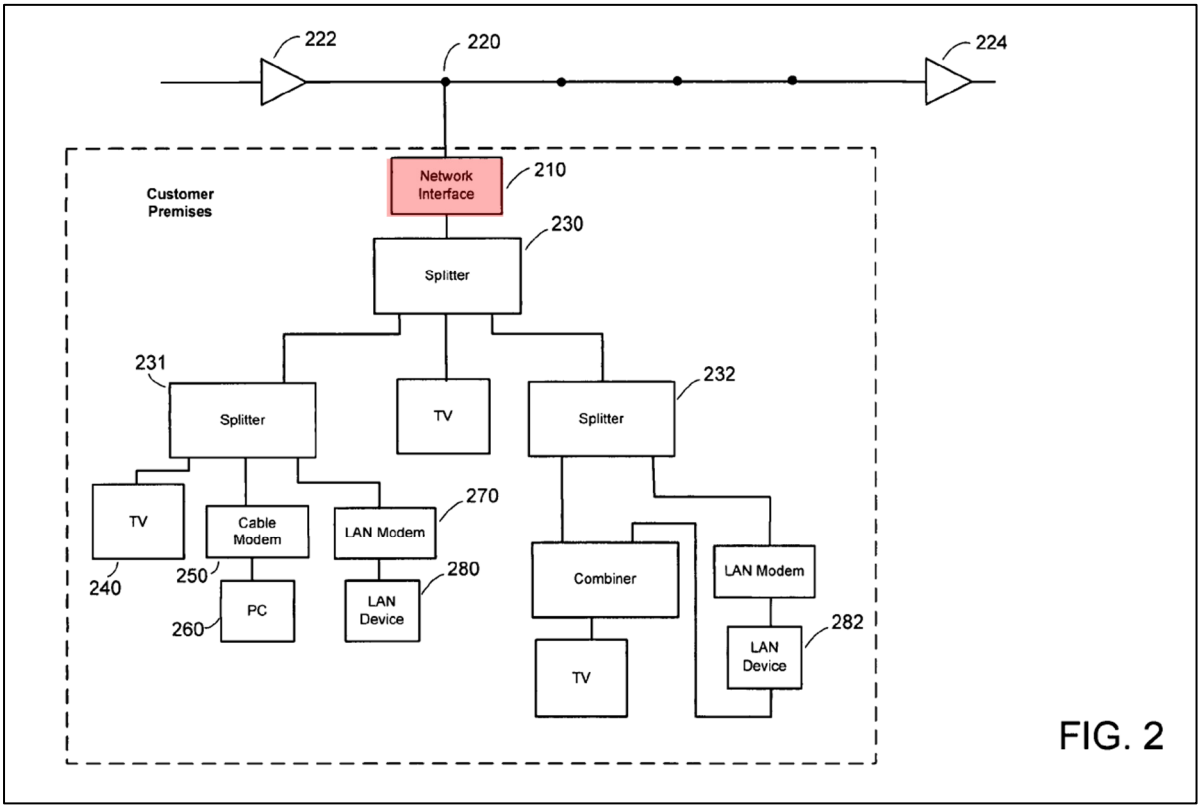
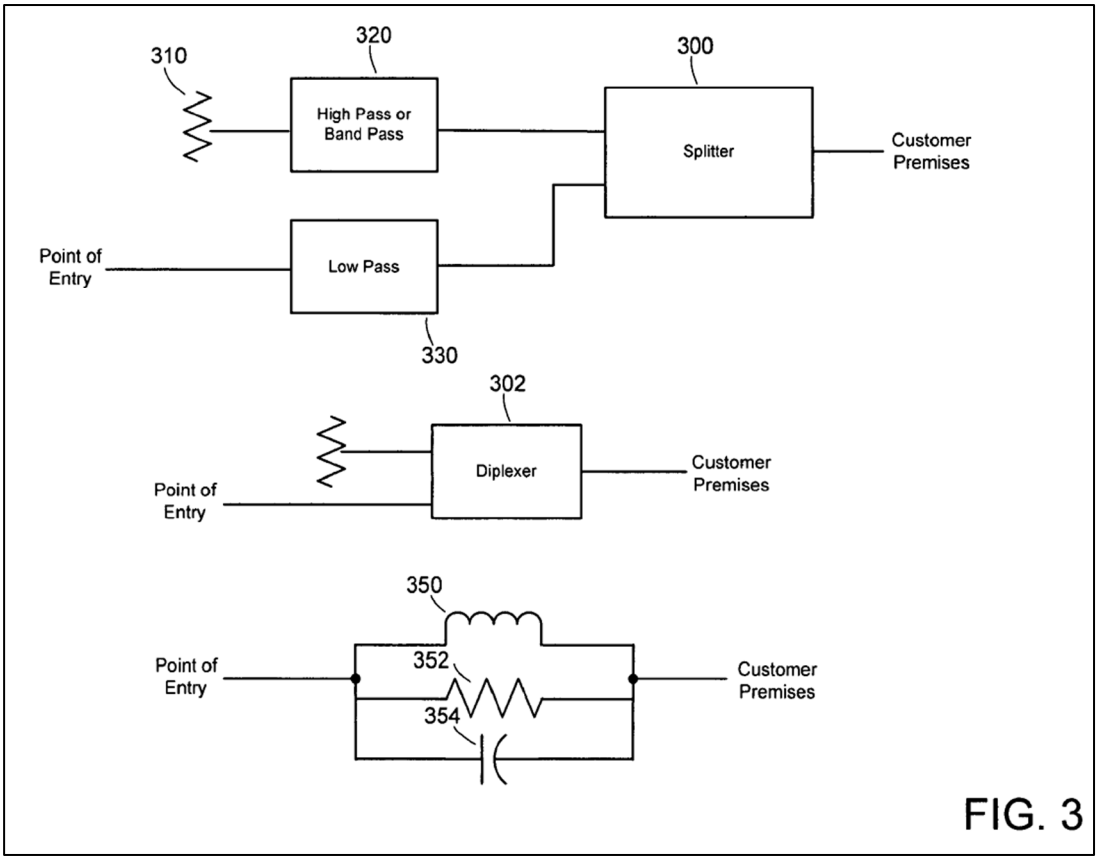


FIG. 2

27. When the network interface device reflects upstream signals back into

the building as downstream signals, the network interface device provides a path for terminal devices to communicate with other terminal devices. *Id.*, 3:18-20.

28. Notably, the hardware of the network interface device was well-known in the prior art, and the ’249 patent does not purport to require or disclose any novel hardware. In fact, the disclosures related to Figure 3, which is reproduced below, describe different embodiments of the network interface device that each use well known devices. *Id.*, 4:18-5:63. For example, the ’249 Patent states that “[s]plitters 300 and diplexer 302 are well known devices” and that splitters were “commonly used in home and other building type coaxial cable wiring” at the time of the 249 patent’s invention. *Id.*, 1:39-40, 5:17. “The selection of components to produce a filter with particular frequency characteristics is done using well known filter design techniques.” *Id.*, 5:21-23. Such a filter can even be implemented using well known electrical elements, including an inductor, resistor, and capacitor. *Id.*, 5:35-36. And “[o]ther techniques which can be used to implement the filters employed in the present invention include … other known filter techniques.” *Id.*, 5:58-63.



29. The ’249 patent also admits that the majority of the elements claimed by the patent were known prior to the purported invention. For example, the patent admits that in the prior art “coaxial cable [is] used for the LAN” and “[s]ignal 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)” or “terminal device[s].” *Id.*, 1:20-33. Moreover, “signal splitters are functioning as signal combiners for upstream signals” and “[g]ood quality splitters used in a properly wired system will provide a high level of isolation between terminal devices connected to the building wiring.” *Id.*, 1:35-39.

These splitters "are commonly used in home and other building type coaxial cable wiring," "have an input port and multiple output ports," and "are generally passive devices and can be constructed using lumped element circuits with discrete transformers, inductors, capacitors, and resistors." *Id.*, 1:39-47. Moreover, a "splitter may have 3 or more tap ports," and "[t]here is typically an N-way splitter at the point of entry of a building." *Id.*, 1:57-58. See also 1:59-2:41.

30. By way of further example, the '249 patent also admits that TDMA and OFDM were known in the art. *Id.*, 2:57-59; 3:1-3, 8:55-60 (OFDM). For example, the '249 patent cited prior art that describes the dynamic allocation of TDMA protocols in broadband networks (U.S. Pat. No. 5,889,765 Bi-directional communications Network issued to Gibbs) and a two-way method for communicating between an upstream and downstream unit using OFDM. *Id.*, 2:57-3:4. Indeed, the '249 patent admits that the only allegedly unsolved problems are "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." *Id.*, 3:4-7.

31. The '249 patent also describes the problems that are created by practicing the purported invention of using the claimed network interface device to introduce a reflection into the network. This reflection creates a multipath signal that causes inter-symbol interference (ISI), which degrades the performance of the communication channel. According to the patent, "[t]he effects of ISI can be

overcome by applying modulation techniques or receiver processing techniques," as further described below. *Id.*, 5:64-6:9.

32. The patent describes using multicarrier modulation to overcome the multipath effects. Multicarrier modulation is sometimes referred to as multitone modulation, and the patent recognizes that "[m]ultitone modulation is also called discrete multitone (DMT) and orthogonal frequency division multiplexing (OFDM)," which "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." *Id.*, 6:14-17, 7:61-8:7. The carriers or frequency channels used in multicarrier modulation are sometimes referred to as frequency bins. *Id.*, 8:42-43.

33. Multicarrier modulation was well known in the art at the time of the '249 patent. The patent itself recognizes that OFDM system architecture is covered in two textbooks—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. *Id.*, 8:55-60.

34. When using multicarrier modulation, frequency channels with a higher signal-to-noise ratio (SNR) can be used to communicate more data by communicating more bits. This can be accomplished by modulating each carrier

with a different order constellation, and frequency channels with a higher SNR can bear a higher order constellations, while those with a lower SNR must use lower order constellations. *Id.*, 8:22-29. The power level of each frequency channel can also be adjusted. *Id.*, 8:30-37.

35. The patent also refers to using equalization to overcome the multipath effects introduced by the network interface device. The patent states that an adaptive equalizer can be used in the terminal device receiver to restore a flat frequency response, which is impaired by the multipath signal. *Id.*, 6:9-13. The equalizer can be a time domain equalizer or a frequency domain equalizer or both. *Id.*, 8:50-52.

B. Prosecution History

36. The ’249 patent issued on September 22, 2009, from U.S. Patent Application 09/910,412 filed on July 21, 2001, and claims priority to Provisional Application No. 60/288,967, which was filed May 4, 2001. DISH-1001, cover.

37. The proposed claims were rejected numerous times during the three-year prosecution. *See* DISH-1002. I have reviewed the entire file history, and address particularly relevant aspects of it below.

38. After receiving a fifth Office Action, the Applicant responded by arguing that “what makes it possible for the present invention to take

advantage of the use of such a filter as a means for reflecting the signals back into the network." 2008-01-22 Amendment, 8. According to the Applicant, "bitloading" and "power control" are "two techniques (used either separately or together) for dealing with the variable nature of the interference that occurs to the transmission of the data over the network." *Id.* These techniques are discussed in 8:22-29 (bitloading) and 8:30-37 (power control) of the specification.

39. The patent went through two additional Office Actions, and the Applicant amended the claims to require the filter to "reject network signals originating in the building, such that the network signals … do not pass through the filter, but rather are reflected back into the building." 2009-01-19 Amendment, 2-4. According to the Applicant, the prior art "is **not tuned to reject** signals that originate in the building" but instead "takes those signals in and loops them back out after processing those signals." *Id.* at 7 (emph. unchanged). The Applicant also argued that "[t]he amount of hardware necessary to perform that looping function (as opposed to rejecting the signal, as recited in the currently amended claims) is significantly more than just the filter that is recited." *Id.*

40. The Examiner issued a Notice of Allowance, indicating that "[t]he prior art of record fails to reasonably show or suggest 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." Notice of Allowance, 05-18-2009 at 2-3.

VII. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. [GROUND 1] – Amit (Claims 1-2)

1) Overview of Amit

41. Amit is a US Patent numbered 7,127,734 that was filed on April 12, 2000, and claims priority to provisional application number 60/128,810, which was filed on April 12, 1999. Amit is titled "System and methods for home network communications." DISH-1005, cover

42. In summary, Amit teaches how to provide "home networking over coaxial TV cables." *Id.*, 2:39-40. Like the '249 patent, this coaxial networking is based on direct communications between two devices and does not require transferring the data to a headend. *Id.*, 2:34-38. This is possible because the "signals will typically propagate between the devices via reflections from other devices in the line, e.g. splitters or amplifiers in the line." *Id.*, 3:19-23. Figure 2, reproduced below, shows one of the preferred embodiments of Amit's home network method and system. *Id.*, 5:22-24.

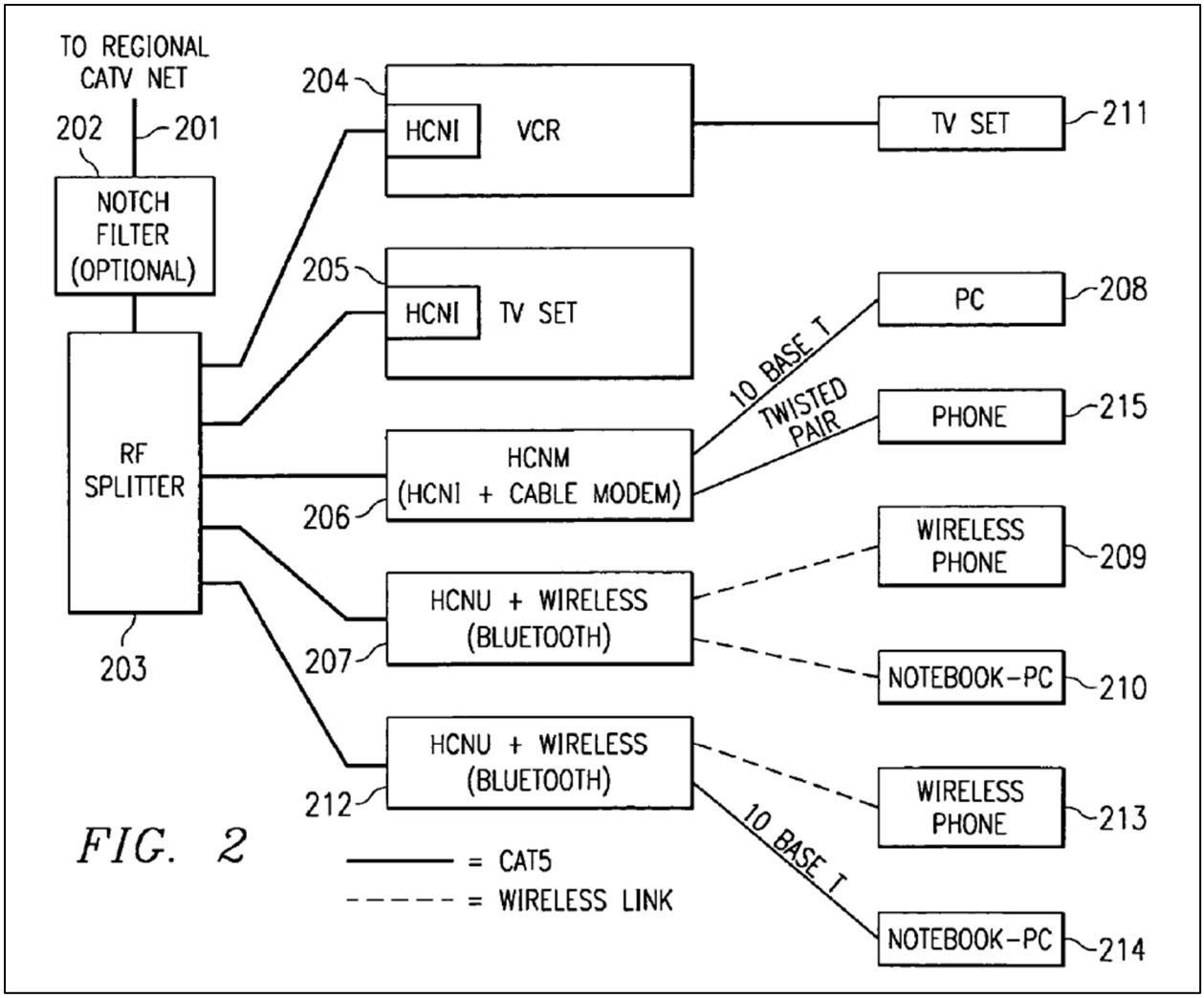


FIG. 2

43. The hardware Amit describes is substantially the same as the hardware described in the '249 patent. For example, Amit explains that "the splitter at the input to the user premises is replaced by a special splitter device that supplies higher quality home networking capabilities, or a filter is connected to the splitter" to "insure[] that the home networking signals in a specific home will not interfere with or be interfered by other home networks." *Id.*, 4:30-39. Like the '249 patent, this hardware allows the signals originating from the home units to arrive at the RF splitter and be reflected back to the home units. *Id.*, 6:39-41. Amit

also explains that this reflection can be "in the power of the signal or it might be higher," and "[w]hen this reflection is higher than the signal we can use this reflection as our main signal." *Id.*, 14:1-5

44. Amit is also similar to the '249 patent because it teaches placing a filter at a building's point of entry to allow signals originating in the building to be reflected back into all branches of the building wiring. In its description related to Figure 7, Amit explains that "the communication between 703 and 704 might be 'hidden' from 701 in particular when the notch filter [707] does not exist" because "the isolation difference between two different nodes is different than the isolation between other two nodes … in a home that contains some splitters [but] no notch filter." *Id.*, 13:55-67. On the other hand, when the home does have a notch filter, devices in the home can communicate via the reflections caused by the notch filter, and Amit shows how the corresponding signal loss in this signal path can be calculated. *Id.*, 14:10-65.

2) Independent Claim 1

[1.pre] "A signal distribution network comprising":

45. I have been asked to consider whether Amit discloses or renders obvious the preamble of claim 1, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 1 is deemed to be a limitation, it is my opinion that Amit teaches this limitation.

46. Specifically, Amit "provides a system and methods for communication between subscribers' devices over cable infrastructure designed to carry video signals," including "home networking solutions that utilize in-home TV wiring for supplying high rate connectivity between any two home networking nodes." DISH-1005, 2:34-46. A POSITA would have understood the home network of Amit to be a "signal distribution network." Amit depicts examples of such "signal distribution networks" in Figures 2 and 7. *Id.*, 5:22-31.

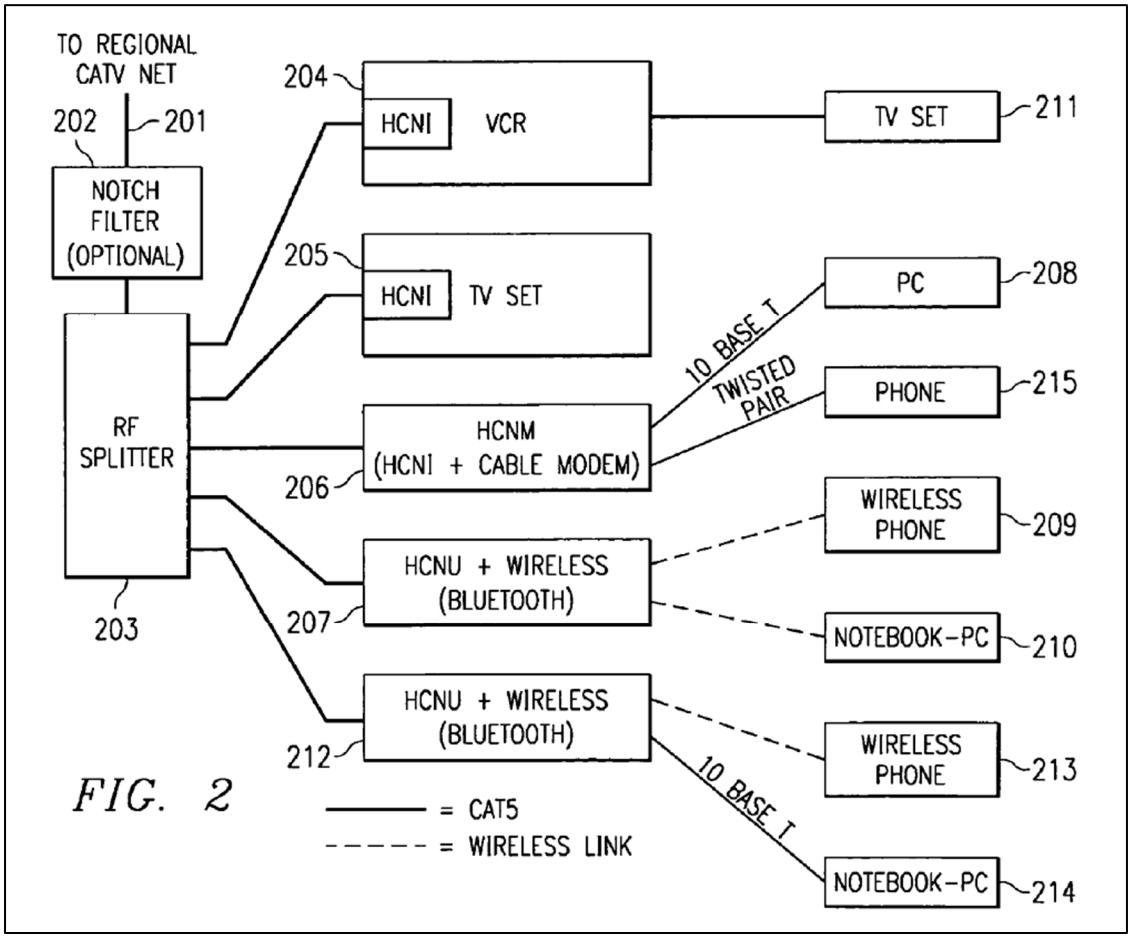
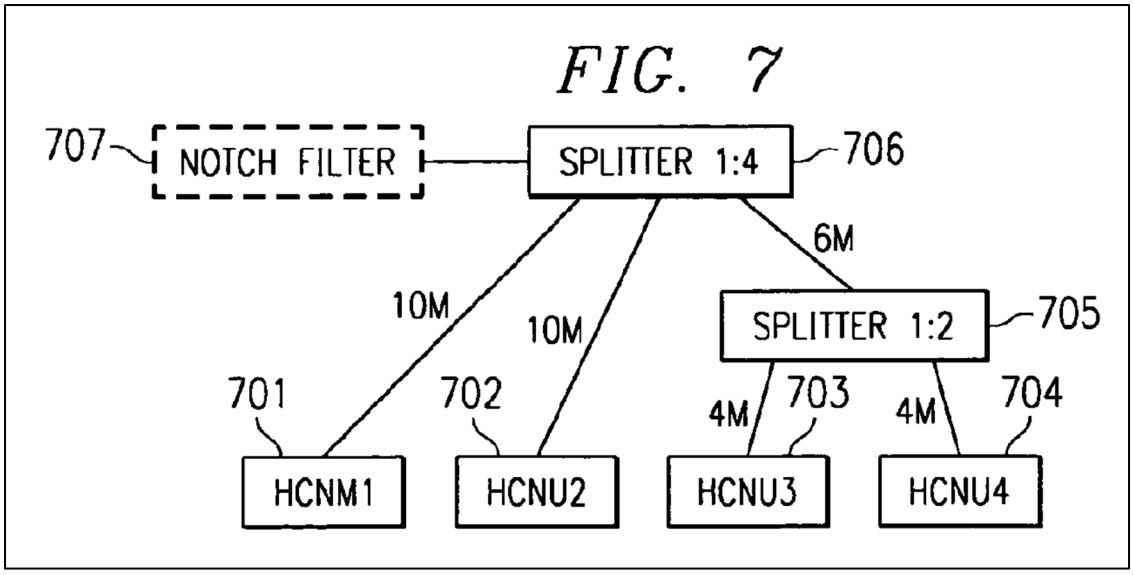


FIG. 2



47. As a result, it is my opinion that Amit discloses or renders obvious this limitation.

[1.a] "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"

48. It is my opinion that Amit discloses or renders obvious this limitation.

49. Amit teaches that "the splitter at the input to the user premises is replaced by a special splitter device that supplies higher quality home networking capabilities, or a filter is connected to the splitter." DISH-1005, 4:30-34. A POSITA would have understood that Amit's special splitter device and filter each teach the "filter" claimed in [1.a]. Amit's filter is "[a] passive filter connected to the splitter [that] insures that the home networking signals in a specific home will not interfere with or be interfered by other home networks" and "provides a 'single home' operational mode that allows for low cost equipment and frequency re-use."

Id., 4:34-39. "When the home coaxial cables are connected to a local or regional CATV network, frequencies are re-used between portions of the CATV plants, so that the same frequency range is allocated to different users in a CATV plant, relying on the isolation between those users due to the attenuation of the cable plant" and the filter mentioned above. *Id.*, 3:31-36. Amit's "special splitter" is "[a] home network splitter that supplies less isolation between the home drops and includes the filter inside." *Id.*, 4:39-42; *see also id.*, 13:40-44. By being tuned to reject network signals originating in the building, such that the network signals originating in the building do not pass through the filter, Amit's filter allows the same frequency range to be used by more than one household. *Id.*, 3:33-35.

50. Amit's special splitter and filter are both taught to be "located at the point of entry of a building." Amit explains that the conventional splitter that is replaced by the special splitter or connected to the filter is "at the input to the user premises." *Id.*, 4:30-34; *see also id.*, 5:8-11. This is further supported in figure 2 (below), which shows that "RF splitter [203] splits the signal coming from and to the regional CATV plant [201], to the signals coming to and from units [204–207, 212] respectively." DISH-1005, 6:36-39. A POSITA would have understood that the signal coming from and to the regional CATV plant enters a building at the point of entry of a building. Indeed, Amit confirms this by explaining that in Amit's "Single Home operation mode … a notch filter should be added … at the

flat/single home entrance." *Id.*, 13:31-45.

51. Amit further explains how the filter reflects the rejected signals back into the building in describing figures 2 and 7.

52. In figure 2 (shown below), notch filter [202] "is connected to the regional CATV plants via cable [201]," and "RF Splitter [203] splits the signal" to devices [204-207, 212]. *Id.*, 6:26-39. A POSITA reading Amit would have understood that the filter and RF splitter are located at the point of entry of a building because that is the location where the cable from the regional CATV network enters the building and where a splitter is typically used to feed multiple cable branches that go to other locations in the building. DISH-1010, Weinberg, 36 ("Actual connections to the subscriber are made from the feeder line using a splitter or tap and RG-59/U coaxial cable.); DISH-1011, Dodds, 19 ("Note that [the splitter] location in the household would be physically close to where the twisted-pair drop-wire enters the house."). Amit confirms this to be the case and refers to this location as the "input to the user premises." DISH-1005, 4:31. Amit also explains that the notch filter [202] "is a band reject filter that does not pass a certain RF range that is used by the home networking devices [204–207, 212]." *Id.*, 4:31, 6:28-31. Amit's notch filter rejects and reflects signals originating in the building, allowing the same frequency range to be used by multiple households. *See id.*, 3:33-35. A POSITA would have understood that by not passing a certain

RF range, the filter may reflect that RF range back into the building. DISH-1012, Maxemchuk, 303 ("Signals transmitted by sources within a homenet are **reflected** back at the head end of the homenet, instead of the head end of the entire network. Sources only contend with other sources in the same homenet for the homenet receive frequency… The upstream channel is only used to communicate between sources in the homenet and the head end of the homenet. Therefore, **notch filters** can be inserted at the boundaries of the homenets to **prevent the upstream signal** from propagating between homenets. This allows the same upstream frequency band to be used in every homenet and reduces the number of upstream channels required by the network. Since every homenet uses the same upstream channel the transmitter in the sources is independent of the source's homenet. The notch filters also reduce the noise sources affecting the transmitted signal to those in the homenet, rather than those in the network."). This is confirmed by Amit, who discusses reflection from the filter. DISH-1005, 14:1-5.

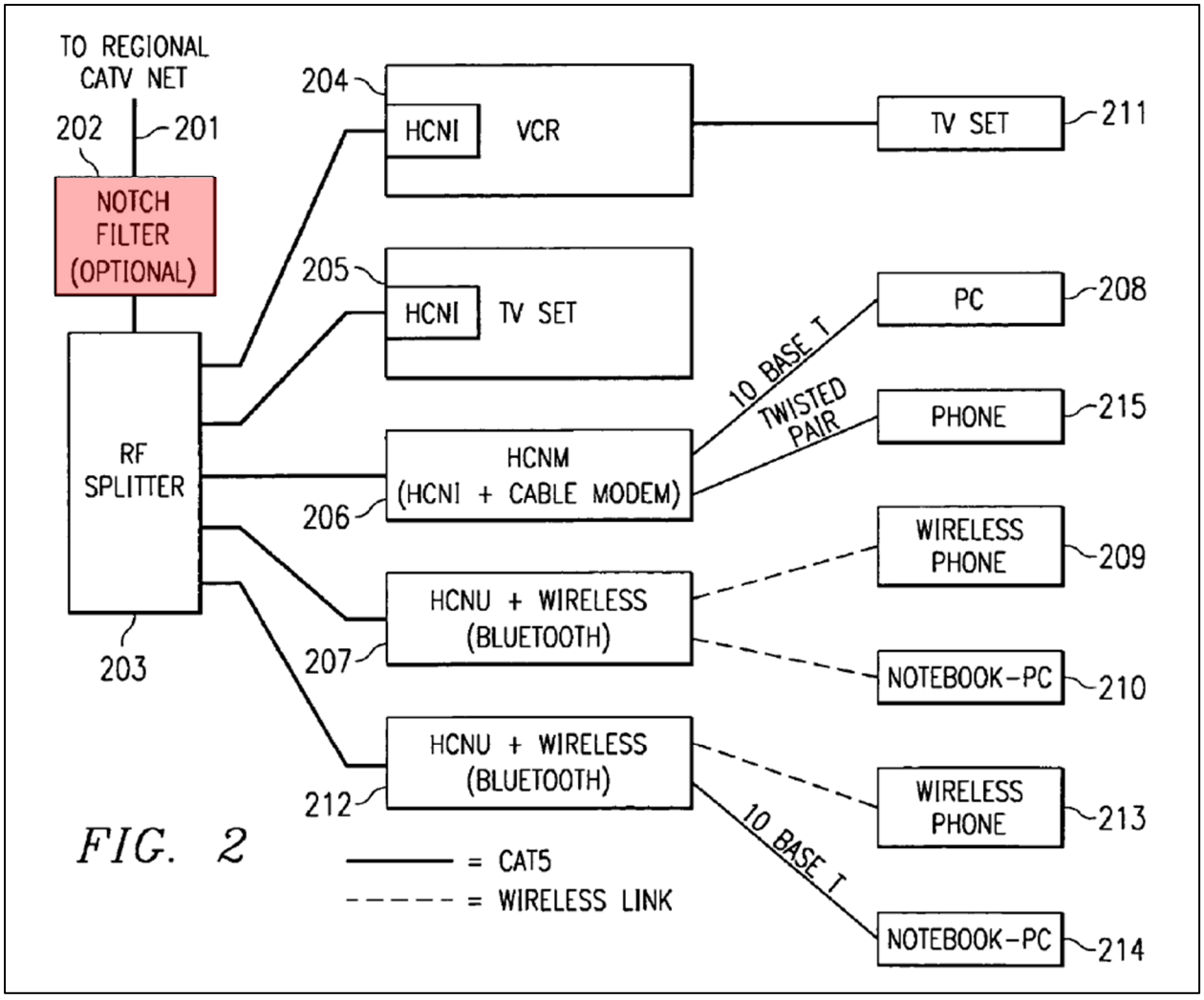

TO REGIONAL CATV NET
202
201
NOTCH FILTER (OPTIONAL)
RF SPLITTER
203
204
HCNI
VCR
TV SET
211
205
HCNI
TV SET
10 BASE T
TWISTED PAIR
PC
208
PHONE
215
HCNM (HCNI + CABLE MODEM)
206
WIRELESS PHONE
209
HCNU + WIRELESS (BLUETOOTH)
207
NOTEBOOK-PC
210
HCNU + WIRELESS (BLUETOOTH)
212
WIRELESS PHONE
213
10 BASE T
NOTEBOOK-PC
214
= CAT5
= WIRELESS LINK

FIG. 2

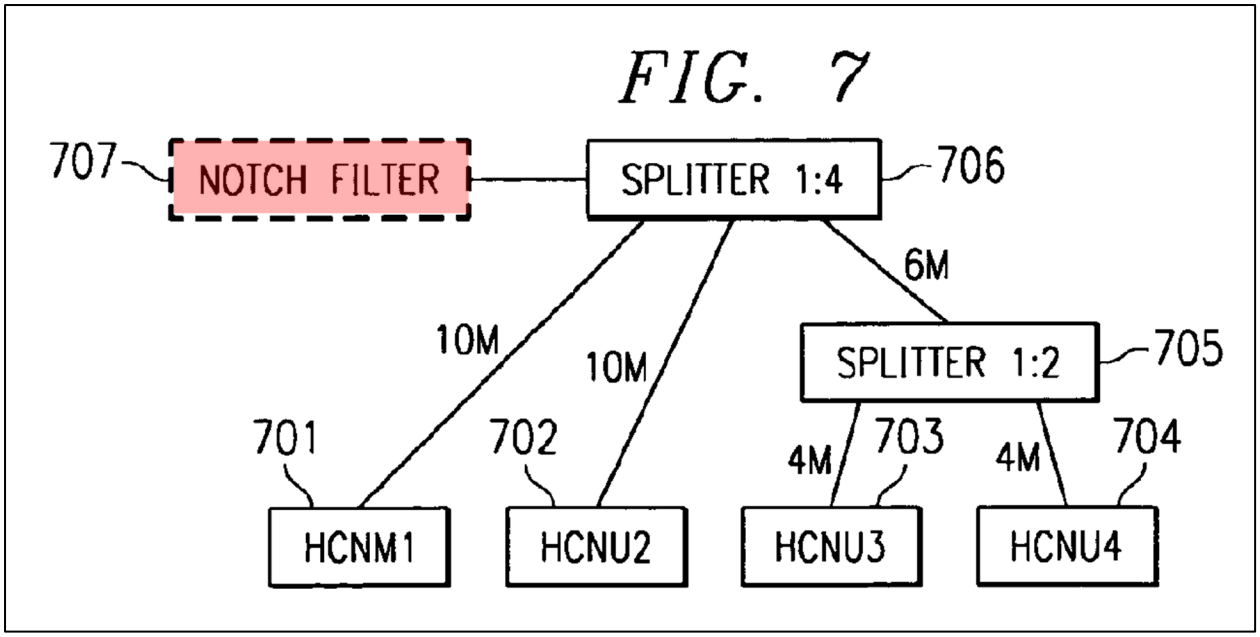

707
NOTCH FILTER
SPLITTER 1:4
706
6M
10M
10M
SPLITTER 1:2
705
701
702
4M
703
4M
704
HCNM1
HCNU2
HCNU3
HCNU4

FIG. 7

53. Amit also teaches that in the "Single Home operation mode … a notch filter should be added … at the flat/single home entrance," enabling "notch filter reflection." *Id.*, 13:31-45. Amit explains that the "reflection from the notch filter is in the power of the signal or it might be higher." *Id.*, 14:1-3. "When this reflection is higher than the signal," Amit explains that "we can use this reflection as our main signal." *Id.*, 14:3-5. A POSITA would have understood that using a reflection as a main signal means that the reflection allows two or more devices to communicate with one another because the filter would reflect the signals from the original device back to other devices in the chain.

54. In its disclosures related to figure 7 (shown above), Amit elaborates that "the communication between 703 and 704 might be 'hidden' from 701 in particular when the notch filter [707] does not exist, but "for homes that have [a] notch filter," "Two Modems in the Same Flat" (*i.e.*, apartment) can communicate via the "Echo from the notch filter," and the corresponding signal loss in this filter-reflection signal path can be calculated. *Id.*, 13:65-67, 14:10-65. In column 14, Amit provides this calculation for a variety of communication paths that utilize the echo from the notch filter:

7. These calculations are only valid for homes that have notch filter.

Data Form 3: Home Networking Typical Calculations Loss Between Two Modems in the Same Flat

1 Connected to the same main filter HCNM1 [701] HCNU2 [702]:

Without Notch Filter			Echo from the notch filter		
Wires [meters]	20	4.2	Wires [meters]	20	4.2
Splitter Isolation [706]		25	Insertion Lost (n = 4)[706]		8.2
			Return Loss [707]		10
Total [dB]		29.2	Insertion Lost (n = 4)[706]		8.2
			Total [dB]		30.6

2 Connected to the same minor filter HCNU3 [703] HCNU4 [704]:

Through the nearest splitter		
Wires [meters]	8	1.68
Splitter Isolation[705]		22
Total [dB]		23.68
Echo from Main Splitter		
Wires [meters]	20	4.2
Insertion Lost (n =[0 2)[705]		4.2
Return Loss [706]		11
Insertion Lost (n =[0 2)[705]		4.2
Total [dB]		23.6
Echo from the notch filter		
Wires[meters]	20	4.2
Insertion Lost (n = 2)[705]		4.2
Insertion Lost (n = 4)[706]		8.2
Return Loss [707]		10
Insertion Lost (n = 4)[706]		8.2
Insertion Lost (n = 2)[705]		4.2
Total [dB]		39

3 Connected to different filters HCNM1 [701] HCNU2 [704]:					
Without Notch Filter			Echo from the notch filter		
Wires [meters]	20	4.2	Wires [meters]	20	4.2
Splitter Isolation		25	Insertion Lost (n = 4)[706]		8.2
[706]		4.2	Return Loss [707]		10
Insertion Lost					
(n = 2)[705]		33.4	Insertion Lost (n = 4)[706]		8.2
Total [dB]			Insertion Lost (n = 2)[705]		4.2
			Total [dB]		34.8

55. As a result, it is my opinion that Amit discloses or renders obvious this limitation.

[1.b.i] "at least one signal splitter,"

56. It is my opinion that Amit discloses or renders obvious this limitation.

57. In its disclosures related to figure 2 (shown below), Amit explains that "RF splitter [203] splits the signal coming from and to the regional CATV plant [201], to the signals coming to and from units [204–207, 212] respectively." *Id.*, 6:36-39.

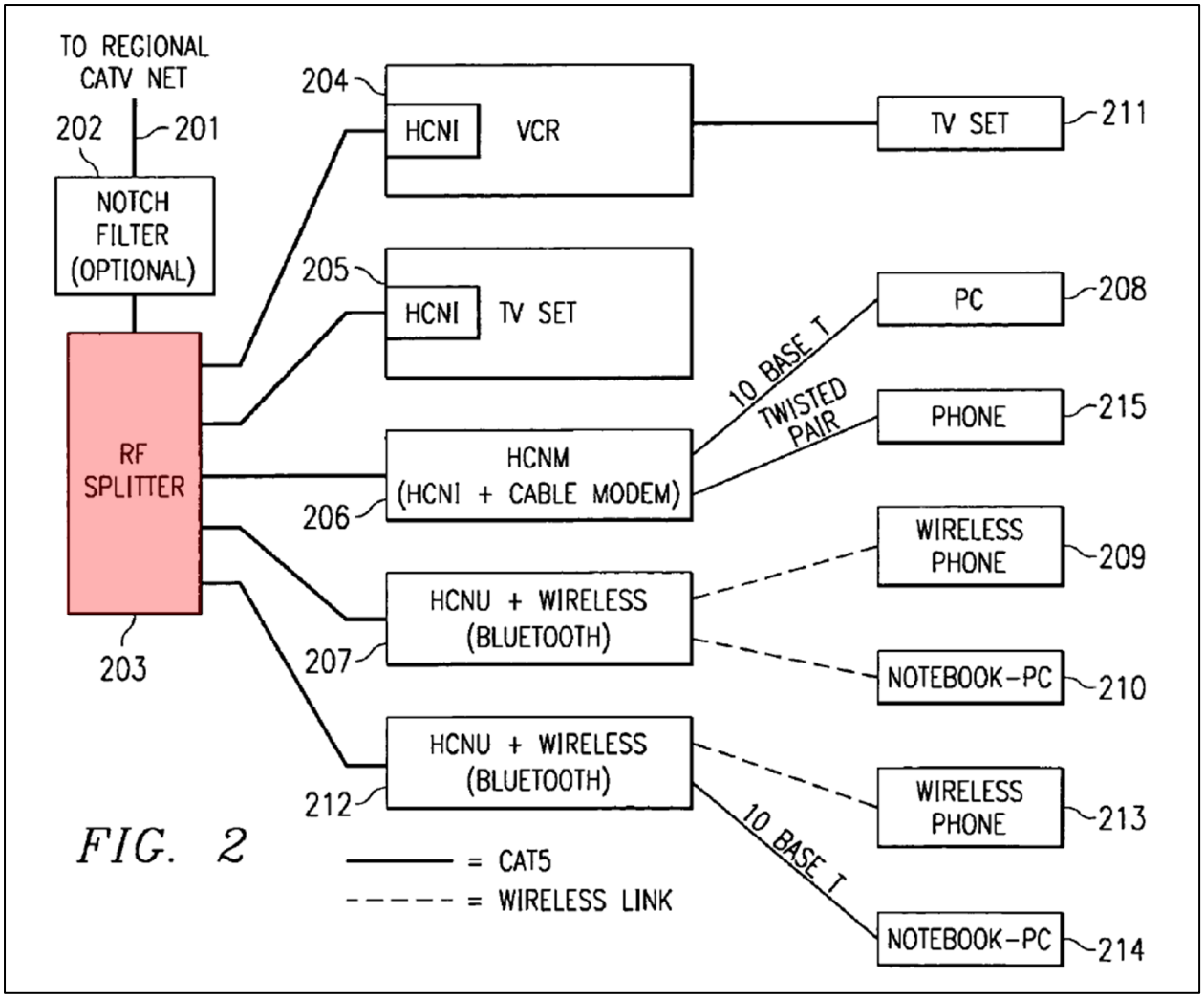

TO REGIONAL CATV NET
202
201
NOTCH FILTER (OPTIONAL)
RF SPLITTER
203
204
HCNI
VCR
TV SET
211
205
HCNI
TV SET
206
HCNM (HCNI + CABLE MODEM)
10 BASE T
TWISTED PAIR
PC
208
PHONE
215
207
HCNU + WIRELESS (BLUETOOTH)
WIRELESS PHONE
209
NOTEBOOK-PC
210
212
HCNU + WIRELESS (BLUETOOTH)
WIRELESS PHONE
213
10 BASE T
NOTEBOOK-PC
214
= CAT5
= WIRELESS LINK

FIG. 2

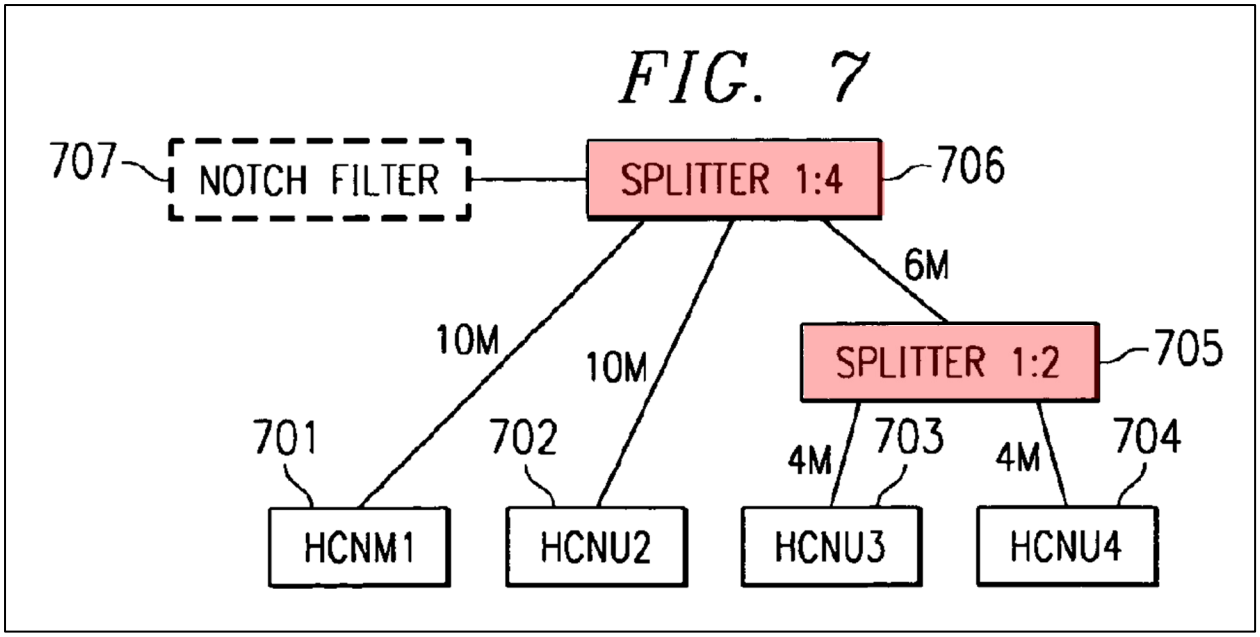

707
NOTCH FILTER
SPLITTER 1:4
706
6M
10M
10M
SPLITTER 1:2
705
701
702
4M
703
4M
704
HCNM1
HCNU2
HCNU3
HCNU4

FIG. 7

58. In its disclosures related to figure 7 (shown above), Amit explains that figure 7 "shows a network with a notch filter," and figure depicts several devices [701-704] that are connected via two splitters [705-706]. *Id.*, 5:31. Either splitter [705] or splitter [706] teaches the "at least one signal splitter" of claim 1, as further explained below.

59. As a result, it is my opinion that Amit discloses or renders obvious this limitation.

[1.b.ii] "the signal splitter having a common port and a plurality of tap ports, the common port of the signal splitter being coupled to the filter; and"

60. It is my opinion that Amit discloses or renders obvious this limitation.

61. The '249 indicates what is meant by the claimed "common port" and "tap port," explaining that "[s]ignal splitters … have an input port and multiple output ports," where "[t]he input port can also be considered a common port" and "[t]he output ports can also be considered tap ports." DISH-1001, 1:41-43.

62. Amit also explains that "[s]plitters [] get a single wire as [an] input, and some wires as output[s]." DISH-1005, 8:66-67.

63. In its disclosures related to figure 2 (shown below), Amit explains that "RF splitter [203] splits the signal coming from and to the regional CATV plant [201], to the signals coming to and from units [204–207, 212] respectively." *Id.*, 6:36-39. A POSITA would have understood that the splitter "splits" the input port

signal amongst the splitter's output ports. In the figure, the splitter's common/input port is coupled to the notch filter, and the plurality of tap/output ports are coupled to units [204–207, 212]. I have annotated the "common port" with a green box and the "plurality of tap ports" with blue boxes:

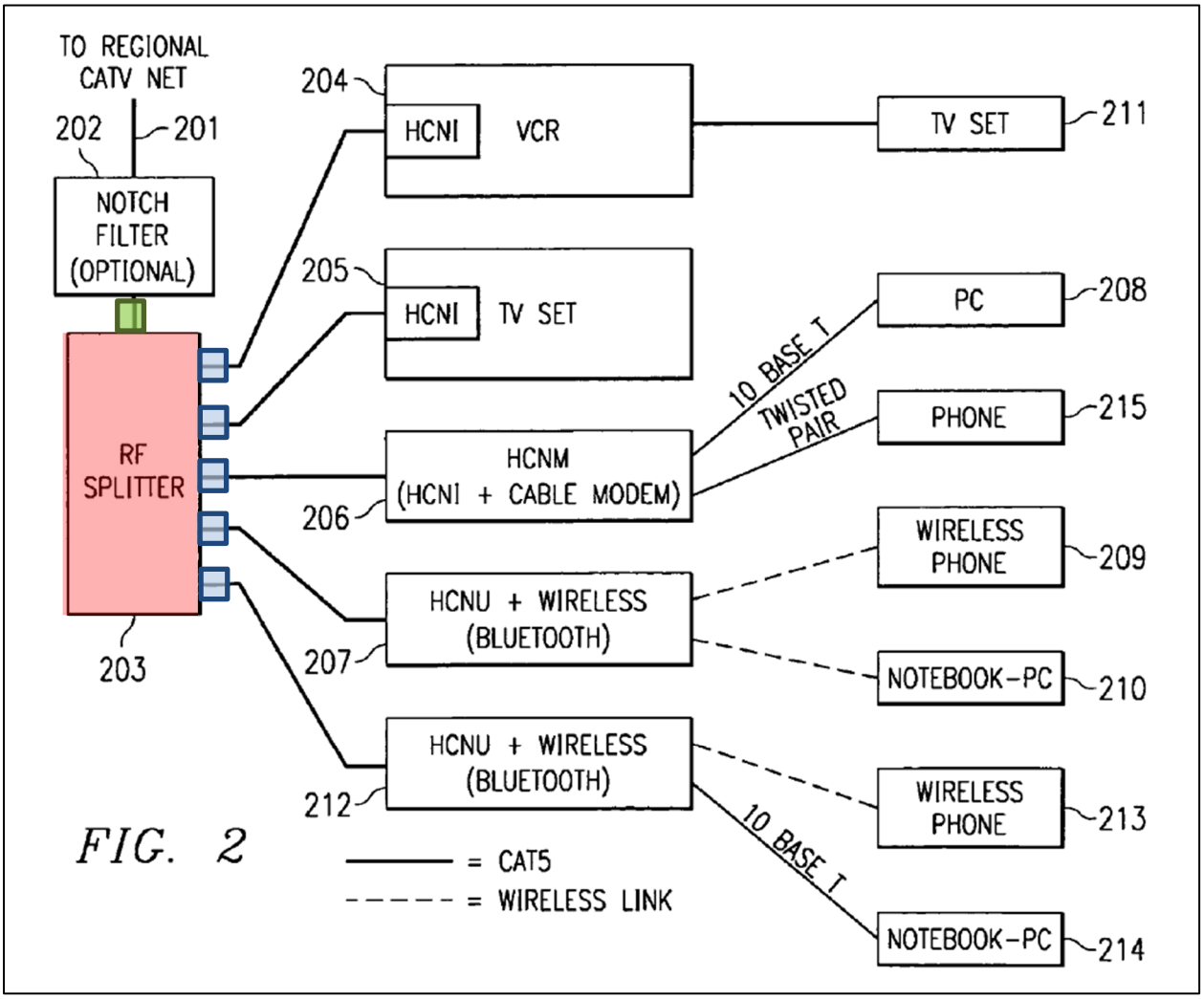
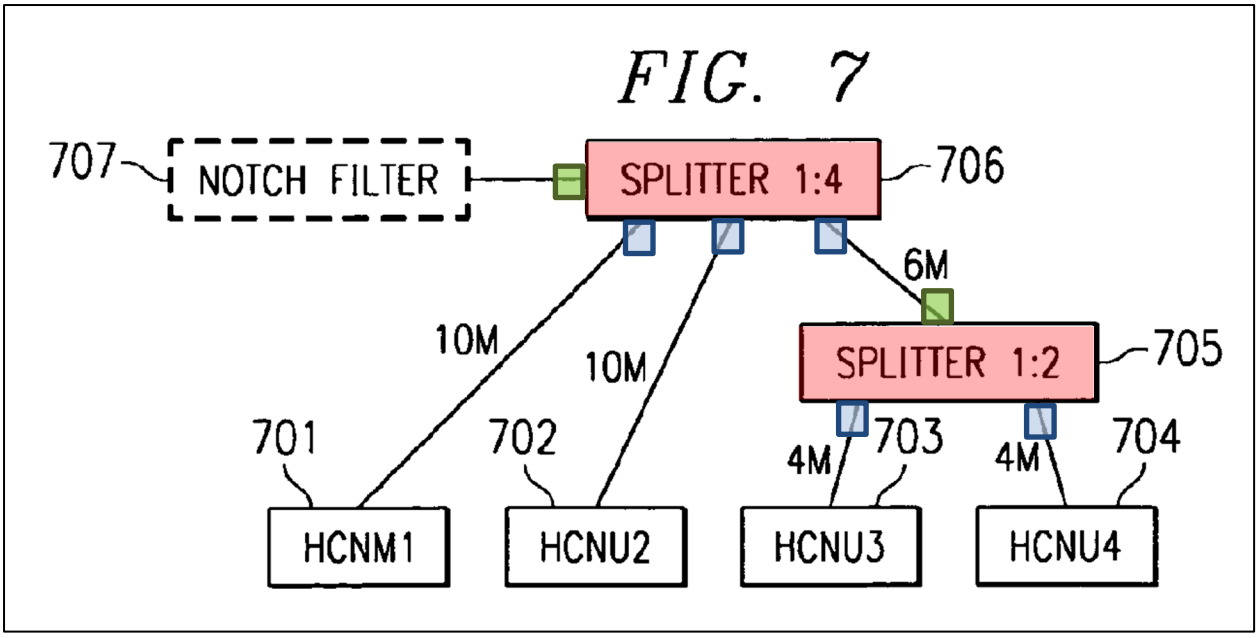


FIG. 2



64. In figure 7 (shown above), Amit shows that the common port of each splitter is coupled directly or indirectly to the notch filter [707]. Each splitter also has a plurality of tap ports that connect to HCNM1 [701], HCNU2 [702], HCNU3 [703], and HCNU4 [704]. I have annotated the common ports with green boxes and the tap ports with blue boxes.

65. For splitter [706], the common port is directly coupled to the notch filter, and the tap ports are directly coupled to HCNM1 and HCNU2. The rightmost tap port of splitter [706] is coupled to HCNU3 and HCNU 4 via the splitter 705.

66. For splitter [705], the common port is coupled to the notch filter via splitter [706]. The tap ports are directly coupled to HCNU3 and HCNU4.

67. As a result, it is my opinion that Amit discloses or renders obvious

this limitation.

[1.c.i] "a plurality of terminal devices,"

68. It is my opinion that Amit discloses or renders obvious this limitation.

69. The '249 patent describes exemplary terminal devices. For example, the patent explains 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." DISH-1001, 3:66-4:2.

70. Amit also teaches such "terminal devices." Amit refers to the claimed "plurality of terminal devices" as "nodes," and Amit "provides home networking solutions that utilize in-home TV wiring for supplying high rate connectivity between any two home networking nodes." DISH-1005, 2:44-46.

71. A POSITA would have understood that the nodes of Amit are terminal devices. This is confirmed by comparing relevant portions of the references. The '249 patent's figure 2 shows that terminal device LAN Modem 270 connects to a LAN device 280 (*e.g.*, a PC). DISH-1001, 4:6-13. Similarly, Amit's figure 2 shows that terminal device (HCNM) 206 connects to LAN device (PC) 208. DISH-1005, 6:46-50.

72. In its disclosures related to figure 2 (shown below), Amit explains that "FIG. 2 shows a Home Cable network[] (HomeCN/HCN) that has 5 nodes [204–207, 212]," and Amit also refers to "nodes" as being "home networking devices,"

"units," and "home units." *Id.*, 6:26-41. A POSITA would have understood that the home networking devices, units, and home units (*i.e.*, nodes) of Amit are "a plurality of terminal devices." For example, figure 2 includes five different "nodes" (*i.e.*, "terminal devices")—a VCR [204] and a TV Set [205], which are each described as "Home Cable Networking Interface (HCNI) devices," as well as the "Home Networking Cable Modem (HNCM) device [206]," and "HCNU+wireless units [207, 212]." *Id.*, 6:44-54. Amit explains that "[t]he HCNU devices are capable of transmitting and receiving digital communications signals between them," and "[t]he HNCI's, the HCNU's and the HNCM use Home Cable Network Protocol HCNP" to communicate. *Id.*, 6:57-64. Thus, a POSITA would have understood that [204]-[207] and [212] are each "terminal devices."

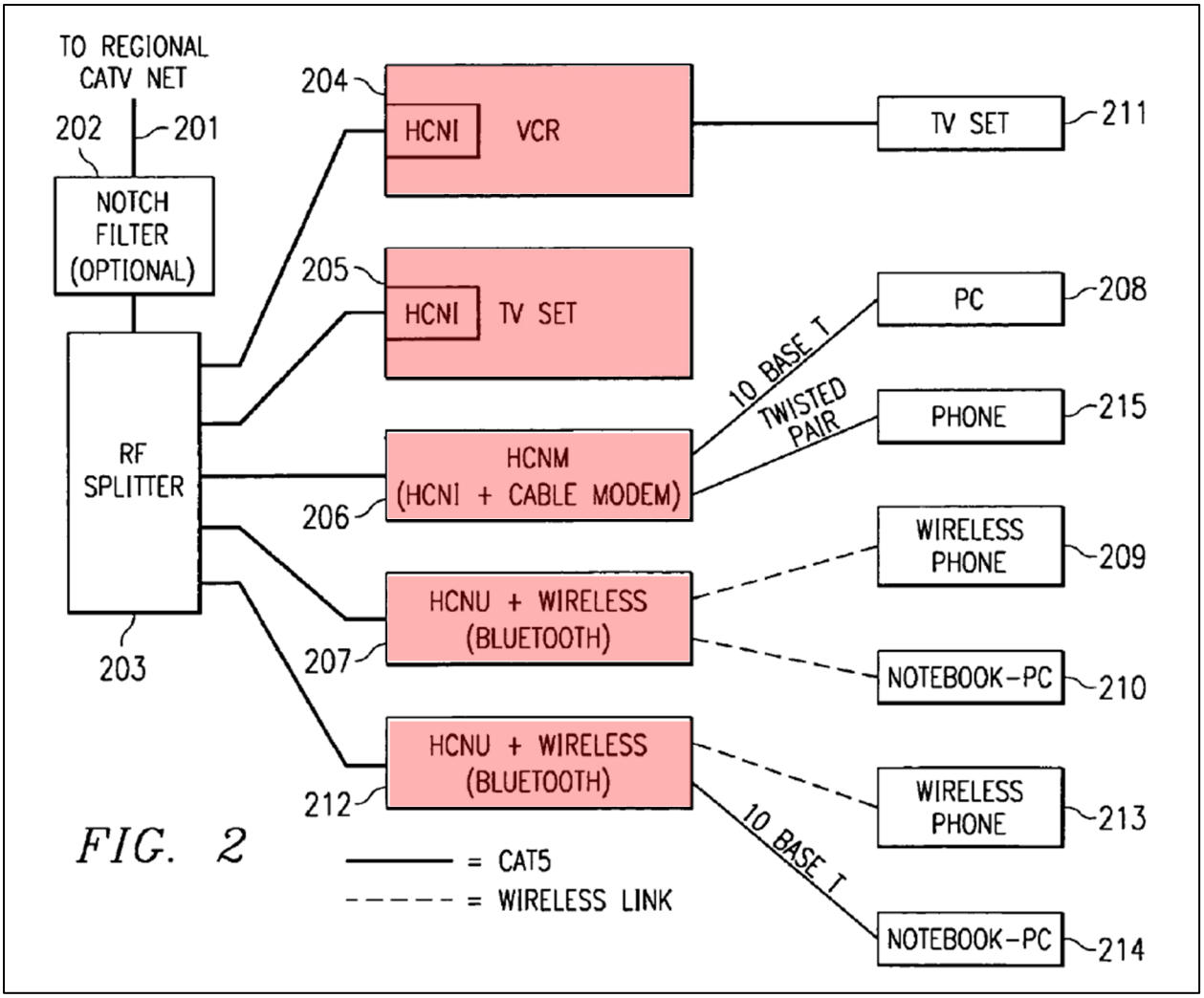
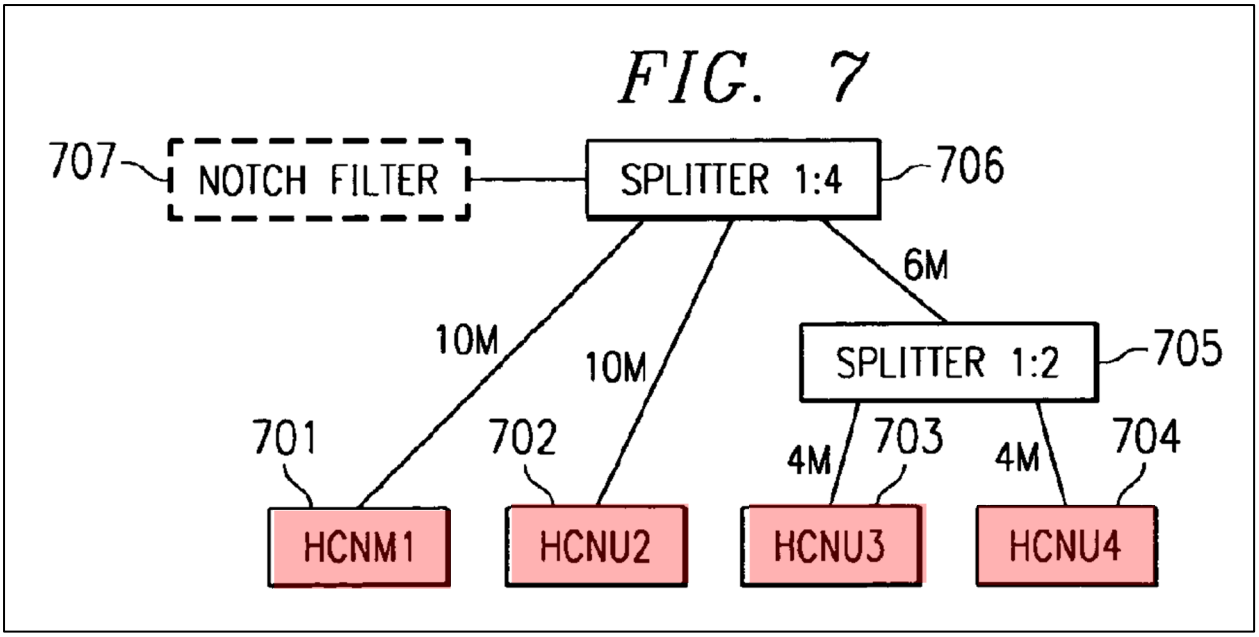

TO REGIONAL CATV NET
202
201
NOTCH FILTER (OPTIONAL)
RF SPLITTER
203
204
HCNI
VCR
205
HCNI
TV SET
206
HCNM (HCNI + CABLE MODEM)
207
HCNU + WIRELESS (BLUETOOTH)
212
HCNU + WIRELESS (BLUETOOTH)
TV SET
211
10 BASE T
TWISTED PAIR
PC
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PHONE
215
WIRELESS PHONE
209
NOTEBOOK-PC
210
WIRELESS PHONE
213
10 BASE T
NOTEBOOK-PC
214
= CAT5
= WIRELESS LINK

FIG. 2


FIG. 7
707
NOTCH FILTER
SPLITTER 1:4
706
6M
10M
10M
SPLITTER 1:2
705
701
702
4M
703
4M
704
HCNM1
HCNU2
HCNU3
HCNU4

73. In figure 7 (shown above), Amit also depicts a plurality of terminal devices. Specifically, the figure shows terminal devices HCNM1 [701], HCNU2 [702], HCNU3 [703], and HCNU4 [704].

74. As a result, it is my opinion that Amit discloses or renders obvious this limitation.

[1.c.ii] "each terminal device being coupled to a tap port of at least one signal splitter,"

75. It is my opinion that Amit discloses or renders obvious this limitation.

76. Figure 2 (below) shows that terminal devices [204–207, 212] are each coupled to a tap port of splitter [203]. In the description related to figure 2, Amit explains that "RF splitter [203] splits the signal coming from and to the regional CATV plant [201], to the signals coming to and from units [204–207, 212] respectively." DISH-1005, 6:36-41. A POSITA reading Amit and analyzing figure 2 would have understood that when the RF splitter splits the signal to the terminal devices [204-207, 212], that necessarily means that the terminal devices are each coupled to a tap port of RF splitter [203]. *See also*, *id.*, 6:39-41 ("signals arriving to RF splitter 203 from the home units 204-207, 212 are partially reflected back to these home units 204-207"); 16:17-20 ("the splitter distributes the energy to the Cable-In connector, and to the other output connectors that are connected to the splitter").

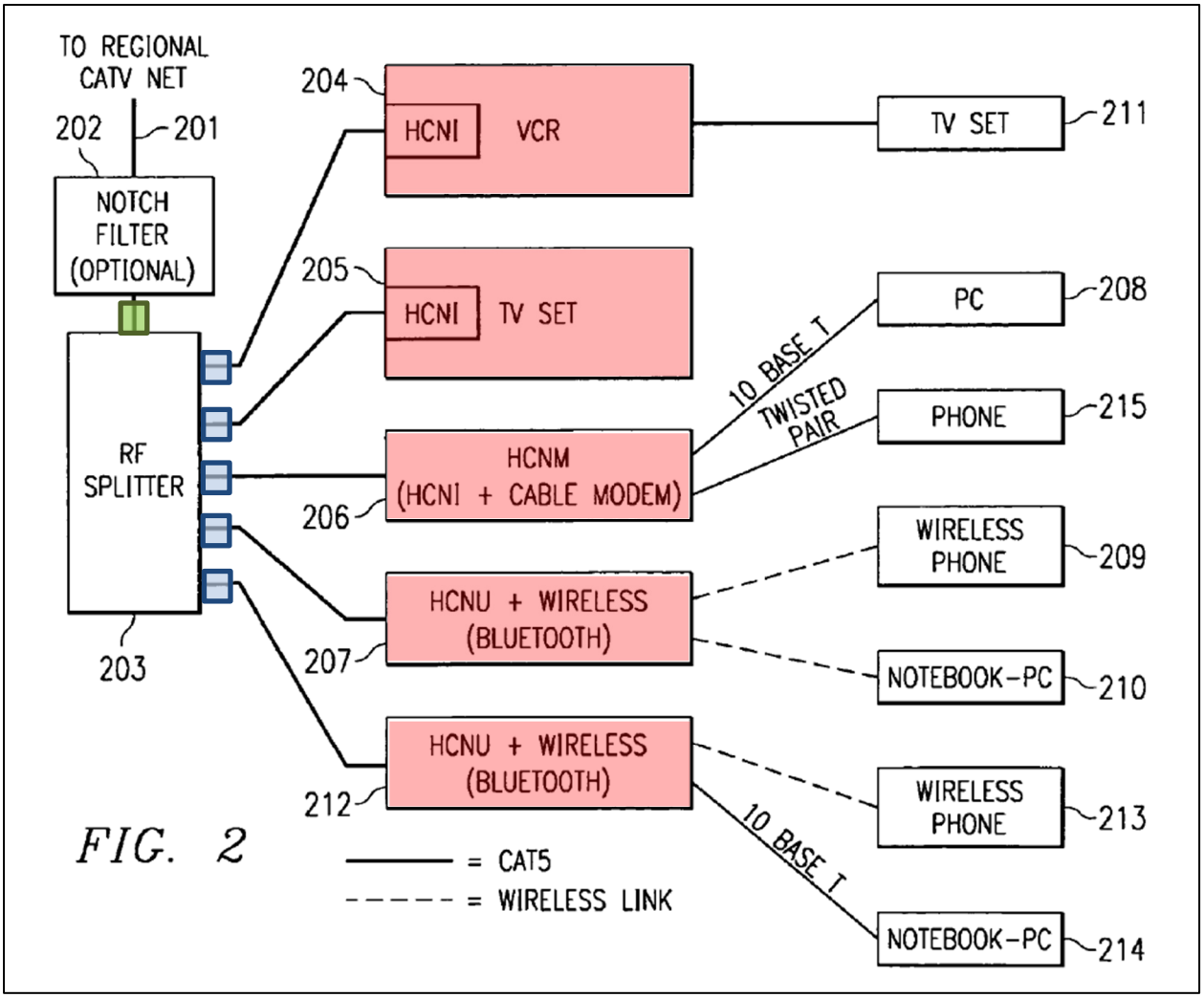

TO REGIONAL CATV NET
202
201
NOTCH FILTER (OPTIONAL)
RF SPLITTER
203
204
HCNI
VCR
205
HCNI
TV SET
206
HCNM (HCNI + CABLE MODEM)
207
HCNU + WIRELESS (BLUETOOTH)
212
HCNU + WIRELESS (BLUETOOTH)
TV SET
211
10 BASE T
TWISTED PAIR
PC
208
PHONE
215
WIRELESS PHONE
209
NOTEBOOK-PC
210
WIRELESS PHONE
213
10 BASE T
NOTEBOOK-PC
214
= CAT5
= WIRELESS LINK

FIG. 2

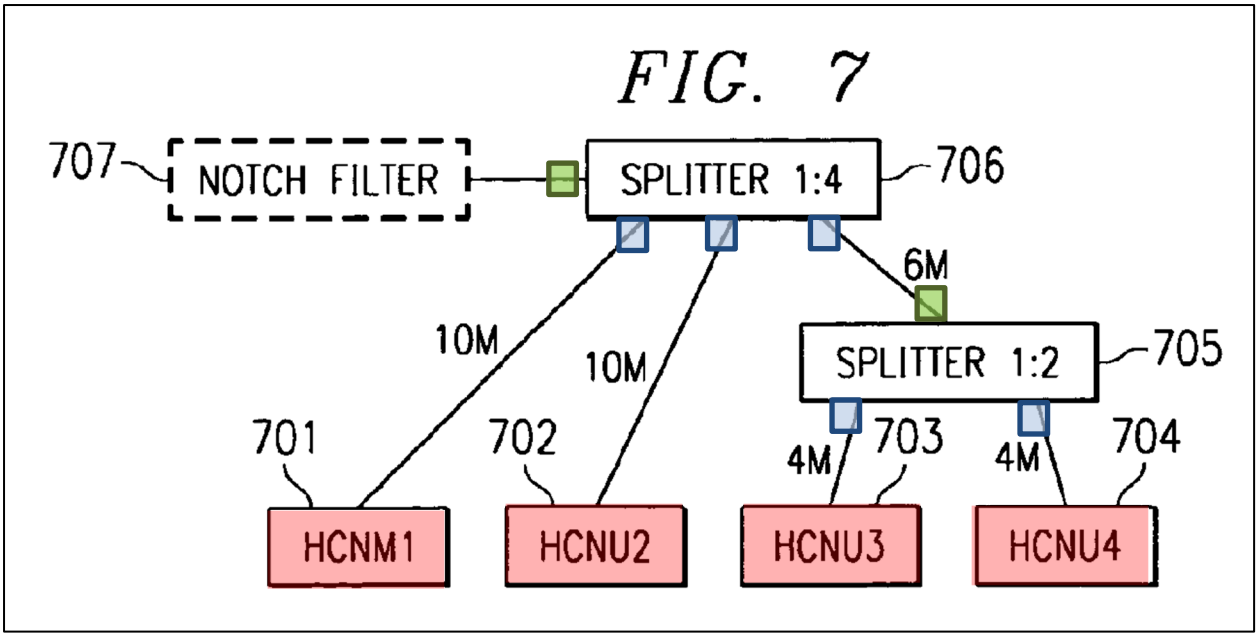

707
NOTCH FILTER
SPLITTER 1:4
706
6M
10M
10M
SPLITTER 1:2
705
701
702
4M
703
4M
704
HCNM1
HCNU2
HCNU3
HCNU4

FIG. 7

77. Figure 7 (above) similarly shows that terminal devices [701]-[704] are coupled to a tap port of splitter [706] and terminal devices [703] and [704] are coupled to a tap port of splitter [705].

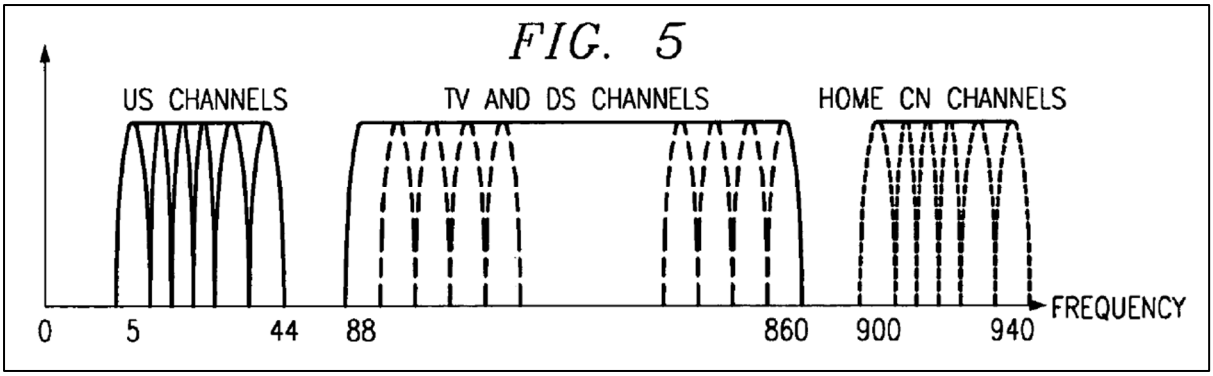
78. As a result, it is my opinion that Amit discloses or renders obvious this limitation.

[1.c.iii] "at least one of the terminal devices providing frequency bins with more transmit bits which occupy parts of the channel where the signal to noise ratio (SNR) is high"

79. It is my opinion that Amit discloses or renders obvious this limitation.

80. A POSITA would have understood that the frequency bins of claim 1 are the same as frequency channels. This understanding is confirmed by the specification of the '249 patent, which explains that "the frequency channels in OFDM may be called frequency bins." DISH-1001, 8:42-43.

81. Amit teaches of providing multiple frequency channels (*i.e.*, "frequency bins") for terminal devices to transmit on. In Figure 5 (shown below), Amit "presents a frequency allocation that may be employed by the present invention." DISH-1005, 5:28-29. Amit further explains that this "typical channel allocation … is suitable for example to a system that supplies TV channels, DOCSIS CM (US and DS), and HomeCN channels." *Id.*, 7:61-65.



82. Amit additionally teaches that the terminal devices provide "more transmit bits which occupy parts of the channel where the signal to noise ratio (SNR) is high." For example, Amit teaches that "[t]he modulation method is QPSK, QAM 16, QAM 64 or QAM 256 **according to the channel conditions**." *Id.*, 8:30-32 (emphasis added). A POSITA would have understood that the "signal to noise ratio" is a measurement that compares the power of a signal to the power of background noise and, thus, varying channel conditions would impact the signal to noise ratio of the channel. Thus, a POSITA would have understood that a channel with better channel conditions will have a higher signal to noise ratio than a channel with worse channel conditions. For example, "DMT takes advantage of these high SNR regions by assigning the appropriate number of bits to those regions, thereby maximizing the channel bit rate. DMT also automatically avoids those regions of the spectrum in which meaningful communications cannot be supported. During initialization, the bit distribution is computed based on the observed channel and noise conditions. Those subchannels with SNRs insufficient

to support any bits are simply turned off. By tailoring the bit distribution to the channel characteristics, DMT optimizes the transmit bandwidth." DISH-1013, Jacobsen-2, 375. Amit further explains that "[t]he modulator of the home networking device MUST provide QPSK and QAM 16" and "MAY provide QAM 64 and QAM 256." DISH-1005, 8:33-36. A POSITA would have understood that QAM 256 is a higher order modulation method than QAM 16 and that higher order modulation methods support higher data transfer rates and thus can transmit more bits than lower order modulation methods in the same timeframe. For example, QAM 256 conveys 8 bits per symbol whereas QAM 16 only conveys 4 bits per symbol. In Fryxell (1999), we see, for example: "…TV channels to offer data rates of 30 Mbps using QAM-64 modulation (in low-noise systems, where **QAM-256 modulation can be used, this value goes up to 43 Mbps**). The upstream channel allocates a narrower block in the low-frequency part of the spectrum that is reserved for upstream communications (between 5 and 42 MHz). Upstream data rates are a function of the upstream channel bandwidth (from 200 KHz to 3.2 MHz) and the modulation scheme used (QPSK or **QAM-16**). The range of possible data rates for upstream channels goes from 320Kbps to 10 Mbps, but typical values currently being used are in the **1.3Mbps to 5.1 Mbps** range." DISH-1014, Fryxell, 7. QAM 256 therefore supports a higher data transfer rate and more transmit bits than QAM 16. Amit confirms as much by explaining that "[t]he modulator MUST

provide 2,560 ksym/sec" and "MAY provide 160, 320, 640, 1,280, and 5,120 ksym/sec." DISH-1005, 8:37-39. A POSITA would have understood that ksym/sec means kilosymbols per second, which is a measure of the rate of data symbol transfer that may be supported. A POSITA would have understood that, in order to determine the data rate, one must multiply the symbol rate by the number of bits per symbol (which is based on the modulation method). Thus, Amit discloses multiple different "frequency bins" with multiple different numbers of available transmit bits based on the multiple modulation methods and multiple different symbol rates available via the modulator. Moreover, a POSITA would have understood that the communication system of Amit would assign higher data rates (*i.e.*, more transmit bits) to parts of the channel(s) with higher signal to noise ratios because those are the parts of the channel(s) that can support such higher data rates. *See* DISH-1005, 8:30-32 ("[t]he modulation method is QPSK, QAM 16, QAM 64 or QAM 256 **according to the channel conditions**."). In sum, a POSITA reading these disclosures would have understood that Amit teaches that the terminal devices provide frequency bins with more transmit bits which occupy parts of the channel where the channel conditions are good and therefore the signal to noise ratio is high. Moreover, a POSITA would have found it obvious for Amit's terminal devices to provide frequency bins with more transmit bits when using QAM64/QAM256 for signals with high SNR because this would take

advantage of the higher-order constellation schemes of QAM64/QAM256 and thus allow nodes to transmit more data-per-second.

83. As a result, it is my opinion that Amit discloses or renders obvious this limitation.

[1.d] "wherein the reflections from the filter provide a path for terminal devices back through the tap port of the signal splitter and out each other tap port to transmit signals to other terminal devices thus allowing terminal devices to communicate directly with each other to form the signal distribution network"

84. It is my opinion that Amit discloses or renders obvious this limitation.

85. Amit teaches of using the reflections from the filter to provide a path for terminal devices back through the tap port of the signal splitter and out each other tap port to transmit signals to other terminal devices thus allowing terminal devices to communicate directly with each other to form the signal distribution network. Amit's first "key principle" is that "Subscribers' devices may communicate **directly** (not via the headend)" because signals "propagate between the devices **via reflections** from other devices in the line." DISH-1005, 3:19-23. Amit teaches that one such device is a notch filter, as "[t]here are some challenges in designing the HomeCN components," and one such challenge is "the reflection from the notch filter," which Amit explains can be "high." *Id.*, 13:53-14:2. Amit explains that "reflection from the notch filter is in the power of the signal or it might be higher," and "[w]hen this reflection is higher than the signal, we can use

this reflection as our main signal." *Id.*, 14:1-5. As discussed in the following paragraphs, a POSITA would have understood that using a reflection as a main signal means that the reflection allows two or more devices to directly communicate with one another. A POSITA would further have understood that this direct communication forms the signal distribution network, which as described above, is Amit's home network.

86. Amit's figure 2 teaches an example of the filter's reflections providing a path for terminal devices back through the tap port of the signal splitter and out each other tap port to transmit signals to other terminal devices thus allowing terminal devices to communicate directly with each other. Amit explains that in figure 2 "Notch filter [202], is a band reject filter that does not pass a certain RF range that is used by the home networking devices [204–207, 212]." *Id.*, 6:29-31. The filter instead reflects signals in that RF range. *Id.*, 14:1-5. A POSITA would have understood that this reflection creates a path back through the tap port of the signal splitter and out each other tap port because, as the '249 patent admits, splitters were known in the art and "a splitter transfers all power from the input port to the output ports." DISH-1001, 1:50-51; *see also id.*, 1:20-2:41. The annotated version of figure 2 below shows an example of the reflection signal path in Amit where HCNU [212] transmits signals through splitter [203] that then reflect off filter [202] before passing through splitter [203] again, flowing out each

other tap port to terminal devices [204]-[207].

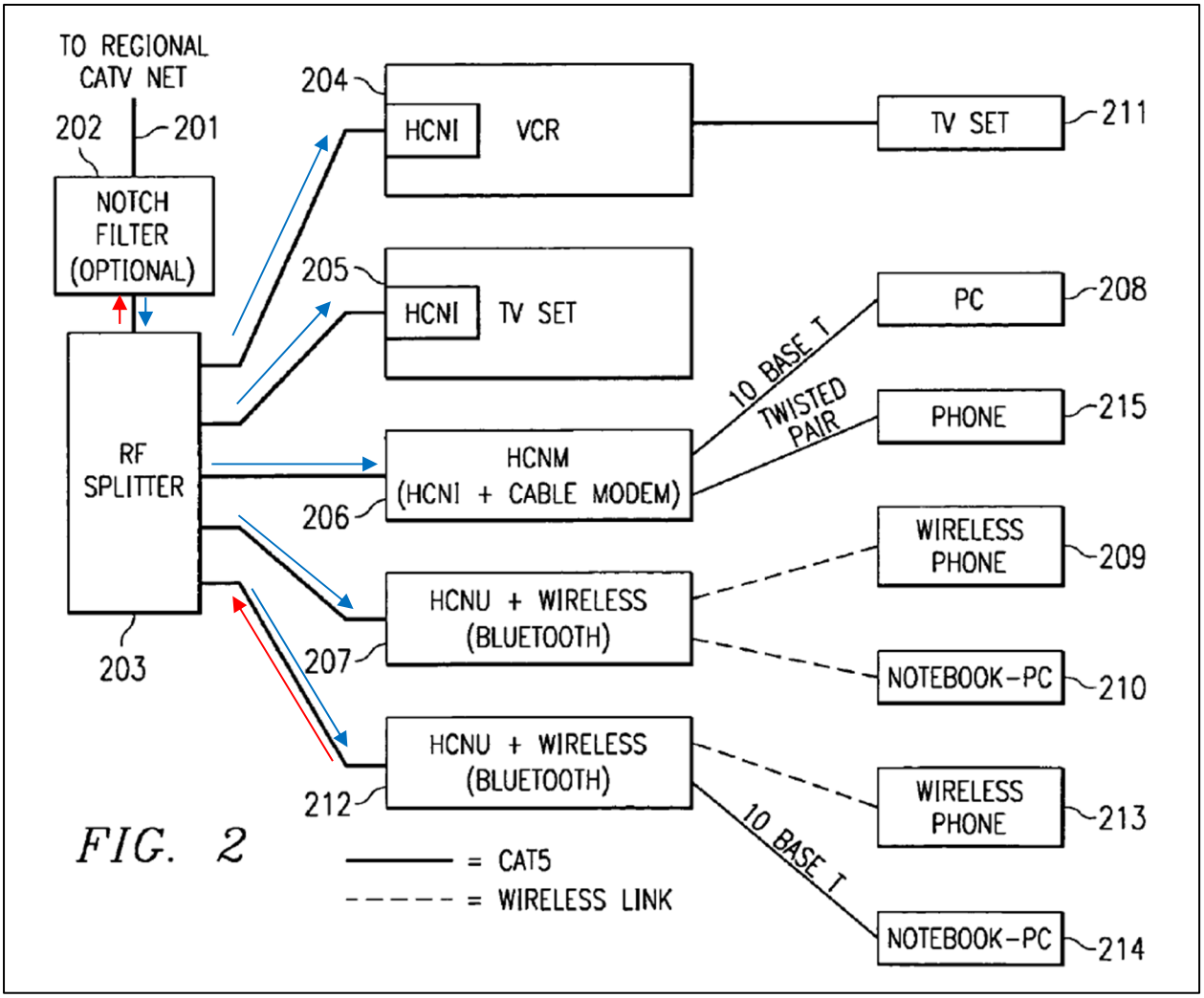
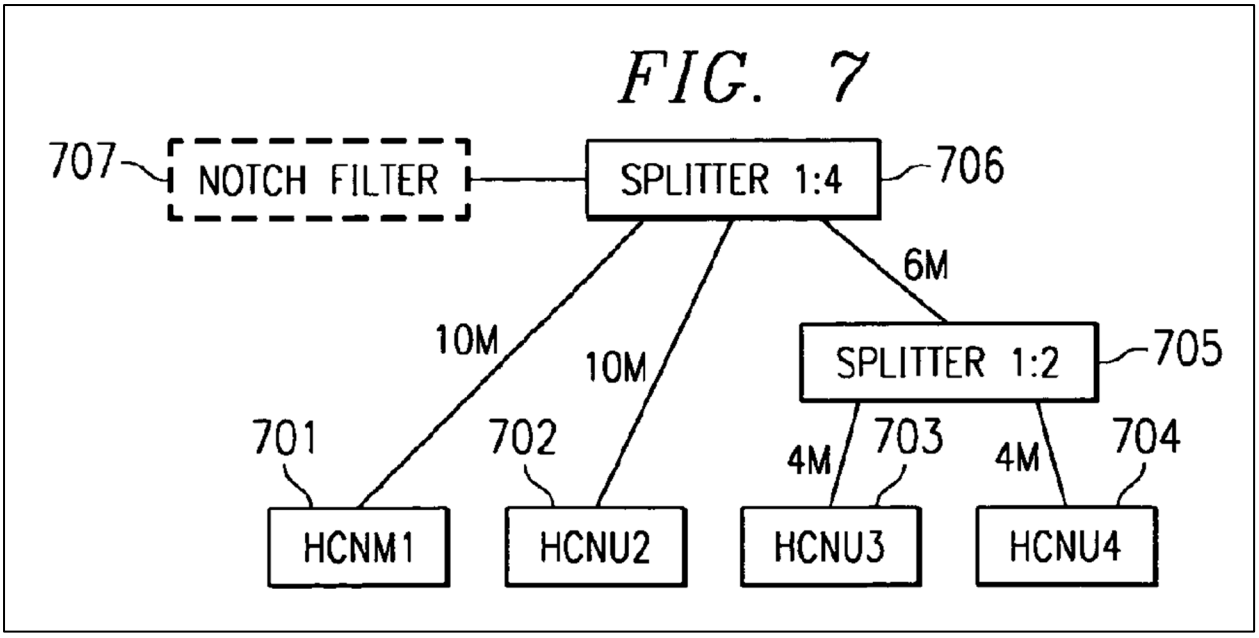


FIG. 2



87. In Figure 7 (above), Amit provides another example of the filter's reflections providing a path for terminal devices back through the tap port of the signal splitter and out each other tap port to transmit signals to other terminal devices thus allowing terminal devices to communicate directly with each other. Amit explains that "the communication between 703 and 704 might be 'hidden' from 701 in particular when the notch filter [707] does not exist." *Id.*, 13:65-67. On the other hand, "for homes that have [a] notch filter," "Two Modems in the Same Flat" can communicate via the "Echo from the notch filter," and the corresponding signal loss in this filter-reflection signal path can be calculated. *Id.*, 14:10-65. In column 14, Amit provides this calculation for a variety of communication paths that utilize the echo from the notch filter, as shown below.

7. These calculations are only valid for homes that have notch filter.

Data Form 3: Home Networking Typical Calculations Loss Between Two Modems in the Same Flat

1 Connected to the same main filter HCNM1 [701] HCNU2 [702]:

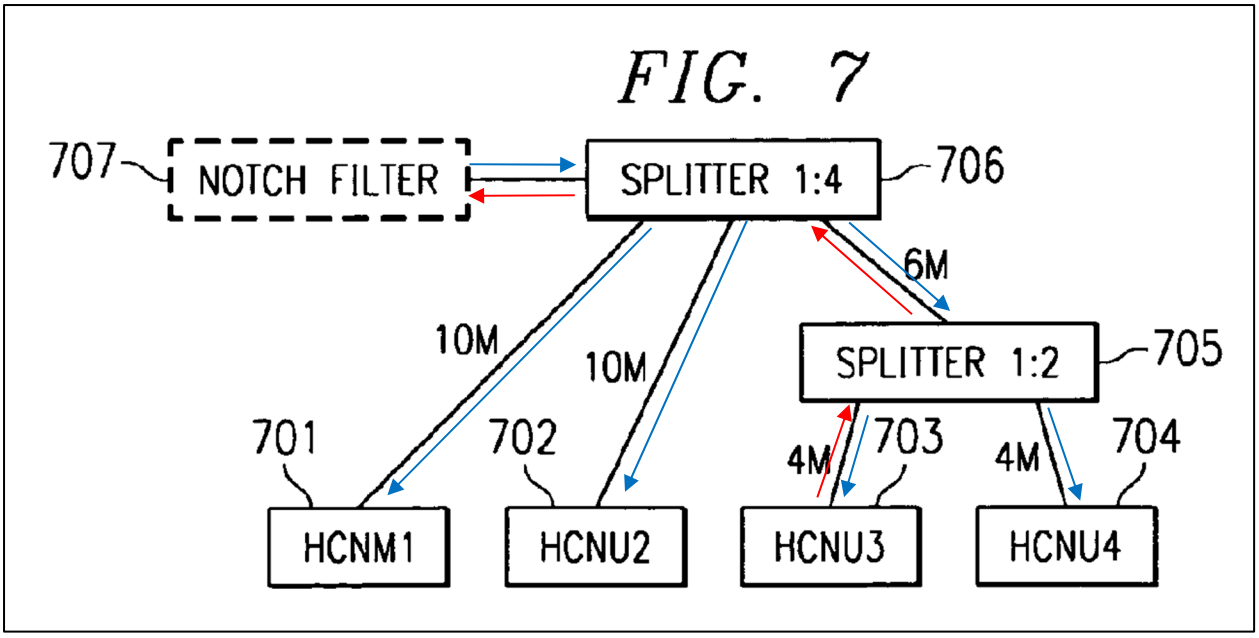
Without Notch Filter			Echo from the notch filter		
Wires [meters]	20	4.2	Wires [meters]	20	4.2
Splitter Isolation [706]		25	Insertion Lost (n = 4)[706]		8.2
			Return Loss [707]		10
Total [dB]		29.2	Insertion Lost (n = 4)[706]		8.2
			Total [dB]		30.6

2 Connected to the same minor filter HCNU3 [703] HCNU4 [704]:

Through the nearest splitter		
Wires [meters]	8	1.68
Splitter Isolation[705]		22
Total [dB]		23.68
Echo from Main Splitter		
Wires [meters]	20	4.2
Insertion Lost (n =[0 2)[705]		4.2
Return Loss [706]		11
Insertion Lost (n =[0 2)[705]		4.2
Total [dB]		23.6
Echo from the notch filter		
Wires[meters]	20	4.2
Insertion Lost (n = 2)[705]		4.2
Insertion Lost (n = 4)[706]		8.2
Return Loss [707]		10
Insertion Lost (n = 4)[706]		8.2
Insertion Lost (n = 2)[705]		4.2
Total [dB]		39

3 Connected to different filters HCNM1 [701] HCNU2 [704]:					
Without Notch Filter			Echo from the notch filter		
Wires [meters]	20	4.2	Wires [meters]	20	4.2
Splitter Isolation		25	Insertion Lost (n = 4)[706]		8.2
[706]		4.2	Return Loss [707]		10
Insertion Lost					
(n = 2)[705]		33.4	Insertion Lost (n = 4)[706]		8.2
Total [dB]			Insertion Lost (n = 2)[705]		4.2
			Total [dB]		34.8

88. In the middle section of these calculations, Amit determines the losses of three possible signal paths that allow terminal devices HCNU3 and HCNU4 to communicate with one another. *Id.*, 14:30-50. These three possible signal paths are: (1) "Through the nearest splitter" [705], (2) "Echo from [the] Main Splitter" [706], and (3) "Echo from the notch filter" [707]. *Id.* A POSITA would have understood that the echo from the notch filter signal path refers to the filter's reflections providing a path for terminal devices back through the tap port of the signal splitter and out each other tap port to transmit signals to other terminal devices. This is confirmed by Amit's calculation, where the signal loss includes a pair of "Insertion Loss[es]" that are signal loss(es) incurred when the signal first travels through splitters [705] and [706], a "Return Loss [707]" that is incurred during the reflection from filter [707], and a second pair of "Insertion Loss[es]" that is incurred when the signal travels back through splitters [705] and [706] after the reflection. *Id.*, 14:42-50. An annotated version of figure 7 showing this signal path from HCNU3 to HCNU4 appears below.



89. As the annotated figure above shows, the reflections from the notch filter provide a path for terminal devices HCNU3 [703] and HCNU4 [704] to communicate directly with each other to form the signal distribution network. For example, a POSITA would have understood that, when HCNU3 is transmitting, the signal path starts at HCNU3 [703] and travels through the tap port of signal splitter [705] and then through the tap port of signal splitter [706] before reaching notch filter [707]. After reflecting off the filter, the signal travels out the other tap ports. The signal first travels out the tap ports of splitter [706] to reach HCNM1 [701], HCNU2 [702], and the common port of splitter [705]. The signal then travels out the tap ports of splitter [705] to reach HCNU3 [703] and HCNU4 [704]. The reverse path between HCNU3 [703] and HCNU4 [704] would exist when HCNU4 transmits and HCNU3 receives.

90. As a result, it is my opinion that Amit discloses or renders obvious this limitation.

91. For the reasons discussed above, Amit therefore discloses or renders obvious claim 1.

3) Dependent Claim 2

2. The signal distribution network of claim 1, wherein at least one of the communication channels between terminal devices uses time division duplex protocol for communications and the communications are synchronized by broadcasting a beacon message on the network.

92. It is my opinion that Amit discloses or renders obvious this claim.

93. The ’249 patent explains that, “[w]ith any form of modulation, the present invention could use a time division duplex (TDD) protocol for communications.” DISH-1001, 6:35-37. Moreover, “[d]ifferent users share a common frequency channel through the use of time division multiple access (TDMA),” where “each user transmits during a different time interval” and “[a]ll users are synchronized by a beacon message broadcast on the network,” which “provides a common time reference to the users and can include other network management information.” *Id.*, 6:40-48.

94. Amit similarly explains using TDD for communications between terminal devices. For example, Amit teaches that “[t]here are some known methods to allocate channels for each home-network,” and one such method is “TDM-Time Domain Multiplexing” where “[t]he bandwidth allocation can be dynamic-

according to the needs" of the network. DISH-1005, 26:1-45. A POSITA would have understood that TDD is the application of TDM to separate outgoing and incoming signals, which is why it is referred to as time domain **duplex**. For example, Lipoff (1994) writes, "In the case of TDD, both receive and transmit of the handset and base station occur on the same frequency, ping-pong alternating in time." DISH-1015, Lipoff, 567. And a POSITA would have understood that TDMA is a type of TDM. For example, in Ovadia (1999), we see: "Performance requirements to increase upstream traffic capacity using time-division-multiplexing (TDM) and frequency stacking methods with directly or externally modulated DFB laser transmitters will be presented. In addition, the advanced upstream physical layer standard for cable moderns consisting of frequency-agile TDMA and synchronous code-division multiple-access (S-CDMA) methods will be reviewed." DISH-1016, Ovadia, 35. Like the '249 patent, Amit explains that TDM "[r]equires synchronization" and that a "Home Cable Networking Unit" is "required to get the sync from the cable modem network." DISH-1005, 26:35-45. The table in Amit col. 27 further explains that a drawback of TDM is that it "Requires synchronization, therefore, it requires CMTS for synchronization." Furthermore, the table says that "equipment is required to get the sync from the cable modem network." Thus, Amit teaches a sync signal, which is, in the parlance of a POSITA, a beacon.

95. A POSITA would have understood that broadcasting a beacon message on the network is a common way of synchronizing communications in TDM systems. As I mentioned above, the '249 patent states that "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." DISH-1001, 6:45-50. Moreover, the '249 patent acknowledges, via reference to Gibbs, that it was known that TD-based protocols use broadcast beacon messages to synchronize nodes. *Id.*, 2:42-59, 6:35-48. The 1985 textbook that I used in my undergraduate studies, Martin Roden's *Analog and Digital Communication Systems*, confirms this well-known practice: "When signals are added together such that they do not overlap in time, this is known as *time division multiplexing* (TDM)… The receiver switch must rotate in synchronism with that at the transmitter… Indeed, a common method of synchronization is to sacrifice one the channels and send a known synchronizing signal in it place [(*i.e.*, a beacon message)]." DISH-1017, Roden, 333. Jorasch and Price's 1988 article also confirms this understanding: "Communications from the satellite to any terminal is achieved at a moderate **TDM** rate of about 30 Mb/s…" DISH-1018, Jorasch, 642. And later in the article, "…it is recommended that a downlink **beacon signal** be monitored in order to determine an offset frequency reference and also to provide a coherent **timing reference**." Jorasch, 646. A

POSITA would have thus understood that Amit teaches of using TDD for communications between terminal devices and further teaches that TDM requires synchronization, which a POSITA would have understood is commonly accomplished by "broadcasting a beacon message on the network."

96. As a result, it is my opinion that Amit discloses or renders this claim obvious.

B. GROUND 2: Amit in view of ADSL/VDSL (Claims 1-17)

1) Overview off ADSL/VDSL

97. ADSL/VDSL is a textbook with a copyright date of 1999 that is titled "ADSL/VDSL Principles: A Practical and Precise Study of Asymmetric Digital Subscriber Lines and Very High Speed Digital Subscriber Lines." DISH-1006, Cover.

98. ADSL/VDSL "discusses networks capable of delivering high-speed data to all end users." DISH-1006, 1. The drivers for delivering high-speed data include "the Internet and World Wide Web (WWW), video services, consumer services, and entertainment services." *Id.*, 5. ADSL/VDSL explains that "[t]he small office/home office (SOHO) provides another good opportunity for DSL technology," which "can be used to connect the SOHO to a corporate LAN, the Internet, or both." *Id.*, 8. At the time of the textbook, "[a] typical corporate LAN might have a 10 Mbps backbone connecting PCs and servers." *Id.*

99. While ADSL/VDSL focuses on ADSL and VDSL communications, it recognizes that "[c]able television delivered via coaxial cable (coax) is available throughout most of the United States." *Id.*, 15. ADSL/VDSL even acknowledges that "[c]oax can handle high bandwidths, and cable modems take advantage of this." *Id.*

100. Based on my review of the '249 patent, I understand that ADSL/VDSL is one of two textbooks referenced in the patent's specification as covering "OFDM system architecture." DISH-1001, 8:55-60.

2) Motivation to combine Amit with ADSL/VDSL

101. A POSITA would have been motivated to modify Amit's system to incorporate the teachings of ADSL/VDSL with a reasonable expectation of success.

102. A POSITA seeking to improve Amit's network would have been familiar with communications textbooks such as ADSL/VDSL. Both references are analogous art because they are in the same field of endeavor as the '249 patent (*i.e.*, broadband networks, including the communications protocols used in such networks). DISH-1001, 8:55-60; DISH-1005, 2:39-40; DISH-1006, Cover, 1-15. Indeed, the '249 patent references ADSL/VDSL, further showing its in the same field of endeavor as the '249 patent and Amit. DISH-1001, 8:55-60. Amit and ADSL/VDSL also each recognize how LANs facilitate communications between

nodes within the same building or residence. And both references further acknowledge that the Internet, video services, consumer services, and entertainment services are motivators for high-speed network communications.

103. A POSITA reading Amit's teachings about coaxial networks would have been motivated to improve such networks with methods used in non-coaxial networks, such as ADSL and VDSL. Unlike the prior art coaxial networking solution, which "[i]nterferes with VDSL," Amit's network indicates that it does not interfere with VDSL. DISH-1005, 28:67. Moreover, Amit recognizes that "[t]here are several home networking solutions that have already been proposed, including networking over the existing telephone wiring …, networking over the existing power lines, … and solutions that require new wiring, such as … CAT 5 Ethernet wiring." *Id.*, 1:31-37. Based on Amit's suggestion, a POSITA would thus have been motivated to look at teachings about improvements in all types of home networks, including the copper-based networks described in ADSL/VDSL.

104. Amit and ADSL/VDSL further demonstrate the overlap between coaxial and non-coaxial networks. Amit recognizes that "[h]ome networks will connect between computing devices … and modems (**such as cable modems, DSL modems**, and PSTN modems) that connect the home outside." *Id.*, 1:18-25. And while ADSL/VDSL primarily focuses on communications over a twisted pair cable, it also recognizes that "[c]able television delivered via coaxial cable (coax)

is available throughout most of the United States" and "can handle high bandwidths, and cable modems take advantage of this." DISH-1006, 15.

105. A POSITA would also have been motivated to combine the teachings of Amit and ADSL/VDSL because they both are reasonably pertinent to overcoming problems in network communication channels, including the problems identified in the specification of the '249 patent, which are "port-to-port isolation and providing a suitable signal path for terminal-to-terminal communication in a coaxial cable wired building." DISH-1001, 3:4-7. For example, Amit recognizes that "coax cable is an excellent communication medium, as it has a high bandwidth and it is shielded to avoid noise," but even when using coax, there can be "houses where there is a problem with reflection." DISH-1005, 2:51-53, 20:42-43. Moreover, Amit teaches that the modulation method will change "according to the channel conditions." *Id.*, 8:30-32. ADSL/VDSL similarly recognizes that "many channels and noise conditions change over the lifetime of operation," and "[a] good example is the change in twisted pair characteristics due to the difference of temperature during the day and night." DISH-1006, 188. Like Amit, ADSL/VDSL describes techniques to overcome communication channel impairments and provide a suitable path for terminal-to-terminal communication via, *e.g.*, OFDM, equalization, FEC, and TDD. *See id.*, 166-203.

106. As discussed below, a POSITA would have been motivated to

improve the bit rate of Amit's networks using ADSL/VDSL's teachings of OFDM modulation, which builds upon the FDM and QAM modulation described in Amit.

107. Amit explains that "[v]arious types of modulation can be used," but the modulation method "should support high bandwidth rate (more th[a]n 10 Mbps)." DISH-1005, 25:1-7. "The selected modulations that comply with these requirements are QPSK and QAM." *Id.*, 25:9-10. Amit also teaches that "[t]he Channel Allocation method should be FDM," and OFDM is a type of FDM. *Id.*, 25:12-15. In frequency domain multiplexing, multiple signals (or different components of the same signal) can be multiplexed by transmitting baseband signals that are modulated to different frequency bins and sent simultaneously. OFDM, orthogonal frequency domain multiplexing, is indeed an FDM scheme. OFDM augments FDM, in digital communications, by transmitting the bitstream among multiple channels (instead of a single carrier for each signal as in vanilla FDM). So, OFDM offers a robust FDM scheme that can accommodate difficult and varying channel conditions, even without complicated equalization schemes. Therefore, a POSITA implementing the FDM of Amit would have certainly looked to the OFDM of ADSL/VDSL to improve robustness without significantly increasing computational workload.

108. ADSL/VDSL explains that DMT, which "is sometimes called orthogonal frequency division multiplexing (OFDM)," "builds on some of the

ideas of QAM." DISH-1006, 166. Specifically, OFDM allows for "more than one constellation encoder," where "[e]ach encoder receives a set of bits that are encoded using a constellation encoder as described in the previous sections" on QAM modulation. *Id.* Like QAM, the "output values from the constellation encoder are again the amplitudes of cosine and sine waves," and "each set of waveforms can be independently decoded in the same way that a QAM signal can be decoded." *Id.*, 166-67.

109. A POSITA would have thus been motivated to use ADSL/VDSL's OFDM teachings with Amit's terminal devices to improve upon the QAM modulation and improve the bit rate.

110. A POSITA would have been motivated to increase the capabilities of the terminal devices of Amit by adding the equalizers taught by ADSL/VDSL.

111. As discussed above, a POSITA would have been motivated to combine the communications systems and modulation methods of Amit and ADSL/VDSL, and a POSITA would have also been motivated to improve Amit's terminal devices to efficiently utilize the limited networking resources. Amit explains that "**frequency resources are limited**," and "[a]n important point is to define this protocol to use **limited 'cable' resources**," including "limited US (up stream) frequencies" and the fact that, when using "higher frequencies," "their distance is limited." DISH-1005, 9:56, 19:32-37. Amit also explains that the

"modulation method" is selected "**according to the channel conditions**, and **according to the equipment capabilities**." *Id.*, 8:30-32.

112. ADSL/VDSL explains that "[m]ost modern communications systems that **operate near theoretical limits employ equalization** in the transmitter, receiver, or both **to optimize or nearly optimize transmission**." DISH-1006, 187. When the equalization "is done digitally by adaptive digital filters," this "provides a very flexible way to **accommodate different types of channels** and **different types of noise environments**." *Id.* Moreover, these equalizers can be updated "as many **channels and noise conditions change** over the lifetime of operation." *Id.*, 188.

113. Based on Amit's and ADSL/VDSL's suggestions, a POSITA thus would have been motivated to add the equalizers of ADSL/VDSL to the terminal devices of Amit in order to increase the capabilities of the terminal devices and more efficiently use the limited available resources as I described above.

114. A POSITA would have been motivated to look to the details of ADSL/VDSL for ways implement the FEC referenced in Amit.

115. Amit teaches that its network has "FEC (Forward Error Correction) [that] MUST support R-S (Reed Salomon [*sic*])." DISH-1005, 8:40-44. ADSL/VDSL provides details on implementing FEC, including that "[a] forward error correction (FEC) block adds redundancy to the data to be transmitted" where

"the FEC block might be able to correct bits that the demodulator decodes incorrectly." DISH-1006, 172. ADSL/VDSL also describes using FEC to recover transmitted signals without errors, where "Reed-Solomon codes allow for error correction in the receiver." *Id.*, 181.

116. A POSITA would also be motivated to use FEC in Amit's network to efficiently utilize the limited networking resources for the reasons described in the preceding paragraphs dealing with equalization.

117. A POSITA would have thus been motivated to increase the capabilities of the terminal devices of Amit by implementing Reed-Solomon FEC as taught in ADSL/VDSL.

118. Similar to FEC, a POSITA would have been motivated to look to ADSL/VDSL for additional details of implementing TDD. Amit teaches that "[t]here are some known methods to allocate channels for each home-network," including "TDM-Time Domain Multiplexing," which "[r]equires synchronization." DISH-1005, 26:1-45. ADSL/VDSL similarly teaches "[s]everal different modulation methods," including "a time-domain duplexing (TDD) category." DISH-1006, 295. ADSL/VDSL provides details on TDD and recognizes that "[t]he most popular TDD approach proposed for VDSL is the synchronous DMT approach," which requires "properly synchronize[d] frames." *Id.*, 296, 301. ADSL/VDSL explains how to achieve such synchronization. *Id.*

119. A POSITA would also be motivated to use TDD in Amit's network to efficiently utilize the limited networking resources for the reasons described in the preceding paragraphs dealing with equalization.

120. A POSITA would thus be motivated to increase the capabilities of the terminal devices of Amit by implementing TDD as taught in ADSL/VDSL.

121. It is my opinion that a POSITA would have had a reasonable expectation that the Amit-VDSL/ADSL combination would produce a successful outcome. When improving Amit's network, a POSITA would have had a reasonable expectation of successfully incorporating the techniques of networks that similarly deliver high-speed data, such as those of ADSL/VDSL. *Id*. Moreover, a POSITA would have had a reasonable expectation of success in incorporating aspects of the high-speed networks that Amit explicitly references, including the VDSL and ADSL networks described in ADSL/VDSL. DISH-1005, 1:18-25, 1:31-37, 28:67.

122. Given Amit's disclosure of using QAM (DISH-1005, 8:30-33, 25:1-10), the notion of building upon QAM and implementing OFDM, as described in ADSL/VDSL, would have been straightforward from a POSITA's perspective. Likewise, a POSITA would have expected ADSL/VDSL's OFDM modulation to work in the context of Amit's network, which employed QAM. Implementing OFDM would have been within the skill level of a POSITA because it and similar

modulation techniques are taught/used in a variety of engineering, science, and/or math courses that a POSITA would have taken and because QAM and OFDM are both well-known in the art.

123. Likewise, given Amit's discussions of limited networking resources and varying channel conditions (DISH-1005, 8:30-32, 9:56, 19:32-37), the idea of using an equalizer to optimize or nearly optimize transmission and accommodate different types of channels and noise environments would have been straightforward from a POSITA's perspective. A POSITA would also have expected ADSL/VDSL's equalization techniques to work in the context of Amit, which recognizes that varying channel conditions can necessitate techniques to improve communications. DISH-1005, 8:30-32. Moreover, a POSITA would have been able to implement the equalizers of ADSL/VDSL because the use of such equalizers is common in the work of a POSITA and is also part of the engineering courses that a POSITA would have taken.

124. For these same reasons, a POSITA would have had a reasonable likelihood of success in implementing the FEC and TDD communication techniques of ADSL/VDSL into the network of Amit. Amit refers to these techniques, and a POSITA would look to the ADSL/VDSL textbook for additional details on implementing them.

125. The Amit-VDSL/ADSL combination would also have yielded

predictable results. As described above, OFDM builds on QAM, so implementing OFDM into Amit's system, which already uses QAM, would have yielded predictable results. Adding equalization to the terminal devices would have also yielded predictable results consistent with ADSL/VDSL's teachings that "[m]ost modern communications systems that operate near theoretical limits employ equalization in the transmitter, receiver, or both to optimize or nearly optimize transmission." DISH-1006, 187. Finally, implementing FEC and TDD in Amit's system would have yielded predictable results because these techniques are already referenced in Amit and implementing these techniques would therefore not have resulted in any unpredictable consequences but would instead have allowed a POSITA to more efficiently use the limited networking resources. In other words, Amit already teaches of using FEC and TDD, and as I explain above, a POSITA would have been familiar with these techniques and how to implement them according to Amit's teachings. Nevertheless, if a POSITA wanted additional details on implementing these well-known techniques in Amit's system, a POSITA would have been motivated to look to textbooks such as ADSL/VDSL.

3) Independent Claim 1

126. It is my opinion that the combination of Amit-ADSL/VDSL renders obvious this claim. As I discussed above, Amit alone discloses or renders obvious each limitation of claim 1, and claim element [1.c.iii] is also rendered obvious by

Amit-ADSL/VDSL, as described below.

[1.c.iii] "at least one of the terminal devices providing frequency bins with more transmit bits which occupy parts of the channel where the signal to noise ratio (SNR) is high"

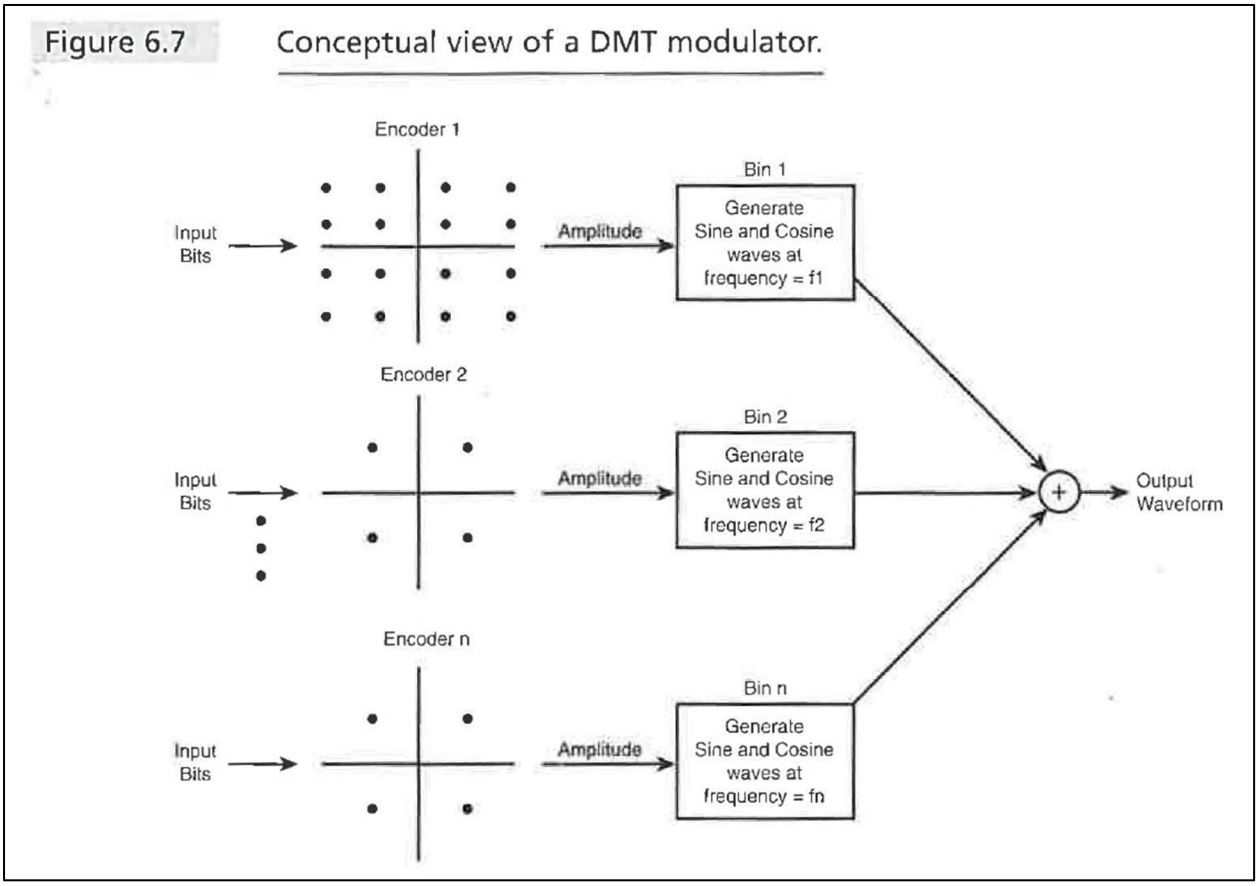
127. It is my opinion that Amit-ADSL/VDSL renders obvious this limitation.

128. A POSITA would have understood the benefits of using the teachings of ADSL/VDSL in the terminal devices [204–207, 212] or [701-704] from Amit. In the "DSL Modulation Basics" chapter of ADSL/VDSL, the book "presents some of the basics of modulation systems," including "a discrete multitone (DMT) system." DISH-1006, 157. Multitone modulation "is sometimes called orthogonal frequency division multiplexing (OFDM)," but "[f]or simplicity, this book simply refers to multitone modulation as DMT." *Id.*, 166. A POSITA would have understood that DMT and OFDM, as used in ADSL/VDSL, refer to the same thing.

129. ADSL/VDSL explains that, in DMT "[e]ach encoder receives a set of bits that are encoded using a constellation encoder," where "a different sine and cosine frequency is used for each constellation encoder." *Id.*, 166-67. The result is that "the waveforms in each bin are completely separable from one another." *Id.*, 167.

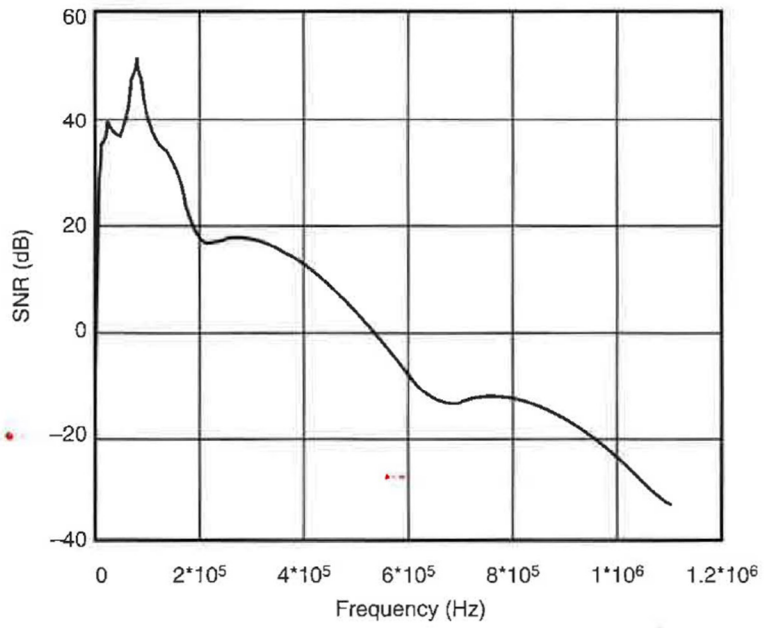
130. Figure 6.7 of ADSL/VDSL (below) further demonstrates providing

frequency bins with different transmit bits.



131. ADSL/VDSL also teaches how "DMT allows a communications system to be very flexible and optimally utilize a channel." *Id.*, 171. In Figure 6.9 (below), ADSL/VDSL depicts the "SNR with respect to frequency of a sample channel," and explains that "DMT bins in the areas where the SNR is high can use more dense QAM constellations." *Id.* ADSL/VDSL further explains that, "[c]ompared to the bins when the SNR is low, **the bins occupying parts of the channel where the SNR is high can be used to transmit more bits**." *Id.*, 172. ADSL/VDSL teaches that this "process involves increasing the number of points used in the constellations of the 'good' bins." *Id.*

Figure 6.9 SNR with respect to frequency of a sample channel; DMT bins in the areas where the SNR is high can use more dense QAM constellations.



132. As discussed above, ADSL/VDSL is cited in the specification of the '249 patent, and the disclosures from both references are nearly identical, as shown below.

"Frequency **bins occupying parts of the channel where the SNR is high can be used to transmit more bits**."	"Compared to the bins when the SNR is low, the **bins occupying parts of the channel where the SNR is high can be used to transmit more bits**."
DISH-1001, 8:23-24.	DISH-1006, 172.

133. As a result, and for the reasons discussed above regarding motivation to combine, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

134. For the reasons discussed above, Amit-ADSL/VDSL therefore renders

obvious claim 1.

4) Independent Claim 5

135. It is my opinion that Amit-ADSL/VDSL renders obvious claim 5. Claim 5 is an independent claim paralleling much of claim 1. Other than claim 5's requirement that the network uses coaxial cable building wiring as a communication channel and that the devices communicate using OFDM modulation, the remaining limitations of claim 5 are substantially similar to the limitations of claim 1.

[5.pre] "A broadband local area network using coaxial cable building wiring as a communication channel, the network comprising"

136. I have been asked to consider whether Amit-ADSL/VDSL renders obvious the preamble of claim 5, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 5 is deemed to be a limitation, it is my opinion that Amit-ADSL/VDSL renders obvious this limitation.

137. Amit teaches that it "provides a system and methods for communication between subscribers' devices over cable infrastructure designed to carry video signals," including "home networking solutions that utilize in-home TV wiring for supplying high rate connectivity between any two home networking nodes." DISH-1005, 2:34-46. Amit also explains that "[i]n many, if not most, of US residential homes, there are several TV inlets, connected by coaxial (coax)

cables," which "is an excellent communication medium" for "home networking over these coax cables." *Id.*, 2:49-55. Amit further teaches how "devices may communicate directly (not via the headend) using RF signaling over the coax cable." *Id.*, 3:19-21. Examples of a broadband local area network using coaxial cable building wiring as a communication channel are also depicted in Figures 2 and 7 of Amit. *Id.*, 5:22-31. ADSL/VDSL's teachings also has utility in coaxial cable LANs. DISH-1006, 5, 15.

138. As a result, it is my opinion that Amit-ADSL/VDSL renders the preamble obvious.

[5.a.i] "a plurality of terminal devices,"

139. This limitation is identical to [1.c.i], and for the same reasons explained in that limitation, it is my opinion that Amit teaches this limitation.

140. As a result, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

[5.a.ii] "each terminal device communicating with other terminal devices using orthogonal frequency division multiplexing (OFDM) modulation,"

141. It is my opinion that Amit-ADSL/VDSL renders obvious this limitation.

142. The '249 patent explains that "[m]ultitone 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" and that "Multitone modulation is also called discrete multitone (DMT) and orthogonal frequency division multiplexing (OFDM)." DISH-1001, 7:61-66.

143. In the "DSL Modulation Basics" chapter, ADSL/VDSL "presents some of the basics of modulation systems," including "a discrete multitone (DMT) system." DISH-1006, 157. Similar to the '249 patent disclosure referenced above, ADSL/VDSL explains that multitone modulation "is sometimes called orthogonal frequency division multiplexing (OFDM)," but "[f]or simplicity, this book simply refers to multitone modulation as DMT." *Id.*, 166. ADSL/VDSL explains that in DMT "[e]ach encoder receives a set of bits that are encoded using a constellation encoder," where "a different sine and cosine frequency is used for each constellation encoder." *Id.*, 166-67

144. ADSL/VDSL also teaches that each terminal device communicates with other terminal devices using OFDM. ADSL/VDSL explains that the "frequency channels in DMT are [called] frequency bins (or bins), tones or DMT tones, and subchannels," and "the waveforms in each bin are completely separable from one another." *Id.*, 167. The result is that each terminal device in "DMT has a 'receiver' tuned to all of the channels at once," and this receiver described by ADSL/VDSL allows terminal devices to communicate using OFDM. *Id.*

145. A POSITA would have understood that the teachings of ADSL/VDSL

can be used with the terminal devices [204–207, 212] or [701-704] from Amit.

146. As a result, and for the reasons discussed above regarding motivation to combine, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

[5.a.iii] "at least one of the terminal devices providing frequency bins with more transmit bits which occupy parts of the channel where the signal to noise ratio (SNR) is high;"

147. This limitation is identical to [1.c.iii], and for the same reasons explained in that limitation, it is my opinion that Amit-ADSL/VDSL renders obvious this limitation.

[5.b] "a network of building cables coupled to the plurality of terminal devices."

148. It is my opinion that Amit teaches this limitation.

149. A POSITA would have understood that "building cables" include a wide variety of cables, including the coaxial cable building wiring referred to in the preamble of claim 5.

150. Amit teaches that "TV wiring that consist of coaxial cables are used to connect the antenna/cable TV output, typically via passive splitters, to the cable outlets at specific points in the home," and "[t]he present invention provides home networking solutions that utilize in-home TV wiring for supplying high rate connectivity between any two home networking nodes." DISH-1005, 2:4-6, 2:44-46.

151. Amit's Figures 2 and 7 also show a plurality of terminal devices ([204-206], [212], [701-704]), which Amit refers to as nodes, that are coupled to a network of building cables made up of coaxial cables and splitters. While figure 2 uses the label "CAT5," a POSITA reading Amit and the figure would have understood that this is a drafting error that should read "CATV." CAT5 is commonly used to refer to Category 5 cable, while CATV refers to cable television, which distributed using coaxial cable. This understanding is further supported by file history of Amit, which uses "CATV" (DISH-1023, 51) as well the disclosures of Amit, which explain that "coaxial (coax) cables" are "an excellent communication medium" for "home networking over these coax cables" and that "devices may communicate directly (not via the headend) using RF signaling over the coax cable." DISH-1005, 2:49-55; 3:19-21.

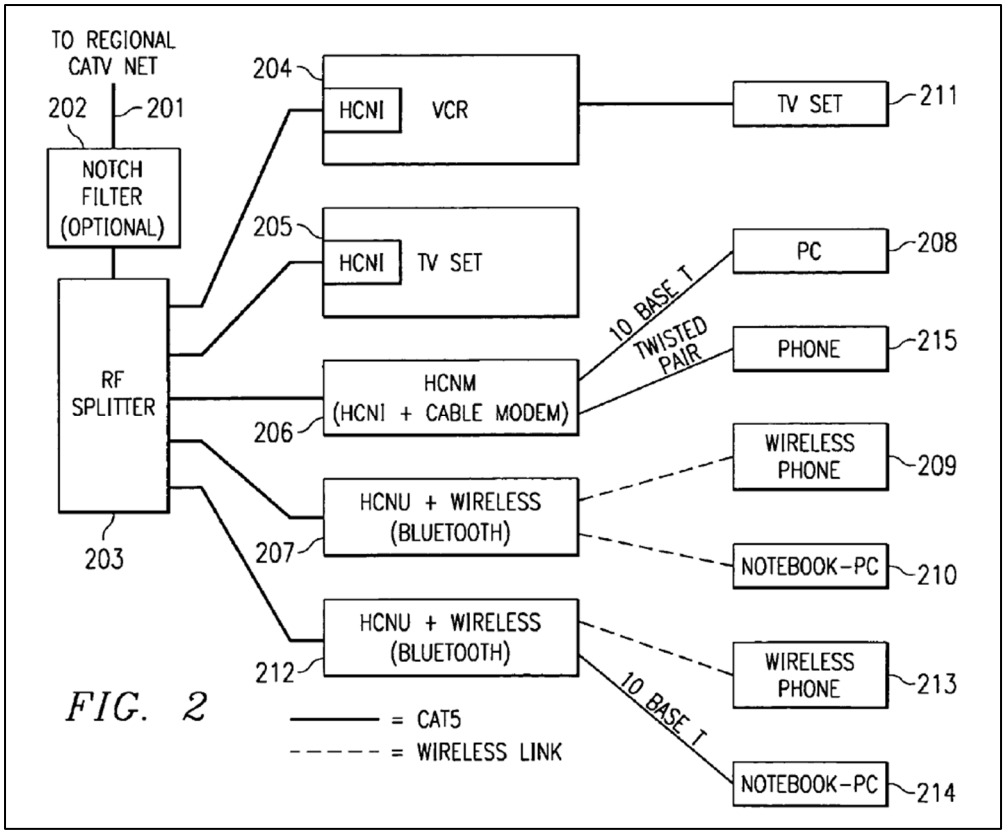
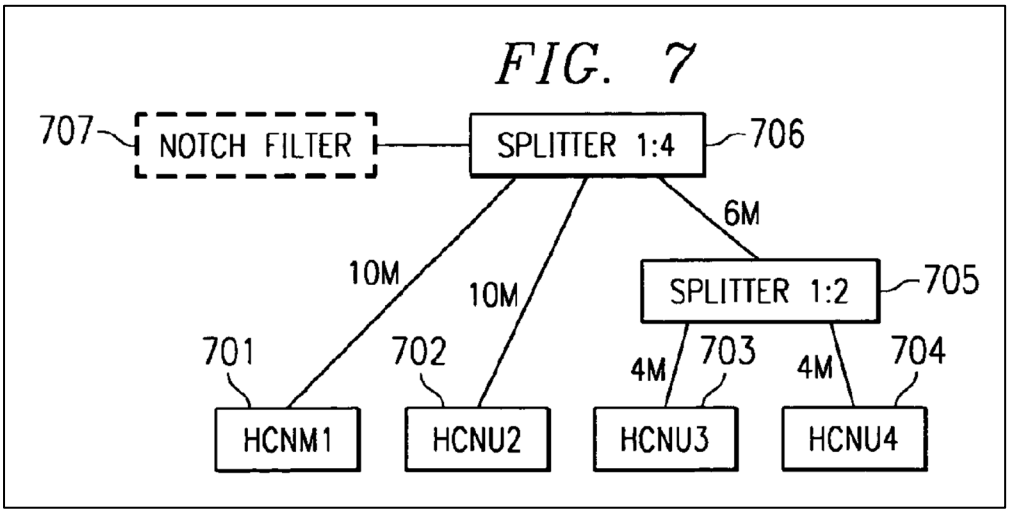


FIG. 2



152. As a result, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

[5.c.i] "a filter having a first and second port, the first port connected to a building point of entry and the second port connected to the plurality

of terminal devices via the network of building cables,"

153. It is my opinion that Amit teaches this limitation.

154. When I addressed claim element [1.a] above, I explained how it is my opinion that Amit renders obvious "a filter located at the point of entry of a building."

155. The filters in Figures 2 and 7 of Amit also meet the additional limitations of [5.c.i]. Each figure shows a filter "having a first and second port." I have annotated the first ports with green boxes and the second ports with blue boxes in the figures below. In Figure 2, the first port of notch filter 202 is shown as connected to a building point of entry. The filter is located at the building point of entry, and its first port "is connected to the regional CATV plants via cable [201]." DISH-1005, 6:28. Amit confirms this by explaining that in Amit's "Single Home operation mode … a notch filter should be added … at the flat/single home entrance." *Id.*, 13:31-45. A POSITA would have thus understood or found it obvious that Amit's notch filter includes a port connected to the building's point of entry.

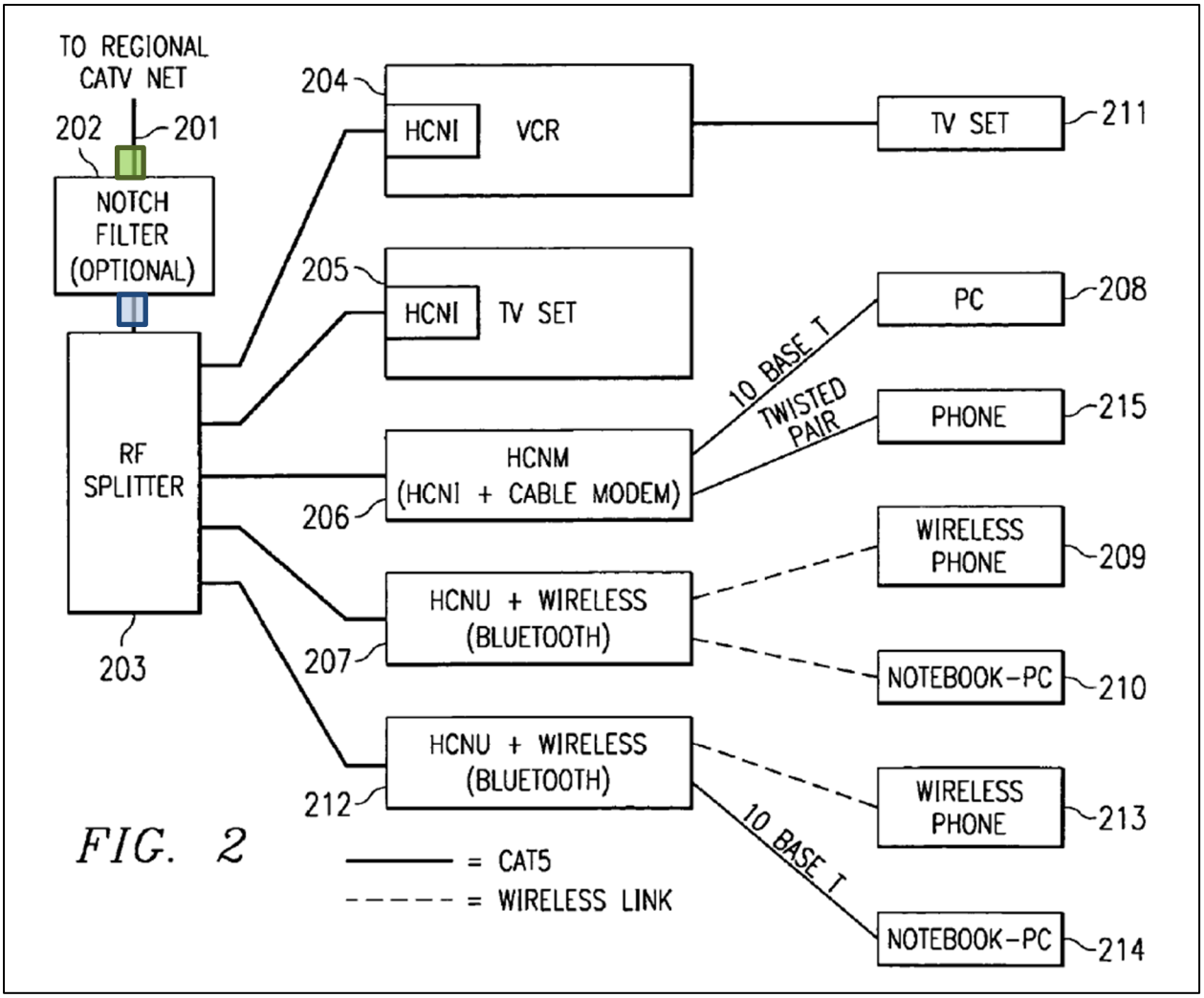

TO REGIONAL CATV NET
202
201
NOTCH FILTER (OPTIONAL)
RF SPLITTER
203
204
HCNI
VCR
TV SET
211
205
HCNI
TV SET
10 BASE T
TWISTED PAIR
PC
208
PHONE
215
HCNM (HCNI + CABLE MODEM)
206
WIRELESS PHONE
209
HCNU + WIRELESS (BLUETOOTH)
207
NOTEBOOK-PC
210
HCNU + WIRELESS (BLUETOOTH)
212
WIRELESS PHONE
213
10 BASE T
NOTEBOOK-PC
214
= CAT5
= WIRELESS LINK

FIG. 2

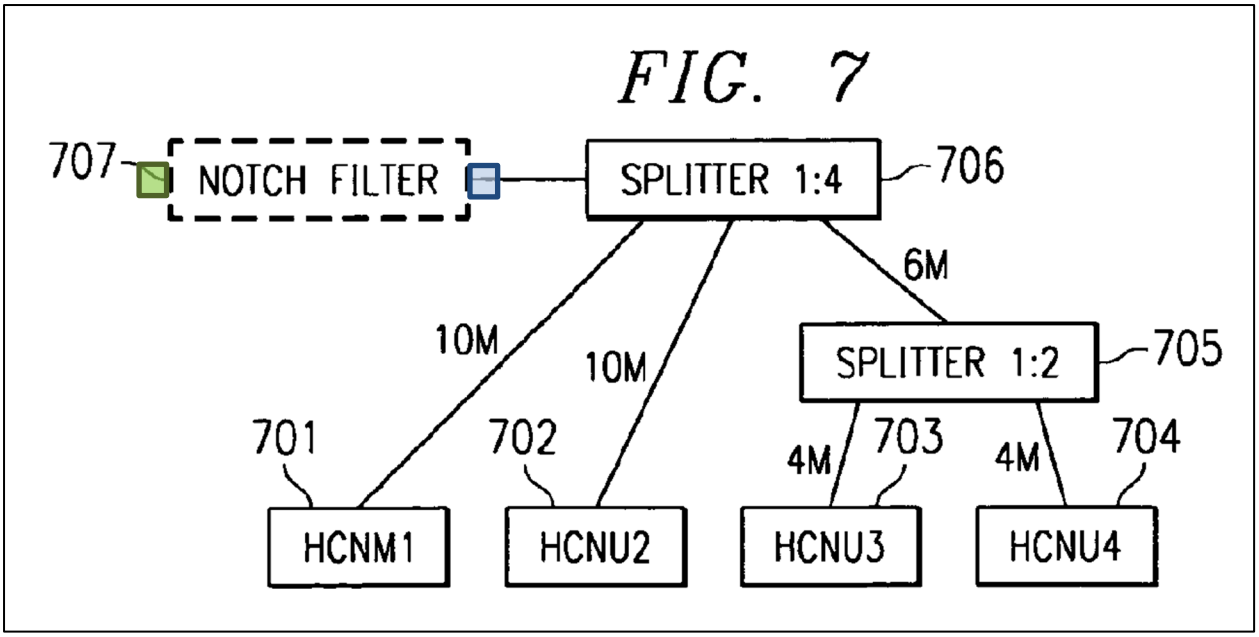

707
NOTCH FILTER
SPLITTER 1:4
706
6M
10M
10M
SPLITTER 1:2
705
701
702
4M
703
4M
704
HCNM1
HCNU2
HCNU3
HCNU4

FIG. 7

156. When I addressed claim elements [1.b.ii.] and [1.c.ii] above, I explained how Amit teaches that the filters of figures 2 and 7 are coupled to at least one signal splitter and each terminal device is coupled to a plurality of tap ports of at least one signal splitter. Figures 2 and 7 of Amit also teach that the terminal devices connect to the second port of the filter via the network of building cables and the splitters. This is further confirmed through Amit's explanation that "[t]he present invention provides home networking solutions that utilize in-home TV wiring for supplying high rate connectivity between any two home networking nodes." *Id.*, 2:44-46; *see also id.* at 6:57-59 ("The HCNU devices are capable of transmitting and receiving digital communications signals between them.). A POSITA reading Amit and analyzing figures 2 and 7 would have understood that the terminal devices are each connected to the second port of the filter, and this connection is made via the network of building cables and the splitters.

157. As a result, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

[5.c.ii] "wherein signals transmitted by any of the terminal devices and received at the second port of the filter are rejected by the filter such that such signals do not pass through the filter, but rather are reflected back into the network of building cables in order to create a communication path between the transmitting terminal device and at least one other terminal device coupled to the network of building cables."

158. It is my opinion that Amit teaches this limitation.

159. When I addressed claim element [5.c.i] above, I explained how Amit teaches that the filter's "second port [is] connected to the plurality of terminal devices via the network of building cables." Because of this connection, the "signals transmitted by any of the terminal devices" will be "received at the second port of the filter" as required by [5.c.ii].

160. When I addressed claim element [1.a] above, I explained how Amit teaches "a filter … 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." Because of this signal rejection and reflection, the "signals … received at the second port of the filter are rejected by the filter such that such signals do not pass through the filter, but rather are reflected back into the network of building" as required by [5.c.ii].

161. When I addressed claim element [1.d] above, I explained how Amit teaches that "the reflections from the filter provide a path for terminal devices … to transmit signals to other terminal devices thus allowing terminal devices to communicate directly with each other." For those same reasons, Amit teaches that the reflections "create a communication path between the transmitting terminal device and at least one other terminal device coupled to the network of building cables" as required by [5.c.ii].

162. As a result, it is my opinion that Amit-ADSL/VDSL renders this

limitation obvious.

163. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 5.

5) Independent Claim 10

164. It is my opinion that Amit-ADSL/VDSL renders obvious claim 10. Claim 10 is an independent claim paralleling much of claim 1. Other than the limitation that the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals, the remaining limitations of claim 10 are substantially similar to the limitations of claim 1.

[10.pre] "A broadband local area network for transmitting modulated signals using coaxial cable building wiring containing a plurality of branches comprising"

165. I have been asked to consider whether Amit-ADSL/VDSL renders obvious the preamble of claim 10, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 10 is deemed to be a limitation, it is my opinion that Amit-ADSL/VDSL renders obvious this limitation.

166. Amit teaches a broadband local area network using coaxial cable building wiring containing a plurality of branches. Amit explains that it "provides a system and methods for communication between subscribers' devices over cable

infrastructure designed to carry video signals," including "home networking solutions that utilize in-home TV wiring for supplying high rate connectivity between any two home networking nodes." DISH-1005, 2:34-46. Amit also explains that "[i]n many, if not most, of US residential homes, there are several TV inlets, connected by coaxial (coax) cables," which "is an excellent communication medium" for "home networking over these coax cables." *Id.*, 2:49-55. Amit further teaches how "devices may communicate directly (not via the headend) using RF signaling over the coax cable." *Id.*, 3:19-21.

167. Figures 2 and 7 further demonstrate that Amit's networks use coaxial cable building wiring containing a plurality of branches that connect the terminal devices to the splitters and notch filter.

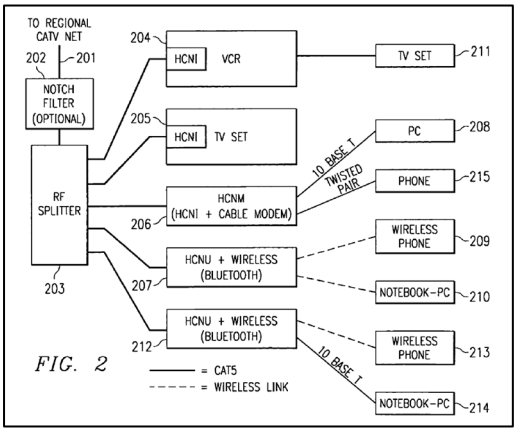


FIG. 2

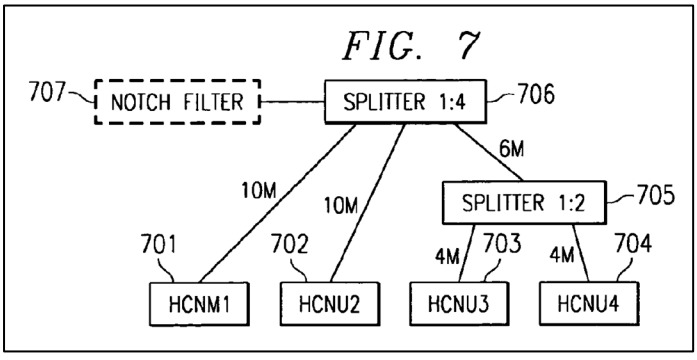


FIG. 7

168. Amit also teaches transmitting modulated signals, as Amit explains that "[v]arious types of modulation can be used," including "QPSK and QAM." *Id.*, 25:1-10.

169. As a result, it is my opinion that Amit-ADSL/VDSL renders the preamble obvious.

[10.a] "a filter located at the point of entry of the building wiring that rejects network signals originating in the building wiring such that the rejected network signals do not pass through the filter, but rather are reflected by the filter back into all branches of the building wiring;"

170. It is my opinion that Amit teaches this limitation.

171. This limitation is nearly identical to [1.a], but instead of the filter being "located at the point of entry of a building," it is "located at the point of entry of the building **wiring**," and instead of rejecting "network signals originating in the building, such that the network signals … are reflected back into the building," the filter "rejects network signals originating in the building **wiring** such that the rejected network signals … are reflected … back into **all branches of the building wiring**."

172. When I addressed claim elements [1.a] and [5.c.i] above, I explained how figure 2 of Amit teaches that notch filter 202 "is connected to the regional CATV plants via cable [201]," indicating that the filter is located at the point of entry of a building, which Amit refers to as "the input to the user premises." DISH-1005, 4:31, 6:28. A POSITA would have understood that the input to the

user premises described in Amit is also the point of entry of the building wiring.

173. When I addressed claim element [10.pre] above, I explained how figures 2 and 7 of Amit show that Amit's networks use coaxial cable building wiring containing a plurality of branches that connect the terminal devices to the splitters and notch filter. These teachings of Amit further demonstrate that when the filter reflects "network signals originating in the building … back into the building," those signals are "originating in the building **wiring**" and "reflected … back into **all branches of the building wiring**." This is further explained in my explanation of claim element [1.d] above, where my annotated figures showed that the reflections travel back into all branches of the building wiring.

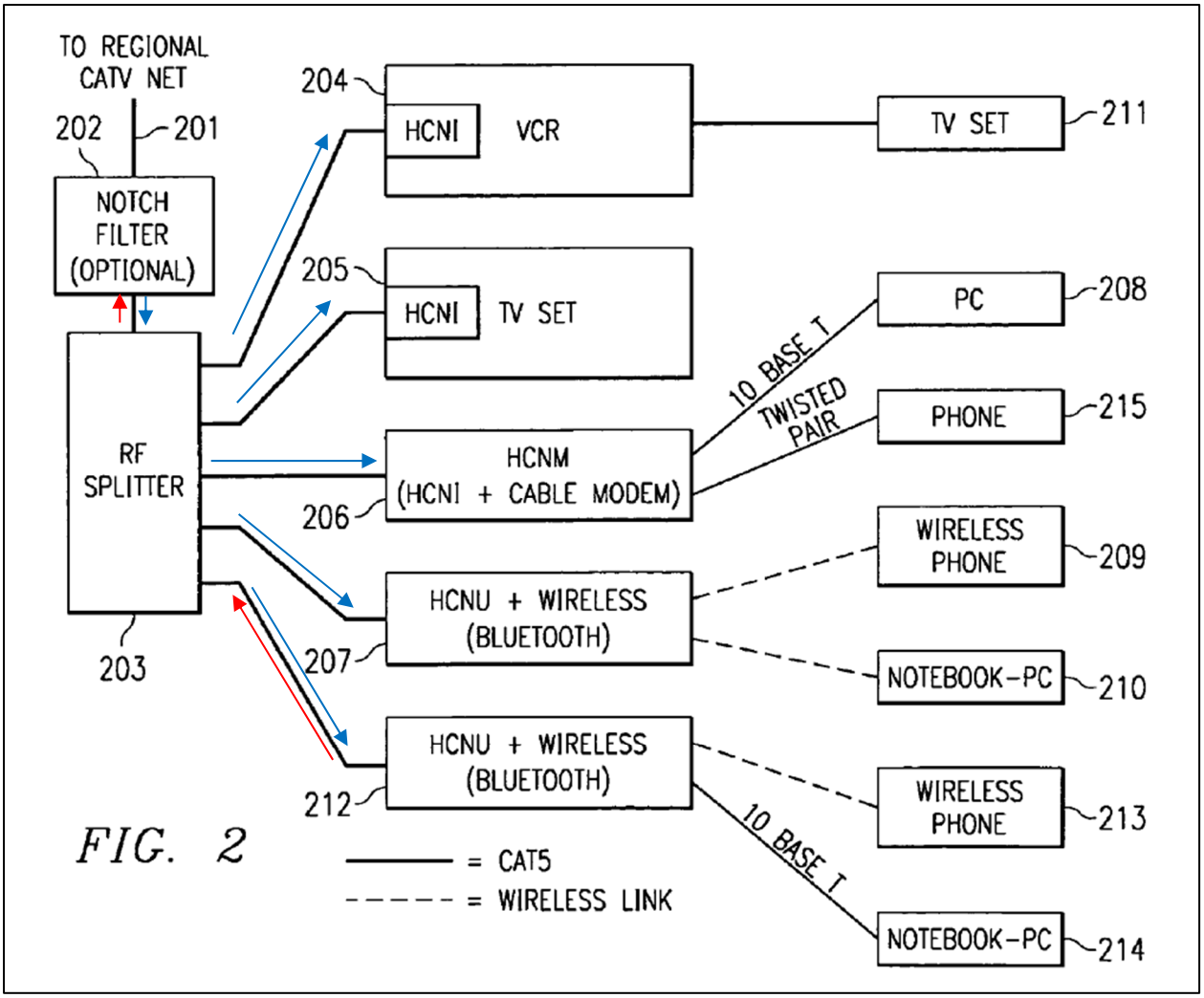

TO REGIONAL CATV NET
202
201
NOTCH FILTER (OPTIONAL)
RF SPLITTER
203
204
HCNI
VCR
205
HCNI
TV SET
206
HCNM (HCNI + CABLE MODEM)
207
HCNU + WIRELESS (BLUETOOTH)
212
HCNU + WIRELESS (BLUETOOTH)
TV SET
211
10 BASE T
TWISTED PAIR
PC
208
PHONE
215
WIRELESS PHONE
209
NOTEBOOK-PC
210
WIRELESS PHONE
213
10 BASE T
NOTEBOOK-PC
214
= CAT5
= WIRELESS LINK

FIG. 2

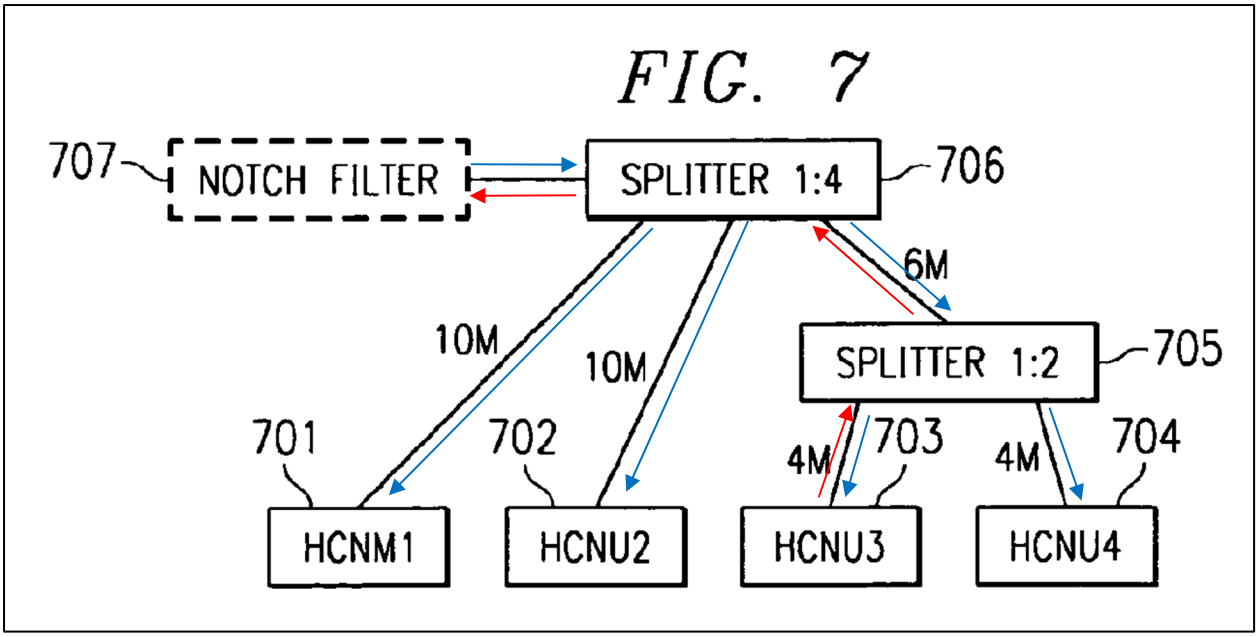

707
NOTCH FILTER
SPLITTER 1:4
706
6M
10M
10M
SPLITTER 1:2
705
701
702
4M
703
4M
704
HCNM1
HCNU2
HCNU3
HCNU4

FIG. 7

174. As a result, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

[10.b] "at least one signal splitter;"

175. This limitation is identical to [1.b.i], and for the same reasons explained in that limitation, it is my opinion that Amit teaches this limitation.

176. As a result, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

[10.c.i] "a plurality of terminal devices connected to the wiring branches"

177. This limitation is nearly identical to [1.c] but also recites that the terminal devices are "connected to the wiring branches." Amit's Figures 2 and 7 demonstrate that its network's coaxial cable building wiring contains wiring branches connected to a plurality of terminal devices, and the same reasons I explained in [1.c] also apply here, so it is my opinion that Amit teaches this limitation.

178. As a result, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

[10.c.ii] "each terminal device capable of communicating with other terminal devices [using] the reflected signal path created by the filter,"

179. It is my opinion that Amit teaches this limitation.

180. When I addressed claim element [1.d] above, I explained how Amit renders obvious that the "the reflections from the filter provide a path … thus

allowing terminal devices to communicate directly with each other." For those same reasons, "each terminal device [is] capable of communicating with other terminal devices [using] the reflected signal path created by the filter" as required by [10.c.ii].

181. As a result, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

[10.c.iii] "wherein the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals."

182. It is my opinion that Amit-ADSL/VDSL renders obvious this limitation.

183. ADSL/VDSL teaches of performing equalization on the received signal that restores a flat frequency response.

184. ADSL/VDSL recognizes that "[m]ost modern communications systems that operate near theoretical limits employ equalization in the transmitter, receiver, or both to optimize or nearly optimize transmission." DISH-1006, 187. It is also my opinion that a POSITA would have understood that most modern communication systems operating near theoretical limits employ equalization. In fact, equalization is commonly used in many types of communication systems, and it is my opinion that a POSITA would have been familiar with applying equalization to the terminal devices of Amit. I first learned about equalization and

equalizing filters in my 1986 class on Communications that used Martin Roden's *Analog and Digital Communication Systems* (1985). In Roden's chapter (6) on pulse modulation and time division multiplexing, he explains that we can use "an equalizer since it cancels the effects of the pulse shape." DISH-1017, Roden, p. 331. Perhaps a more detailed explanation of equalization in communications is found in David Smalley's 1994 survey entitled "Equalization Concepts: A Tutorial." DISH-1019, 1-29.

185. ADSL/VDSL further elaborates that "[o]ften the equalization is done digitally by adaptive digital filters," which "provides a very flexible way to accommodate different types of channels and different types of noise environments." DISH-1006, 187. The book explains that these "adaptive filters converge to optimal initial settings during a training period and then can be updated during normal runtime operation of the system." *Id.*, 187-88. ADSL/VDSL teaches that "[u]pdating is necessary as many channels and noise conditions change over the lifetime of operation." *Id.*.

186. ADSL/VDSL teaches that "[a]ny time a channel's frequency response is not flat over the range of frequencies being transmitted, intersymbol interference (ISI) can occur." *Id.*, 188. "The different types of equalization discussed in" ADSL/VDSL "are mainly intended to remove some or all of this ISI so that optimal decisions can be made on incoming symbols in the receiver." *Id.*, 189.

187. ADSL/VDSL describes various types of equalization that can be performed on the received signal to restores a flat frequency response, including time-domain and frequency-domain equalization. *Id.*, 189-203. It is my opinion that a POSITA at the time of the '249 patent would have been familiar with time-domain and frequency-domain equalization.

188. The Amit-ADSL/VDSL combination also teaches communication channel impairments can include those caused by the reflected signals.

189. Amit acknowledges communication channel impairments caused by the reflected signals. Amit teaches of "houses where there is a problem with reflection," and Amit explains that a "two-frequency mode exists to eliminate the echo problem that exists in some of the homes in the single frequency mode." DISH-1005, 20:15-17, 20:42-43. The two-frequency mode of Amit involves "transmitting the information i[n] a specific frequency range (e.g. 900–906 MHz) and receiving the information in a different frequency range (e.g. 910–916 MHz)." *Id.*, 20:17-20. A POSITA reading these teachings from Amit would have understood that Amit recognizes how the reflections from the filter can cause frequency selective channel impairments, such as the echo problem referenced above that was avoided by using a different frequency range for transmit than for receive.

190. ADSL/VDSL also acknowledges communication channel

impairments. ADSL/VDSL recognizes that "many channels and noise conditions change over the lifetime of operation," and "[a] good example is the change in twisted pair characteristics due to the difference of temperature during the day and night." DISH-1006, 188. A POSITA would have understood that another example of changing channel conditions is the varying channel and noise conditions caused by the reflected signals.

191. For the reasons explained in the paragraphs above, a POSITA would have understood that the teachings of ADSL/VDSL can be used with the terminal devices [204–207, 212] or [701-704] from Amit to perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals.

192. As a result, and for the reasons discussed above regarding motivation to combine, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

193. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 10.

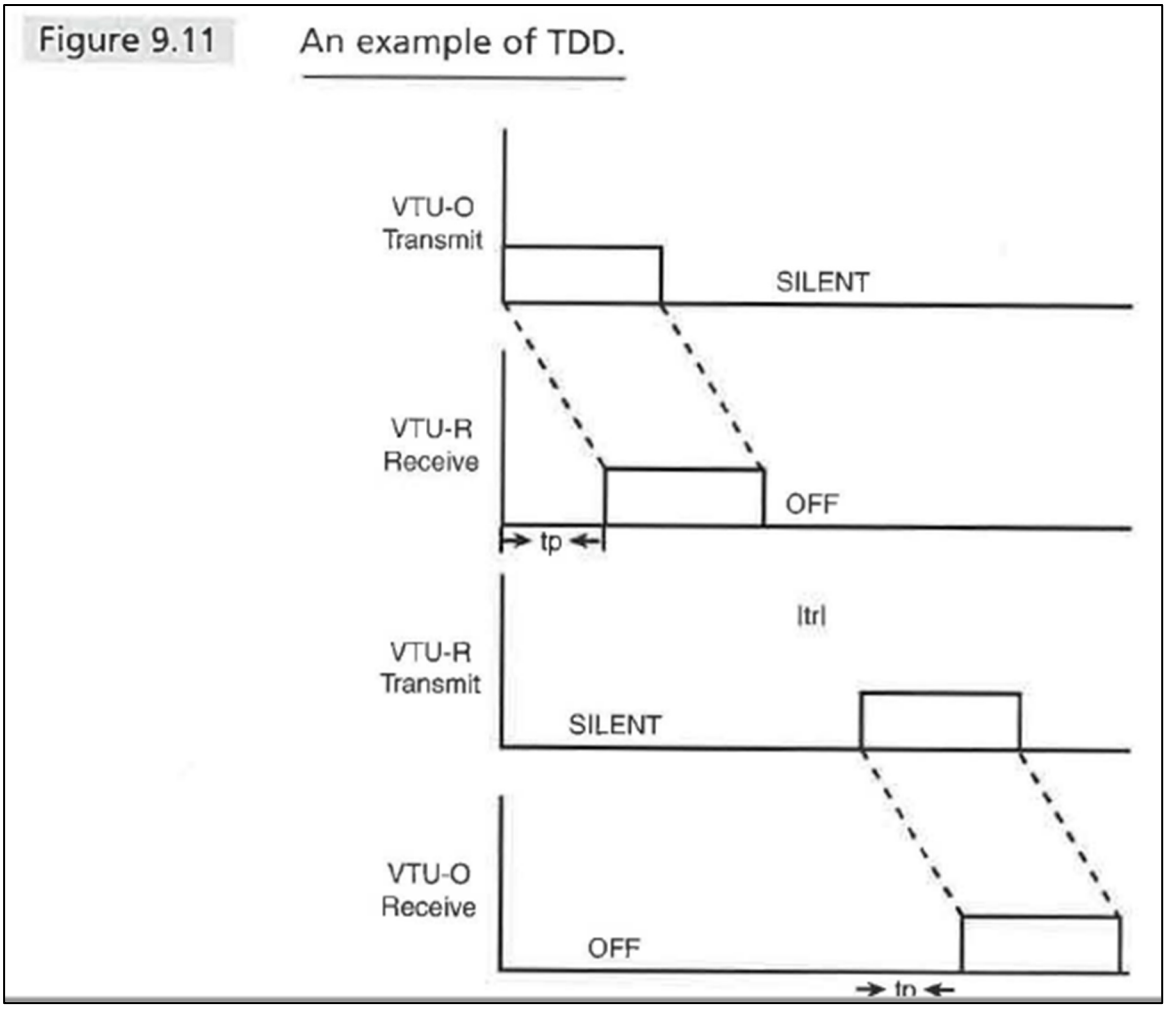
6) Dependent Claim 2

2. The signal distribution network of claim 1, wherein at least one of the communication channels between terminal devices uses time division duplex protocol for communications and the communications are synchronized by broadcasting a beacon message on the network.

194. It is my opinion that the combination of Amit-ADSL/VDSL renders

obvious this claim. As I discussed above, Amit alone discloses or renders obvious claim 2, and the claim is also taught by Amit-ADSL/VDSL, as described below.

195. Like Amit, ADSL/VDSL teaches that "[s]everal different modulation methods have been developed to satisfy the requirements of VDSL," including "a time-domain duplexing (TDD) category and a frequency-domain duplexing (FDD) category." DISH-1006, 295. ADSL/VDSL explains that "TDD is a half-duplex approach for sending signals between two endpoints" where "one modem transmits while its peer modem only receives." *Id.* ADSL/VDSL elaborates that, "[a]fter a set amount of time, the process reverses, and the first modem only receives while its peer transmits," and "[t]his basic concept is shown in Figure 9.11." *Id.* An example is shown in Figure 9.11 from ADSL/VDSL below.



196. ADSL/VDSL also teaches of synchronizing communications on the network. In particular, ADSL/VDSL teaches that "[t]he most popular TDD approach proposed for VDSL is the synchronous DMT approach (SDMT)," and "[o]ne issue related to SDMT is the requirement to properly synchronize frames," which "might be feasible by using a common clock." *Id.*, 296, 301.

197. ADSL/VDSL gives an example of synchronizing by broadcasting a beacon message on the network. ADSL/VDSL explains that "[f]or proper operation of most systems, the sampling clock at the transmitter and receiver must

be exactly the same frequency," meaning "the transmitter and receiver clocks must be locked." *Id.*, 228. ADSL/VDSL further explains, "[t]ypically, locking is done by one end being the master clock and the other end recovering the clock." *Id.* A POSITA would have appreciated the benefits of implementing TDD for communications on the terminal devices of Amit, where the communications would be synchronized by broadcasting a beacon message. For example, Amit explains that one possible terminal device is a HCMN: Home Cable Networking Modem, which is a component that includes a HCNU and a cable modem. DISH-1005, 6:14-16. A POSITA would have been motivated to have Amit's HCMN function as the master clock that transmits a beacon, as described by ADSL/VDSL, while the other terminal devices recover the clock to synchronize the communications.

198. ADSL/VDSL also describes the use of a pilot signal as a beacon signal. ADSL/VDSL teaches that "one of the DMT tones is reserved for a pilot signal," and "[t]he pilot tones can be used to resolve sample timing at the receiver." DISH-1006, 225. A POSITA would have been familiar with pilot signals, as further explained above in my prior discussion of claim 2 in Ground 1, and a POSITA would have understood that the pilot signal of ADSL/VDSL could function as the beacon signal of claim 2.

199. For the reasons discussed above, Amit-ADSL/VDSL therefore renders

obvious claim 2.

7) Dependent Claim 3

3. The signal distribution network of claim 2, 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 caused by the reflections from the filter.

200. It is my opinion that the combination of Amit-ADSL/VDSL renders obvious this claim.

201. As I explained above with respect to claim element [5.a.ii], Amit-ADSL/VDSL renders obvious that each terminal device communicates with other terminal devices using OFDM modulation.

202. As I also explained above, the ’249 patent explains that carriers or frequency channels used in multicarrier modulation are sometimes referred to as frequency bins. DISH-1001, 8:42-43.

203. ADSL/VDSL explains that “a simple method to increase or decrease the output PSD [(Power Spectral Density)] of a transmitter in selected frequency regions.” DISH-1006, 172. This process “involves scaling the complex valued vector **for the bin where power adjustment is desired** before performing the IFFT,” and ADSL/VDSL explains that “[s]uch adjustment can **boost power** in regions **where the channel insertion loss is poor**, **or reduce power** in regions where interference with other systems must be avoided.” *Id.* A POSITA reading these teachings of ADSL/VDSL would have understood that each bin’s power

level (*i.e.*, each OFDM carrier's power level) is adjusted according to the signal loss at each bin, as ADSL/VDSL refers to the "channel insertion loss" as well as the "regions where interference with other systems must be avoided."

204. As I mentioned above, ADSL/VDSL is cited in the specification of the '249 patent, and the disclosures from both references are nearly identical, as shown below.

"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**."	"The process involves **scaling the complex valued vector for the bin where power adjustment is desired before performing the IFFT**."
DISH-1001, 8:32-35.	DISH-1006, 172.

205. As I explained above with respect to claim element [10.c.iii], Amit recognizes how the reflections from the filter can cause frequency selective channel impairments. ADSL/VDSL likewise explains that communications systems must "accommodate different types of channels and different types of noise environments," both of which "change over the lifetime of operation." DISH-1006, 187-88. As described above, Amit-ADSL/VDSL teaches how to overcome these impairments by adjusting the power level of each OFDM carrier according to the signal loss at each OFDM carrier frequency.

206. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 3.

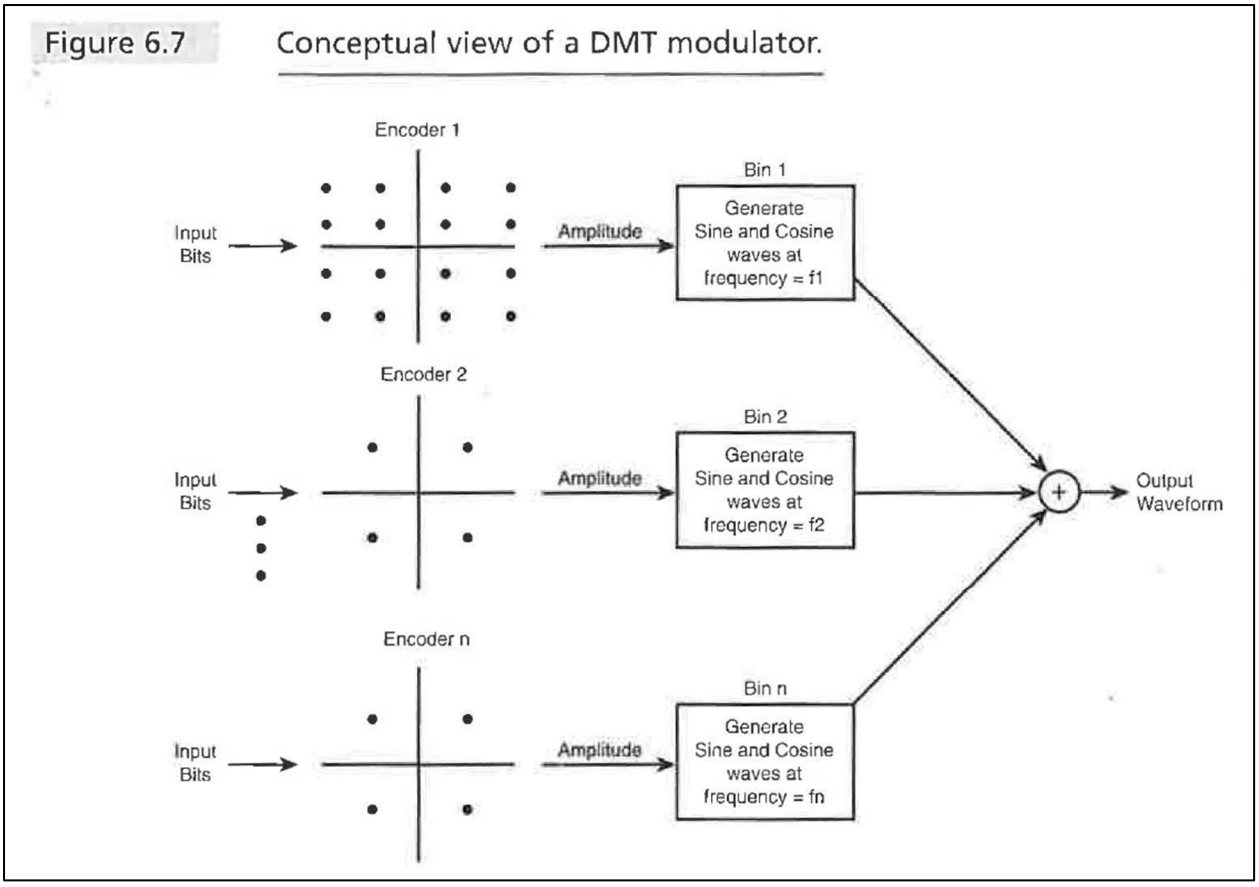
8) Dependent Claim 4

4. The signal distribution network of claim 1, wherein the signal modulation used by the terminal devices is orthogonal frequency division multiplexing (OFDM) and 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 caused by the reflections from the filter.

207. It is my opinion that the combination of Amit-ADSL/VDSL renders obvious this claim.

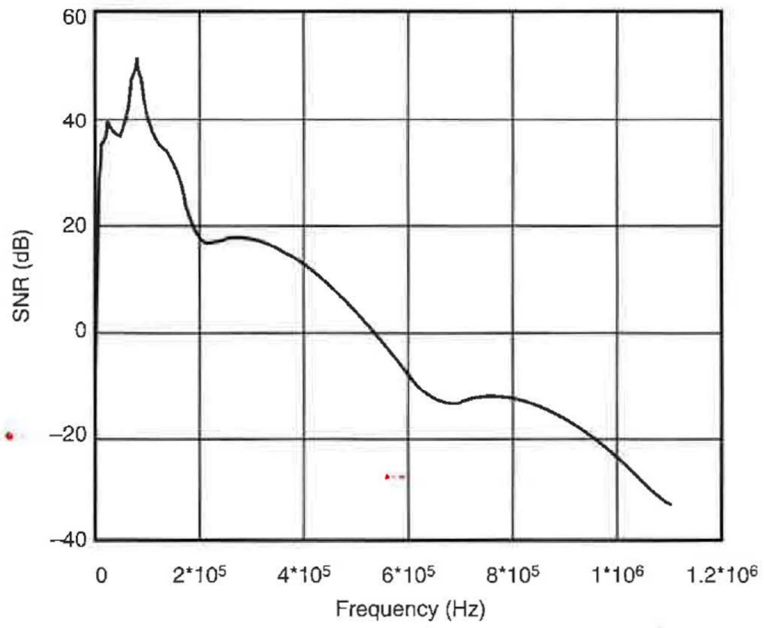
208. As I explained above with respect to claim element [5.a.ii], Amit-ADSL/VDSL renders obvious that each terminal device communicates with other terminal devices using OFDM modulation. ADSL/VDSL also explains how the modulation order of each OFDM carrier is adjusted according to the signal to noise ratio (SNR) at each OFDM carrier frequency.

209. The ’249 patent explains that “[e]ach 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.” DISH-1001, 8:24-29. Like the ’249 patent, ADSL/VDSL teaches that “[e]ach encoder receives a set of bits that are encoded using a constellation encoder,” as shown in Figure 6.7 below. DISH-1006, 166-67.



210. ADSL/VDSL elaborates that "DMT allows a communications system to be very flexible and optimally utilize a channel." *Id.*, 171.

Figure 6.9 SNR with respect to frequency of a sample channel; DMT bins in the areas where the SNR is high can use more dense QAM constellations.



211. Figure 6.9 (above) depicts the "SNR with respect to frequency of a sample channel," and ADSL/VDSL explains that "DMT bins in the areas where the SNR is high can use **more dense QAM constellations**." *Id.* ADSL/VDSL teaches that, "[c]ompared to the bins when the SNR is low, **the bins occupying parts of the channel where the SNR is high can be used to transmit more bits**." *Id.*, 172. This "process involves increasing the number of points used in the constellations of the 'good' bins." *Id.*

212. As I mentioned above, ADSL/VDSL is cited in the specification of the '249 patent, and the disclosures from both references are nearly identical, as shown below.

"Frequency **bins occupying parts of the channel where the SNR is high can be used to transmit more bits**."	"Compared to the bins when the SNR is low, the **bins occupying parts of the channel where the SNR is high can be used to transmit more bits**."
DISH-1001, 8:32-35.	DISH-1006, 172.

213. Like ADSL/VDSL, Amit also recognizes that "[t]he modulation method is QPSK, QAM 16, QAM 64 or QAM 256 **according to the channel conditions**." DISH-1005, 8:30-32. A POSITA would have understood that channel conditions impact the signal to noise ratio of the channel, and a channel with better channel conditions will have a higher signal to noise ratio than a channel with worse channel conditions.

214. As I explained above with respect to claim element [10.c.iii], Amit teaches about how the reflections from the filter can cause frequency selective channel impairments. and as described above, Amit and ADSL/VDSL both disclose how to overcome channel impairments by adjusting the modulation order of each OFDM carrier.

215. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 4.

9) Dependent Claim 6

6. The broadband local area network of claim 5 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 filter.

216. This claim is identical to claim 4, and for the same reasons explained above for that claim, it is my opinion that Amit-ADSL/VDSL renders obvious claim 6.

10) Dependent Claim 7

7. The broadband local area network of claim 5, 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 filter.

217. This claim is identical to claim 3, and for the same reasons explained above for that claim, it is my opinion that Amit-ADSL/VDSL renders obvious claim 7.

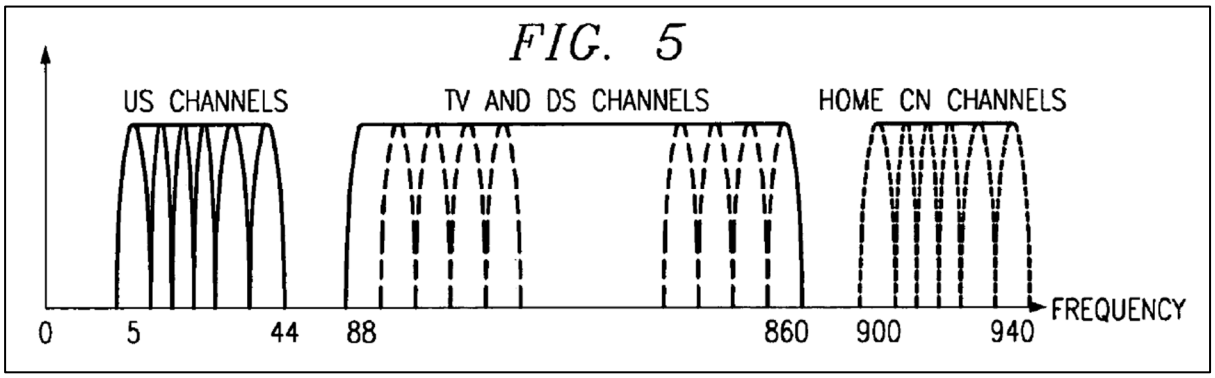
11) Dependent Claim 8

8. The broadband local area network of claim 5 wherein the frequency used for communicating is above the cable television band.

218. It is my opinion that the combination of Amit-ADSL/VDSL renders obvious this claim.

219. As the ’249 patent acknowledges, “the standard cable use frequencies [] extend to 550 MHz or 750 MHz.” DISH-1001, 5:28-30. Amit teaches that “[w]hen the home coaxial cables are connected to a local or regional CATV network, the HomeCN is done in an out-of-band frequency (i.e. band that is not in use, e.g. **above 860 MHz**).” DISH-1005, 3:24-30.

220. The use of a frequency above the cable television band is further demonstrated by Figure 5 of Amit. Figure 5 "presents a frequency allocation that may be employed by the present invention." *Id.*, 5:28-29. As shown below, the HomeCN channels used from communicating are above the TV channels.



221. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 8.

12) Dependent Claim 9

9. The broadband local area network of claim 5, wherein at least one of the communication channels between terminal devices uses time division duplex protocol for communications and the communications are synchronized by broadcasting a beacon message on the network.

222. This claim is identical to claim 2, and for the same reasons explained above for that claim, it is my opinion that Amit-ADSL/VDSL renders obvious claim 9.

13) Dependent Claim 11

11. The network of claim 10 wherein the equalization is frequency domain equalization.

223. It is my opinion that the combination of Amit-ADSL/VDSL renders

obvious this claim.

224. As I explained above with respect to claim 10, Amit-ADSL/VDSL teaches how the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals.

225. Amit-ADSL/VDSL further renders obvious that the equalization described in claim 10 can be frequency domain equalization. ADSL/VDSL teaches that "[e]qualization can be done in the frequency domain instead of in the time domain." DISH-1006, 201. ADSL/VDSL also explains that "a modulation technique such as DMT, which involves a transformation between the time domain and frequency domain at the receiver using a discrete fourier transform, may lend itself nicely to frequency-domain equalization." *Id.*

226. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 11.

14) Dependent Claim 12

12. The network of claim 10 wherein the equalization is time domain equalization.

227. It is my opinion that the combination of Amit-ADSL/VDSL renders obvious this claim.

228. As I explained above with respect to claim 10, Amit-ADSL/VDSL teaches how the terminal devices perform equalization on the received signal that

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

229. Amit-ADSL/VDSL further renders obvious that the equalization described in claim 10 can be time domain equalization. As I explained above with respect to claim 11, ADSL/VDSL teaches of using frequency domain equalization as an alternative to time domain equalization. DISH-1006, 201. ADSL/VDSL also teaches that "if the impulse response of the channel is larger than the length of added cyclic prefix, energy from the previous symbol will leak into the N saved samples and the channel will no longer look circular." *Id.*, 202. According, to ADSL/VDSL, "[t]he solution is to combine some front-end **time-domain equalization** before removing the N samples at the receiver," which "can effectively shorten the channel response to less than L samples, thus restoring the circular property desired." *Id.*, 203.

230. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 12.

15) Dependent Claim 13

13. The network of claim 10 wherein the equalization is adaptive.

231. It is my opinion that the combination of Amit-ADSL/VDSL renders obvious this claim.

232. As I explained above with respect to claim 10, Amit-ADSL/VDSL

teaches how the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals.

233. As I also explained with respect to claim element [10.c.iii], ADSL/VDSL teaches that "[o]ften the equalization is done digitally by **adaptive** digital filters," which "provides a very flexible way to accommodate different types of channels and different types of noise environments." DISH-1006, 187. A POSITA would have understood that equalization by adaptive digital filters is also known as adaptive equalization.

234. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 13.

16) Dependent Claim 14

14. The network of claim 13 wherein the terminal devices use orthogonal frequency division multiplexing (OFDM) modulation to overcome the communication channel impairments caused by the reflected signals.

235. It is my opinion that the combination of Amit-ADSL/VDSL renders obvious this claim.

236. As I explained above with respect to claim element [5.a.ii], Amit-ADSL/VDSL renders obvious that the terminal devices use OFDM modulation.

237. As I also explained above with respect to claims 3 and 4, Amit-ADSL/VDSL also teaches of using OFDM modulation "to overcome frequency the

communication channel impairments caused by the reflected signals."

238. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 14.

17) Dependent Claim 15

15. The network of claim 14 wherein the terminal devices use forward error correction to recover the transmitted signals without errors.

239. It is my opinion that the combination of Amit-ADSL/VDSL renders obvious this claim.

240. A POSITA would have understood that two common types of forward error correction are Reed-Solomon error correction and convolutional coding error correction. This is further supported by the '249 patent, which teaches that "[v]arious types of forward error correction can be applied to transmitted data blocks, such as Reed-Solomon and convolutional coding." DISH-1001, 8:44-47.

241. Like the '249 patent, Amit teaches that "FEC (Forward Error Correction) MUST support R-S (Reed Salomon) T=0,10" and "MAY support R-S (Reed Salomon) T=0, . . . ,10." DISH-1005, 8:40-44.

242. Similarly, ADSL/VDSL teaches that "[t]wo types of forward error correction are common," including "Reed-Solomon coding" and "a convolution code known as trellis-coded modulation (TCM)." DISH-1006, 172.

243. ADSL/VDSL also explains how forward error correction is implemented to recover the transmitted signals without errors. ADSL/VDSL

explains that "[a] forward error correction (FEC) block adds redundancy to the data to be transmitted," where "the FEC block might be able to correct bits that the demodulator decodes incorrectly." *Id.*

244. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 15.

18) Dependent Claim 16

16. The network of claim 10 wherein the terminal devices use orthogonal frequency division multiplexing (OFDM) modulation to overcome the communication channel impairments caused by the reflected signals.

245. This claim is identical to claim 14, and for the same reasons explained above for that claim, it is my opinion that Amit-ADSL/VDSL renders obvious claim 16.

19) Dependent Claim 17

17. The broadband local area network of claim 10, wherein at least one of the communication channels between terminal devices uses time division duplex protocol for communications and the communications are synchronized by broadcasting a beacon message on the network.

246. This claim is identical to claim 2, and for the same reasons explained above for that claim, it is my opinion that Amit-ADSL/VDSL renders obvious claim 17.

C. [GROUND 3] – Amit in view of Jacobsen (claims 1, 4-6, 8, 10,

12-14, 16

1) Overview of Jacobsen

247. Jacobsen is a paper published in 1994 that is titled "An Efficient Digital Modulation Scheme for Multimedia Transmission on the Cable Television Network." DISH-1007, 305.

248. Jacobsen "present[s] a comparison between the performances of single-carrier modulation with equalization and multicarrier modulation on simulated cable television (CATV) channels." DISH-1007, 305. Jacobsen also explores "[t]he feasibility of offering high-speed interactive data services to customers on CATV networks or similar broadband coaxial networks" and recognizes that "there are several electrical transmission problems that must be overcome before these services can be supplied reliably over CATV networks." *Id.* One such problem is that "the hardware in CATV networks is not ideal" as the "[t]aps, amplifiers, and splitters can all cause signals to be reflected at their insertion points." *Id.*

249. Jacobsen also recognizes that "[v]ariations in a channel's frequency response cause successively transmitted symbols to interfere with one another, an effect known as intersymbol interference (ISI)." *Id.* "Without some scheme to combat ISI, a receiver would make detection errors." *Id.* Jacobsen analyzes and "discuss[es] two candidate techniques for multimedia transmission on the CATV

network: single-carrier quadrature amplitude modulation (QAM) with equalization and multicarrier modulation." *Id.*, 306.

2) Motivation to combine Amit with Jacobsen

250. It is my opinion that a POSITA would have been motivated to modify Amit's system to incorporate Jacobsen's teachings with a reasonable expectation of success.

251. The Amit-Jacobsen combination incorporates Jacobsen's techniques for multimedia transmission on the CATV network, including modulation and equalization, into Amit's home network, which also utilizes coaxial TV cables.

252. A POSITA seeking to implement Amit's coaxial cable home network would have looked to analogous references that address broadband coaxial networks, including Jacobsen, which is in the same field of endeavor as the '249 patent. DISH-1001, 8:55-60; DISH-1005, 2:39-40; DISH-1007, 305. The references describe broadband coaxial networks and the techniques for communicating in such networks. The references also recognize how high-speed interactive data services are a driver for implementing broadband coaxial networks.

253. A POSITA reading Amit's teachings about coaxial networks would have been motivated to improve such networks using techniques from analogous coaxial networking publications, such as Jacobsen. A POSITA would also have been motivated to combine the teachings of Amit and Jacobsen because they both

are reasonably pertinent to overcoming problems in network communication channels, including the problems identified in the specification of the '249 patent, which are "port-to-port isolation and providing a suitable signal path for terminal-to-terminal communication in a coaxial cable wired building." DISH-1001, 3:4-7.

254. A POSITA would also have been motivated to combine the teachings of Amit and Jacobsen because they both are reasonably pertinent to utilizing the reflections present in coaxial networks and overcoming the resulting communication channel impairments. For example, Amit recognizes that "coax cable is an excellent communication medium, as it has a high bandwidth and it is shielded to avoid noise," but even when using coax, there can be "houses where there is a problem with reflection." DISH-1005, 2:51-53, 20:42-43. Moreover, "channel conditions" can vary and necessitate different communication techniques, like QAM. *Id.*, 8:30-32.

255. Jacobsen similarly recognizes that "[t]aps, amplifiers, and splitters can all cause signals to be reflected at their insertion points," and the corresponding "[v]ariations in a channel's frequency response cause successively transmitted symbols to interfere with one another, an effect known as intersymbol interference (ISI)." DISH-1007, 305. Moreover, "[a] second source of signal degradation in CATV networks is interference from other signals." *Id.*, 306. Like Amit, Jacobsen describes techniques to overcome communication channel impairments and

provide a suitable path for terminal-to-terminal communication. *See id.*, 305-06. For example, Jacobsen teaches of single-carrier quadrature amplitude modulation (QAM) with equalization and multicarrier modulation. *Id.*

256. A POSITA would have been motivated to improve the bit rate of Amit's networks using Jacobsen's teachings that build upon the FDM and QAM modulation described in Amit.

257. Amit explains that "[v]arious types of modulation can be used," but the modulation method "should support high bandwidth rate (more th[a]n 10 Mbps)." DISH-1005, 25:1-7. "The selected modulations that comply with these requirements are QPSK and QAM." *Id.*, 25:9-10.

258. Jacobsen "discuss[es] two candidate techniques for multimedia transmission on the CATV network: single-carrier quadrature amplitude modulation (QAM) with equalization and multicarrier modulation." DISH-1007, 306. Jacobsen explains that in multicarrier modulation, "a channel is divided into N equal-bandwidth subchannels" where "[e]ach subchannel then supports its own QAM constellation." *Id.*, 306-07.

259. A POSITA starting with Amit's terminal devices that use QAM modulation would have been motivated to apply Jacobsen's teachings to arrive at single carrier QAM modulation with equalization or multicarrier modulation, which builds upon QAM by allowing for several subchannels have their own QAM

constellation. Moreover, Amit recognizes that "signals will typically propagate between the devices via reflections from other devices in the line" (DISH-1005, 3:19-23) and that there can be "houses where there is a problem with reflection" (*id.*, 20:42-43), and a POSITA would have been motivated to look to Jacobsen's teachings of how to compensate for "[v]ariations in a channel's frequency response," which are caused by the signal reflections and result in ISI. DISH-1007, 305.

260. A POSITA would have thus been motivated to use Jacobsen's modulation teachings with Amit's terminal devices to improve upon the QAM modulation and improve the bit rate.

261. A POSITA would have been motivated to increase the capabilities of the terminal devices of Amit by adding the equalizers taught by Jacobsen.

262. As discussed above, a POSITA would have been motivated to combine the coaxial broadband networks and modulation methods of Amit and Jacobsen, and a POSITA would have also been motivated to efficiently utilize the limited networking resources. Amit explains that "**frequency resources are limited**," and "[a]n important point is to define this protocol to use **limited 'cable' resources**," including "limited US (up stream) frequencies" and the fact that, when using "higher frequencies," "their distance is limited"—meaning a higher frequency signal cannot travel as far. DISH-1005, 9:56, 19:32-37. Amit also

explains that the "modulation method" is selected "**according to the channel conditions**, and **according to the equipment capabilities**." *Id.*, 8:30-32.

263. Jacobsen teaches how to utilize limited frequency resources with the assistance of equalizers. For example, Jacobsen recognizes that CATV networks will "demand high spectral efficiency in those channels allocated for the new services." DISH-1007, 305. To help satisfy this demand, Jacobsen teaches that "CATV networks can also have high-frequency attenuation reduced by the installation of **equalizing diplex amplifiers** that can boost the usable spectrum to 1 GHz." *Id.*

264. Jacobsen also teaches of using equalizers to improve communications despite less than ideal channel conditions. Jacobsen recognizes that "[t]aps, amplifiers, and splitters can all cause signals to be reflected," which can cause "intersymbol interference (ISI)." DISH-1007, 305. Jacobsen explains that given "the desire to achieve high throughput with little latency," one of "two practical options" is "single-carrier quadrature amplitude modulation (QAM) with equalization." *See id.*, 306. "Because practical channels cause ISI, **an equalizer is used to reduce the ISI**, thereby improving the performance of the system with a fixed complexity." *Id.*

265. A POSITA thus would have been motivated to add the equalizers of Jacobsen to the terminal devices of Amit.

266. A POSITA would have had a reasonable expectation that the Amit-Jacobsen combination would produce a successful outcome. When improving Amit's network, a POSITA would have had a reasonable expectation of successfully incorporating the techniques of networks that similarly deliver high-speed data over coax, such as those of Jacobsen. Moreover, a POSITA would have had a reasonable expectation of success in combining teachings regarding coax networks that use QAM. DISH-1007, 305-06.

267. Given Amit's disclosure of using QAM (DISH-1005, 8:30-33, 25:1-10), Jacobsen's teachings of building upon QAM to arrive at single carrier QAM modulation with equalization or multicarrier modulation (OFDM) would have been straightforward to a POSITA. A POSITA would have expected Jacobsen's modulation methods to work in the context of Amit because Amit employed QAM. Implementing OFDM would have been within the skill level of a POSITA because it is taught/used in a variety of engineering, science, and/or math courses that a POSITA would have taken and because QAM and OFDM were both well-known in the art. In fact, by the time the '249 patent was filed, QAM-OFDM systems were well known. That is, systems were common that used multiple carriers (such as OFDM) and in-phase and quadrature components (*i.e.*, QAM). One such example is found in Santella and Mazzenga's 1998 QAM-OFDM system. DISH-1020, Santella, 142-151. Another example is the QAM-OFDM solution by Corvaja

et al. published in 1998. DISH-1021, Corvaja, 481-486.

268. A POSITA would also have been able to implement the equalizers of Jacobsen into Amit's terminal devices because the use of such equalizers is part of the work and the engineering courses that a POSITA would have experienced.

269. Similarly, given Amit's discussions of limited networking resources and varying channel conditions (DISH-1005, 8:30-32, 9:56, 19:32-37), the idea of using Jacobsen's single-carrier QAM modulation with equalization or multicarrier modulation (OFDM) to accommodate different types of channels and noise environments would have been straightforward from a POSITA's perspective. A POSITA would also have expected Jacobsen's techniques to work in the context of Amit, which recognizes that varying channel conditions can necessitate techniques to improve communications. DISH-1005, 8:30-32. Jacobsen similarly recognizes that "given a finite-complexity constraint and the desire to achieve high throughput with little latency, there are two practical options: single-carrier quadrature amplitude modulation (QAM) with equalization and multicarrier modulation." DISH-1007, 306.

270. A POSITA would have understood that the Amit-Jacobsen combination would have also yielded predictable results. As described above, Jacobsen's modulation techniques build upon QAM, so implementing them into Amit's system, which already uses QAM, would have yielded predictable results.

Adding equalization to the terminal devices would also have yielded predictable results, as equalizers are commonly used in communications devices like the terminal devices of Amit.

3) Independent Claim 1

271. It is my opinion that the combination of Amit-Jacobsen renders obvious this claim. As I discussed above, Amit alone discloses or renders obvious each limitation of claim 1, and claim element [1.c.iii] is also taught by Amit-Jacobsen, as described below.

[1.c.iii] "at least one of the terminal devices providing frequency bins with more transmit bits which occupy parts of the channel where the signal to noise ratio (SNR) is high"

272. It is my opinion that Amit-Jacobsen renders obvious this limitation.

273. As discussed above, a POSITA would have understood that the frequency bins of claim 1 are the same as frequency channels. This understanding is confirmed by the specification of the '249 patent, which explains that "the frequency channels in OFDM may be called frequency bins." DISH-1001, 8:42-43. Jacobsen similarly explains that "[i]n multicarrier modulation, a channel is divided into N equal-bandwidth subchannels, each with its own carrier." DISH-1007, 306. A POSITA would have understood that these subchannels of Jacobsen are the same as the frequency channels and frequency bins referred to by the '249 patent.

274. A POSITA would have understood that the benefits of using the

teachings of Jacobsen in the terminal devices [204–207, 212] or [701-704] from Amit. This would result in the terminal devices providing frequency bins with more transmit bits which occupy parts of the channel where the signal to noise ratio (SNR) is high. Jacobsen explains that, "[i]n contrast to traditional frequency-division multiplexing (FDM) techniques, multicarrier modulation does not constrain the number of bits per subchannel to be equal for all subchannels." *Id.*, 306-07. "Instead, **bits are originally assigned to subchannels** just after training during system initialization **in direct proportion to the subchannel signal-to-noise ratios**." *Id.*, 307. Jacobsen continues by explaining that, "[a]s a result, **subchannels that suffer from little attenuation and/or little noise carry the most bits**, while subchannels that are severely attenuated and/or very noisy might not carry any bits." *Id.*

275. As a result, and for the reasons discussed above regarding motivations to combine, it is my opinion that Amit-Jacobsen renders this limitation obvious.

276. For the reasons discussed above, Amit-Jacobsen renders obvious claim 1.

4) Independent Claim 5

277. It is my opinion that the combination of Amit-Jacobsen renders obvious this claim. As I discussed above, Amit renders obvious claim elements [5.pre]-[5.a.i] and [5.b]-[5.c.ii] of claim 5, and claim element [5.a.ii] and [5.a.iii]

are also rendered obvious by Amit-Jacobsen, as described below.

[5.a.ii] "each terminal device communicating with other terminal devices using orthogonal frequency division multiplexing (OFDM) modulation,"

278. It is my opinion that Amit-Jacobsen renders obvious this limitation.

279. As discussed above, the '249 patent explains that "[m]ultitone 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" and that "Multitone modulation is also called discrete multitone (DMT) and orthogonal frequency division multiplexing (OFDM)." DISH-1001, 7:61-66.

280. Jacobsen similarly "discuss[es] two candidate techniques for multimedia transmission on the CATV network," including "multicarrier modulation." DISH-1007, 306. Jacobsen teaches that "[i]n multicarrier modulation, a channel is divided into N equal-bandwidth subchannels, each with its own carrier, such that the frequency response is roughly constant across each subchannel." *Id.* Like the '249 patent, Jacobsen recognizes that "Discrete multitone modulation (DMT)" is "a common form of multicarrier modulation," where DMT "makes the subchannels exactly independent and memoryless in the white Gaussian noise case by using the basis vectors of the inverse fast Fourier transform (IFFT) as the subchannel carriers and adding a cyclic prefix to each symbol." *Id.*

281. Jacobsen further explains that "[i]n contrast to **traditional** frequency-

division multiplexing (FDM) techniques, multicarrier modulation does not constrain the number of bits per subchannel to be equal for all subchannels." *Id.*, 306-07. A POSITA would have understood that Jacobsen is referring to **orthogonal** frequency-division multiplexing when it refers to multicarrier modulation that is unlike **traditional** frequency-division multiplexing.

282. A POSITA would have understood that the teachings of Jacobsen can be used with the terminal devices [204–207, 212] or [701-704] from Amit. A POSITA seeking to implement one the terminal devices that mediate communications with, for example, a "wireless phone" or a "notebook PC," would have been motivated to incorporate Jacobsen teachings of OFDM in the network and devices of Amit. First of all, simply to be adherent to the wireless standards of the day, a POSITA would modify Amit to include the OFDM teachings of Jacobsen to achieve compliance with the IEEE 802.11a wireless communications standard of 1999. Earlier digital video broadcasting standards, such as DAB Eureka 147 (1995) and DVB-T (1997), also used OFDM in delivering video content. So, a POSITA would have been motivated to include OFDM teachings of Jacobsen in the terminal devices of Amit in order to receive video in locations of world that used DAB and DVB.

283. As a result, it is my opinion that Amit-ADSL/VDSL renders this limitation obvious.

[5.a.iii] "at least one of the terminal devices providing frequency bins with more transmit bits which occupy parts of the channel where the signal to noise ratio (SNR) is high;"

284. This limitation is identical to [1.c.iii], and for the same reasons explained in that limitation, it is my opinion that Amit-Jacobsen renders obvious this limitation.

285. For the reasons discussed above, Amit-ADSL/VDSL therefore renders obvious claim 5.

5) Independent Claim 10

286. It is my opinion that the combination of Amit-Jacobsen renders obvious this claim. As I discussed above, Amit renders obvious claim elements [10.pre]-[10.c.ii] of claim 10, and claim element [10.c.iii] is also rendered obvious by Amit-Jacobsen, as described below.

[10.c.iii] "wherein the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals."

287. It is my opinion that that Amit-Jacobsen renders obvious this limitation.

288. Jacobsen acknowledges that "[s]ome CATV networks can also have high-frequency attenuation reduced by the installation of **equalizing** diplex amplifiers that can boost the usable spectrum to 1 GHz." DISH-1007, 305. A POSITA would have understood that such equalizing diplex amplifiers perform equalization on the received signal.

289. Jacobsen further "discuss[es] two candidate techniques for multimedia transmission on the CATV network: single-carrier quadrature amplitude modulation (QAM) with **equalization** and multicarrier modulation." *Id.*, 306. In single-carrier QAM with equalization, Jacobsen teaches that "[b]ecause practical channels cause ISI, **an equalizer is used to reduce the ISI, thereby improving the performance of the system** with a fixed complexity." *Id.*

290. Jacobsen also teaches of using equalization in the second candidate technique of multicarrier modulation. Jacobsen explains that "the complexity of DMT systems is proportional to the FFT/IFFT size used in the implementation (or, equivalently, the number of sub channels into which the channel is divided)." *Id.*, 308. As a result, Jacobsen teaches to "var[y] the FFT size to determine the effect of a reduced number of subchannels on the achievable bit rate." *Id.* Jacobsen further explains that "we could use the smaller FFT sizes (for example, $2N \leq 256$) by implementing a **time-domain equalizer (TEQ)**, the purpose of which is to reduce the required length of the cyclic prefix in exchange for an increase in system complexity." DISH-1007, 309.

291. The Amit-Jacobsen combination further explains how equalization overcomes frequency selective communication channel impairments caused by the reflected signals. As I explained with respect to claim element [10.c.iii] above, Amit recognizes how the reflections from the filter can cause frequency selective

channel impairments. Amit teaches of "houses where there is a problem with reflection," and Amit explains that a "two-frequency mode exists to eliminate the echo problem that exists in some of the homes in the single frequency mode." DISH-1005, 20:15-17, 20:42-43. The two-frequency mode of Amit involves "transmitting the information i[n] a specific frequency range (e.g. 900–906 MHz) and receiving the information in a different frequency range (e.g. 910–916 MHz)." *Id.*, 20:17-20. A POSITA reading these teachings from Amit would have understood that Amit recognizes how the reflections from the filter can cause frequency selective channel impairments.

292. Jacobsen also acknowledges "the effects of various distortions on a CATV network, including microreflections." DISH-1007, 305. Jacobsen teaches that "[t]he transmission of digital signals over the CATV network is complicated" because "[t]aps, amplifiers, and splitters can all cause **signals to be reflected** at their insertion points." *Id.* "In particular, splitters in subscriber homes are known to have poor isolation characteristics," and "[t]he **effect of reflected signals on the frequency transfer characteristic** of a CATV channel is passband ripple." *Id.* A POSITA would have understood that Jacobsen is referring to communication channel impairments caused by the reflected signals and that the passband ripple means that there would not be a flat frequency response.

293. Jacobsen also explains that these "[v]ariations in a channel's

frequency response cause successively transmitted symbols to interfere with one another, an effect known as intersymbol interference (ISI).” *Id.* “Without some scheme to combat ISI, a receiver would make detection errors.” *Id.* “Consequently, a robust digital transmission technique for multimedia signals must alleviate the ISI caused by CATV channels if reliable transmission is to be achieved.” *Id.*, 306.

294. As explained above, Jacobsen also teaches of using an equalizer to reduce ISI. A POSITA would therefore have understood that Jacobsen teaches of performing equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals.

295. Further, for the reasons discussed above regarding motivations to combine, a POSITA would have understood the benefits of using the teachings of Jacobsen in the terminal devices [204–207, 212] or [701-704] from Amit.

296. As a result, it is my opinion that Amit-Jacobsen renders this limitation obvious.

6) Dependent Claims 2, 9, 17

2. The signal distribution network of claim 1, wherein at least one of the communication channels between terminal devices uses time division duplex protocol for communications and the communications are synchronized by broadcasting a beacon message on the network.

9. The broadband local area network of claim 5, wherein at least one of the communication channels between terminal devices uses time division duplex protocol for communications and the communications

are synchronized by broadcasting a beacon message on the network.

17. The broadband local area network of claim 10, wherein at least one of the communication channels between terminal devices uses time division duplex protocol for communications and the communications are synchronized by broadcasting a beacon message on the network.

297. It is my opinion that the combination of Amit-Jacobsen renders obvious these claims.

298. As I discussed above, Amit alone discloses or renders obvious a TDD protocol for communication in a channel.

299. Moreover, the '249 patent acknowledges, via reference to Gibbs, that it was known that TD-based protocols use broadcast beacon messages to synchronize nodes. DISH-1001, 2:42-59, 6:35-48.

300. For the reasons discussed above, Amit-Jacobsen therefore renders obvious claims 2, 9, and 17.

7) Dependent Claims 4 and 6

4. The signal distribution network of claim 1, wherein the signal modulation used by the terminal devices is orthogonal frequency division multiplexing (OFDM) and 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 caused by the reflections from the filter.

6. The broadband local area network of claim 5 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 filter.

301. It is my opinion that the combination of Amit-Jacobsen renders

obvious these claims.

302. As I explained above with respect to claim element [5.a.ii], Amit-Jacobsen renders obvious that each terminal device communicates with other terminal devices using OFDM modulation. Jacobsen also explains that the modulation order of each OFDM carrier is adjusted according to the signal to noise ratio (SNR) at each OFDM carrier frequency.

303. The ’249 patent explains that “[e]ach 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.” DISH-1001, 8:24-29. Like the ’249 patent, Jacobsen teaches that “[i]n multicarrier modulation, a channel is divided into N equal-bandwidth subchannels, each with its own carrier, such that the frequency response is roughly constant across each subchannel.” DISH-1007, 306. Jacobsen further explains that, “[i]n contrast to traditional frequency-division multiplexing (FDM) techniques, multicarrier modulation does not constrain the number of bits per subchannel to be equal for all subchannels.” *Id.*, 306-07.

304. Jacobsen further explains how unlike traditional frequency division multiplexing, OFDM does not constrain the number of bits per subchannel to be equal for all subchannels because, “[i]nstead, **bits are originally assigned to**

subchannels just after training during system initialization **in direct proportion to the subchannel signal-to-noise ratios**." *Id.*, 307. Jacobsen then recognizes that, "[a]s a result, **subchannels that suffer from little attenuation and/or little noise carry the most bits**, while subchannels that are severely attenuated and/or very noisy might not carry any bits." *Id.*

305. Jacobsen goes on to explain that "[t]his property can be used to alleviate the problems caused by both frequency-domain ripple and interferers," where "[e]ach subchannel [] supports its own QAM constellation." *Id.*

306. Like Jacobsen, Amit teaches that "[t]he modulation method is QPSK, QAM 16, QAM 64 or QAM 256 **according to the channel conditions**." DISH-1005, 8:30-32. A POSITA would have understood that channel conditions impact the signal to noise ratio of the channel, and a channel with better channel conditions will have a higher signal to noise ratio than a channel with worse channel conditions.

307. As I explained above with respect to claim element [10.c.iii], Amit teaches about how the reflections from the filter can cause frequency selective channel impairments. and as described above, Amit and Jacobsen both disclose how to overcome channel impairments by adjusting the modulation order of each OFDM carrier.

308. For the reasons discussed above, Amit-Jacobsen therefore renders

obvious claims 4 and 6.

8) Dependent Claim 8

8. The broadband local area network of claim 5 wherein the frequency used for communicating is above the cable television band.

309. It is my opinion that the combination of Amit-Jacobsen renders obvious this claim.

310. As the ’249 patent indicates, “the standard cable use frequencies [] extend to 550 MHz or 750 MHz.” DISH-1001, 5:28-30. Amit teaches that “[w]hen the home coaxial cables are connected to a local or regional CATV network, the HomeCN is done in an out-of-band frequency (i.e. band that is not in use, e.g. **above 860 MHz**).” DISH-1005, 3:24-30.

311. Like the ’249 patent and Amit, Jacobsen teaches of using a frequency above the cable television band. Jacobsen teaches that “[s]ome CATV networks can also have high-frequency attenuation reduced by the installation of equalizing diplex amplifiers that can **boost the usable spectrum to 1 GHz**.” DISH-1007, 305. A POSITA would have understood that boosting the usable spectrum to 1 GHz involves using a frequency for communicating that is above the cable television band. For example, communicating from 860 MHz to 1 GHz is using a frequency that is above the cable television band.

312. For the reasons discussed above, Amit-Jacobsen therefore renders obvious claim 8.

9) Dependent Claim 12

12. The network of claim 10 wherein the equalization is time domain equalization.

313. It is my opinion that the combination of Amit-Jacobsen renders obvious this claim.

314. As I explained above with respect to claim 10, Amit-Jacobsen teaches how the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals.

315. As I also explained with respect to claim element [10.c.iii], it would have been obvious to implement Jacobsen's technique of "implementing a **time-domain equalizer (TEQ)**, the purpose of which is to reduce the required length of the cyclic prefix in exchange for an increase in system complexity" into Amit. DISH-1007, 309.

316. For the reasons discussed above, Amit-Jacobsen therefore renders obvious claim 12.

10) Dependent Claim 13

13. The network of claim 10 wherein the equalization is adaptive.

317. It is my opinion that the combination of Amit-Jacobsen renders obvious this claim.

318. As I explained above with respect to claim 10, Amit-Jacobsen teaches

how the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals.

319. Amit-Jacobsen further renders obvious that the equalization described in claim 10 can be adaptive equalization. Jacobsen "note[s] that by using a **decision feedback equalizer (DFE) instead of a linear equalizer**, the complexity of the single-carrier system might be reduced slightly with respect to the MMSE-LE case because only the feedforward filter would need to run at the T/2 rate." DISH-1007, 310. A POSITA would have understood that a decision feedback equalizer is an example of an adaptive equalizer (*i.e.*, one that adapts to changing conditions as opposed to being linear). By taking into account feedback regarding the distortion of previously transmitted symbols, instead of simply being a linear equalizer, the decision feedback equalizer adapts to varying characteristics of the channel, making it adaptive.

320. For the reasons discussed above, Amit-Jacobsen therefore renders obvious claim 13.

11) Dependent Claims 14 and 16

14. The network of claim 13 wherein the terminal devices use orthogonal frequency division multiplexing (OFDM) modulation to overcome the communication channel impairments caused by the reflected signals.

16. The network of claim 10 wherein the terminal devices use

orthogonal frequency division multiplexing (OFDM) modulation to overcome the communication channel impairments caused by the reflected signals.

321. It is my opinion that the combination of Amit-Jacobsen renders obvious these claims.

322. As I explained above with respect to claim element [5.a.ii], Amit-Jacobsen renders obvious that the terminal devices use OFDM modulation.

323. As I also explained above with respect to claims 3 and 4, Amit-Jacobsen also teaches of using OFDM modulation "to overcome frequency the communication channel impairments caused by the reflected signals."

324. For the reasons discussed above, Amit-Jacobsen therefore renders obvious claims 14 and 16.

D. [GROUND 4] – Amit in view of Jacobsen and DSL-Book (claims 2, 3, 7, 9-13, 15, 17)

1) DSL-Book Overview

325. DSL-Book is a textbook with a copyright date of 1998 that is titled "DSL: Simulation Techniques and Standards Development for Digital Subscriber Line Systems." DISH-1008, Cover.

326. DSL-Book teaches its readers that "[w]ith the advanced development of computer and consumer electronics, traditional telephone subscribers are ready for new services based on digital technologies," and as a result, "there will be a stronger need by consumers to access the Internet for telecommunication,

shopping, and 'infotainment.'" DISH-1008, 3. DSL-Book recognizes that one "limiting factor in integrating consumers to the evolving high-speed digital communication network … can be overcome with the Digital Subscribe Line (DSL) technology," which "can utilize the full potential of a copper telephone subscriber loop." *Id.*, 4.

327. DSL-Book also provides "a collection of simulation/implementation techniques and reference materials for the design and development of DSL systems." *Id.*, 12. The teachings of DSL-Book are not limited to DSL systems, however, as DSL-Book recognizes that "[m]any techniques developed for DSLs can be very useful also for next-generation communication systems, such as a high-throughput home digital network." *Id.* DSL-Book explains that it "also can be used a reference guide" to "research studies in digital communication systems." *Id.*

328. DSL-Book is one of two textbooks referenced in the specification of the '249 patent because it covers "OFDM system architecture." DISH-1001, 8:55-60.

2) Further Combining DSL-Book with the Amit-Jacobsen Combination

329. It is also my opinion that a POSITA would have been motivated to modify the Amit-Jacobsen combination to also incorporate the teachings of DSL-Book with a reasonable expectation of success.

330. A POSITA would have been motivated to incorporate into the Amit-

Jacobsen combination the: (1) OFDM techniques, (2) equalization techniques; (3) time division duplex protocol, and (4) forward error correction of DSL-Book.

331. A POSITA seeking to improve the coaxial cable network of Amit-Jacobsen would have been familiar with communications textbooks such as DSL-Book because all three references are analogous art from the same field of endeavor as the '249 patent (*i.e.*, communication techniques for use in broadband networks) and all three references are reasonably pertinent to the problems identified in the specification of the '249 patent, which are "port-to-port isolation and providing a suitable signal path for terminal-to-terminal communication in a coaxial cable wired building." DISH-1001, 3:4-7. Indeed, the '249 patent references DSL-Book as covering "OFDM system architecture," which also further shows DSL-Book is in the same field of endeavor as the '249 patent and the Amit and Jacobsen references. DISH-1001, 8:55-60. And Amit, Jacobsen, and DSL-Book each recognize that the Internet and consumer and entertainment services are motivators for high-speed network communications. DISH-1005, 2:39-40; DISH-1007, 305; DISH-1008, 12.

332. A POSITA reading Amit's and Jacobsen's teachings about coaxial networks would have been motivated to improve such networks with methods used in non-coaxial networks, as all three articles demonstrate the overlap between coaxial and non-coaxial networks. Unlike the prior art coaxial networking solution,

which "[i]nterferes with VDSL," Amit's network has "[n]o interferes." DISH-1005, 28:67. Moreover, Amit recognizes that "[t]here are several home networking solutions that have already been proposed, including networking over the existing telephone wiring …, networking over the existing power lines, … and solutions that require new wiring, such as … CAT 5 Ethernet wiring." *Id.*, 1:31-37. Amit also acknowledges that "[h]ome networks will connect between computing devices … and modems (**such as cable modems, DSL modems**, and PSTN modems) that connect the home outside." *Id.*, 1:18-25. A POSITA would thus be motivated to look at teachings about all types of home networks, including the copper-based networks described in ADSL/VDSL.

333. Jacobsen itself cites to an article titled "Computationally Efficient Adaptive Transceiver for HighSpeed **Digital Subscriber Lines**" as providing "more information on multicarrier modulation and DMT." DISH-1007, 307, 312. Likewise, DSL-Book recognizes that "[m]any techniques developed for DSLs can be very useful also for **next-generation communication systems, such as a high-throughput home digital network**," and DSL-Book "also can be used a reference guide" to "research studies in digital communication systems." DISH-1008, 12.

334. A POSITA would also have been motivated to combine the teachings of Amit and Jacobsen with DSL-Book because all three references seek to overcome network communication channel impairments, including the problems

identified in the specification of the '249 patent, which are "port-to-port isolation and providing a suitable signal path for terminal-to-terminal communication in a coaxial cable wired building." DISH-1001, 3:4-7. The relevant disclosures from Amit and Jacobsen are discussed in their motivation to combine section, and DSL-Book similarly recognizes that while "[t]he usable bandwidth of a twisted-pair telephone subscriber loop is much wider than the voice band telephony channel," "the channel distortion is also more severe for using the full available bandwidth." DISH-1008, 149. "Specifically, amplitude attenuation and phase delay could be very different at different frequency regions within the available bandwidth." *Id.* Like Amit and Jacobsen, DSL-Book describes techniques to overcome communication channel impairments and provide a suitable path for terminal-to-terminal communication via, *e.g.*, equalization. *See id.*, 149-50.

335. DSL-Book further builds upon the concepts already discussed in Amit and Jacobsen, including OFDM, Equalization, TDD, and FEC, and for at least that reason, a POSITA would have been motivated to use a textbook like DSL-Book for additional details on implementing these concepts.

336. The paragraphs below provide further examples of the motivation to combine specific teachings of ADSL/VDSL with Amit's coaxial home network.

337. A POSITA would have been motivated to improve the bit rate of the network of Amit-Jacobsen using DSL-Book's teachings of OFDM modulation. As

discussed in previously, a POSITA would have been motivated to improve the FDM and the QAM modulation of Amit to arrive at Jacobsen's single carrier QAM modulation with equalization or multicarrier modulation, both of which build upon QAM. A POSITA would have been further motivated to implement the additional OFDM teachings of DSL-Book. Like Jacobsen, DSL-Book teaches that DMT "is a multi-carrier system," where "[t]he spectrum of a DMT signal consists of many narrow bandwidth QAM-like carriers with different and equally distributed carrier frequencies." DISH-1008, 436-37. Moreover, "[e]ach multibit subchannel can use a QAM signal constellation." *Id.*, 438.

338. The earlier motivation to combine section also discussed how Amit and Jacobsen each recognize that reflections can cause frequency selective channel impairments, and DSL-Book similarly recognizes and addresses how to overcome communication channel impairments. DSL-Book explains that "the channel distortion can be avoided by a DMT system through the fine division of the available bandwidth into many subcarriers such that each subchannel is almost distortion free." DISH-1008, 439. Like Amit and Jacobsen, DSL-Book recognizes that "channel distortion could cause inter-subchannel interference," which "is caused by amplitude attenuation and phase delay differences between sub-channels." *Id.*, 440. DSL-Book teaches that "[o]ne way to improve the transmission efficiency … is to assign a different signal power for each

subchannel" in the OFDM signal. *Id.*, 443. A POSITA would have thus been motivated to improve the modulation of the terminal devices of Amit-Jacobsen using the teachings of DSL-Book.

339. Much like OFDM, a POSITA would have looked to the equalization teachings in DSL-Book so the terminal devices of Amit-Jacobsen could more efficiently use the network. In the same section where DSL-Book addresses channel distortion and OFDM, DSL-Book also explains that "inter-subchannel interference can be minimized … by using a channel equalizer." DISH-1008, 440. As discussed in their motivation to combine section, Amit and Jacobsen both recognize that reflections can cause frequency selective channel impairments and that frequency resources are limited, and DSL-Book similarly recognizes that the limitations of a communications channel can be overcome by using techniques such as equalization. A POSITA would have thus been motivated to add the equalizers of DSL-Book to the terminal devices of Amit-Jacobsen.

340. A POSITA would have been motivated to look to the details of DSL-Book for ways implement the FEC referenced in Amit.

341. Amit teaches that its network has "FEC (Forward Error Correction) [that] MUST support R-S (Reed Salomon [*sic*])." DISH-1005, 8:40-44. DSL-Book provides additional details of such FEC, including that "Trellis and forward error correction coding techniques had been introduced in conjunction with the Discrete

MultiTone (DMT) line code to improve the transmission performance under the crosstalk and impulse noise environment." DISH-1008, 428.

342. A POSITA would also be motivated to use FEC to efficiently utilize the limited networking resources for the reasons described in the preceding paragraphs dealing with equalization.

343. A POSITA would have thus been motivated to increase the capabilities of the terminal devices of Amit-Jacobsen by implementing FEC as taught in DSL-Book.

344. Similar to FEC, a POSITA would have been motivated to look to DSL-Book for additional details of implementing the TDD. Amit teaches that "[t]here are some known methods to allocate channels for each home-network," including "TDM-Time Domain Multiplexing," which "[r]equires synchronization." DISH-1005, 26:1-45. DSL-Book similarly teaches of duplex communications where "[t]he transmission direction can also be **time divided**: transceivers at both ends are synchronized and take turns transmitting," which "is sometimes called … **Time Division Duplex (TDD)**." DISH-1008, 91. DSL-Book also explains how to achieve such synchronization. *Id.*, 443-44.

345. A POSITA would also be motivated to use TDD to efficiently utilize the limited networking resources for the reasons described in the preceding paragraphs dealing with equalization.

346. A POSITA would thus be motivated to increase the capabilities of the terminal devices of Amit by implementing TDD as taught in DSL-Book.

347. A POSITA would have had a reasonable expectation that the Amit-Jacobsen-DSL-Book combination would produce a successful outcome.

348. OFDM and equalization are already taught in the Amit-Jacobsen combination, so for that reason alone, a POSITA would have a reasonable expectation of success in implementing the additional details of OFDM and equalization that are taught by DSL-Book.

349. Moreover, when contemplating the network of Amit-Jacobsen, a POSITA would have had a reasonable expectation of successfully incorporating the teachings from textbooks like DSL-Book, which discusses similar networks capable of delivering high-speed data and the corresponding methods of implementing such a network. *Id*. A POSITA would also had a reasonable expectation of success in implementing techniques from the high-speed networks that Amit and Jacobsen explicitly refer to, including the DSL networks described in DSL-Book. DISH-1005, 1:18-25, 1:31-37, 28:67; DISH-1007, 312, n.5.

350. Given the teachings of using QAM in Amit and Jacobsen, the notion of building upon QAM and implementing multitone modulation (OFDM) or single carrier modulation with QAM, as described in Jacobsen and DSL-Book, would have been straightforward from a POSITA's perspective. Likewise, a POSITA

would have expected DSL-Book's teachings of OFDM modulation to work in the context of the Amit-Jacobsen network, which already employed OFDM. Implementing the OFDM details of DSL-Book would have been within the skill level of a POSITA because it and similar modulation techniques are taught/used in a variety of engineering, science, and/or math courses that a POSITA would have taken and because QAM and OFDM are both well-known in the art.

351. Likewise, given the discussions of limited networking resources and varying channel conditions in Amit and Jacobsen, the idea of using an equalizer to optimize or nearly optimize transmission and accommodate different types of channels and noise environments would have been straightforward from a POSITA's perspective. A POSITA would also have expected DSL-Book's equalization techniques to work in the network of Amit-Jacobsen, as both references recognize that varying channel conditions can necessitate techniques to improve communications. DISH-1005, 8:30-32. Moreover, a POSITA would have been able to implement the equalizers of DSL-Book because the use of such equalizers is common in the work of a POSITA and is also part of the engineering courses that a POSITA would have taken.

352. For these same reasons, a POSITA would have had a reasonable likelihood of success in implementing the FEC and TDD communication techniques of DSL-Book into the network of Amit-Jacobsen. *Id.* Moreover, Amit

refers to these techniques, and a POSITA would look to the DSL-Book textbook for additional details on implementing them. *Id.*

353. The Amit-Jacobsen-DSL-Book combination would also have yielded predictable results. As described above, DSL-Book's modulation techniques build upon QAM, so implementing them into the Amit-Jacobsen system, which already uses QAM, would have yielded predictable results. Adding equalization to the terminal devices would have also yielded predictable results, as equalizers are commonly used in communications devices like the terminal devices of Amit-Jacobsen. Finally, implementing FEC and TDD in the Amit-Jacobsen system would have yielded predictable results because these techniques are already referenced in Amit.

3) Independent Claim 10

354. It is my opinion that the combination of Amit-Jacobsen-DSL-Book renders obvious this claim. As I discussed above, Amit-Jacobsen alone renders obvious each limitation of claim 10, and claim element [10.c.iii] is also taught by Amit-Jacobsen-DSL-Book, as described below.

[10.c.iii] "wherein the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals."

355. It is my opinion that that Amit-Jacobsen-DSL-Book renders obvious this limitation.

356. The DSL-Book textbook teaches that "channel distortion could cause inter-subchannel interference," which "is caused by amplitude attenuation and phase delay differences between subchannels," but "[t]he inter-subchannel interference can be **minimized** by selecting a lower baud rate or **by using a channel equalizer**." DISH-1008, 440.

357. As I discussed with respect to claim element [10.c.iii] above, Amit and Jacobsen both recognize how the reflections from the filter can cause frequency selective channel impairments, such as ripple. I also explained how these impairments can be overcome using the equalization described above, and how such equalization restores a flat frequency response.

358. As a result, and for the reasons discussed above regarding motivations to combine, it is my opinion that Amit-Jacobsen-DSL-Book renders this limitation obvious.

4) Dependent Claim 11

11. The network of claim 10 wherein the equalization is frequency domain equalization.

359. It is my opinion that the combination of Amit-Jacobsen renders obvious this claim.

360. As I explained above with respect to claim 10, Amit-Jacobsen-DSL-Book teaches how the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel

impairments caused by the reflected signals.

361. DSL-Book also teaches that "[t]o complete the received signal detection, a Frequency-Domain Equalizer is also required." DISH-1008, 442. DSL-Book explains that "[t]he purpose of the Frequency-Domain Equalizer (FEQ) is to correct phase and amplitude distortion of each subchannel such that a unified symbol detection mechanism can be applied to all subchannels." *Id.*

362. For the reasons discussed above, Amit-Jacobsen-DSL-Book therefore renders obvious claim 11.

5) Dependent Claim 12

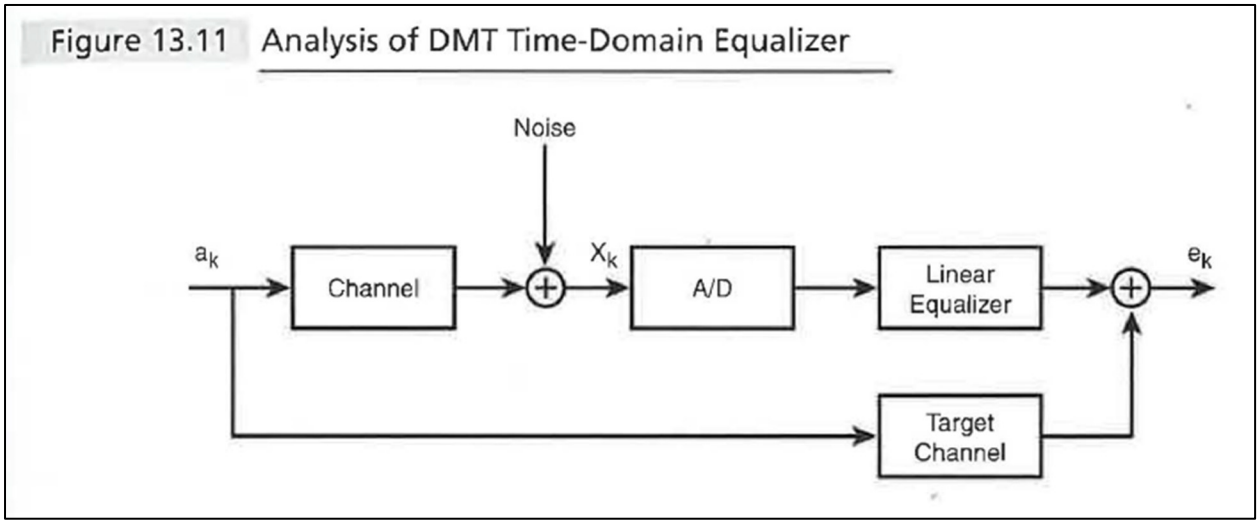
12. The network of claim 10 wherein the equalization is time domain equalization.

363. It is my opinion that the combination of Amit-Jacobsen renders obvious this claim.

364. As I explained above with respect to claim 10, Amit-Jacobsen-DSL-Book teaches how the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals.

365. DSL-Book also teaches that "[a] time domain channel equalizer is necessary for the DMT receiver to reduce the amount of channel distortion present in the subscriber loop environment." DISH-1008, 441. DSL-Book elaborates that "[a] DMT Time Domain Equalizer can modify the loop channel response to the

target channel response, as shown in Figure 13.11." *Id.*



366. For the reasons discussed above, Amit-Jacobsen-DSL-Book therefore renders obvious claim 12.

6) Dependent Claim 13

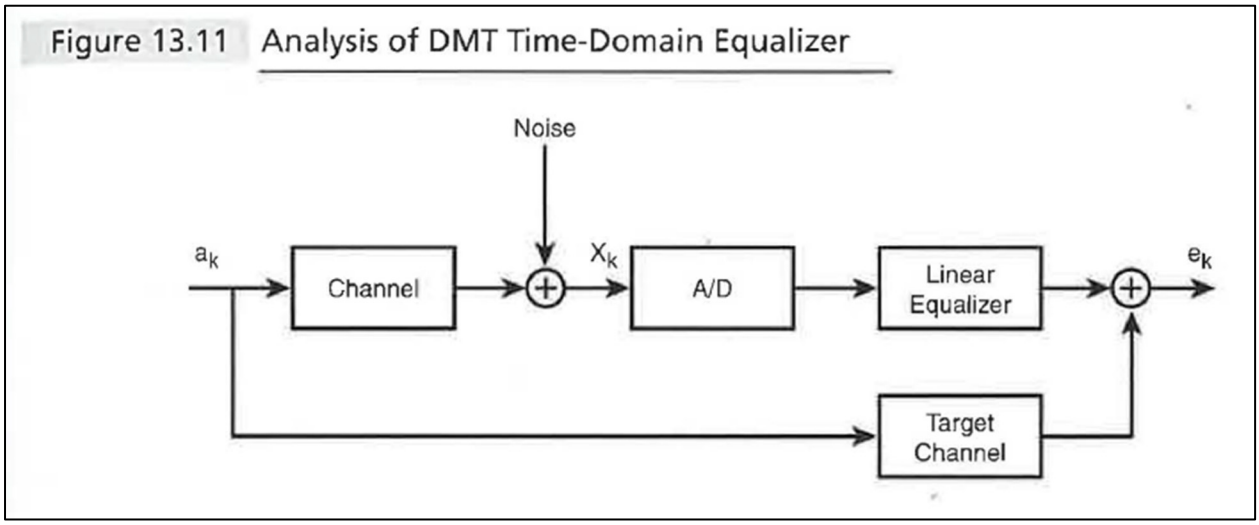
13. The network of claim 10 wherein the equalization is adaptive.

367. It is my opinion that the combination of Amit-Jacobsen renders obvious this claim.

368. As I explained above with respect to claim 10, Amit-Jacobsen-DSL-Book teaches how the terminal devices perform equalization on the received signal that restores a flat frequency response to overcome communication channel impairments caused by the reflected signals.

369. As explained above with respect to claim 12, DSL-Book also teaches that "[a] DMT Time Domain Equalizer can modify the loop channel response to the target channel response, as shown in Figure 13.11." DISH-1008, 441. DSL-

Book further explains that "[i]n practice, DMT Time-Domain Equalizer coefficients are identified iteratively in real-time in frequency or time domain." *Id.*



370. A POSITA would have understood that an equalizer whose coefficients are identified iteratively in real-time is an adaptive equalizer.

371. For the reasons discussed above, Amit-Jacobsen-DSL-Book therefore renders obvious claim 13.

7) Dependent Claims 2, 9, and 17

2. The signal distribution network of claim 1, wherein at least one of the communication channels between terminal devices uses time division duplex protocol for communications and the communications are synchronized by broadcasting a beacon message on the network.

9. The broadband local area network of claim 5, wherein at least one of the communication channels between terminal devices uses time division duplex protocol for communications and the communications are synchronized by broadcasting a beacon message on the network.

17. The broadband local area network of claim 10, wherein at least one of the communication channels between terminal devices uses time division duplex protocol for communications and the communications

are synchronized by broadcasting a beacon message on the network.

372. It is my opinion that the combination of Amit-Jacobsen-DSL-Book renders obvious these claims. As I explained above with respect to claim 2, it is my opinion that Amit renders obvious claim 2, and this claim is also taught by Amit-Jacobsen-DSL-Book, as described below.

373. Like Amit, DSL-Book teaches of duplex communications where "transmission was carried out only in one direction … at a given time," so the transmission direction is "regulated through some handshake protocol whenever a transceiver at one end has data to transmit." DISH-1008, 91. In the duplex communications described, "[t]he transmission direction can also be **time divided**: transceivers at both ends are synchronized and take turns transmitting," which "is sometimes called … **Time Division Duplex (TDD)**." *Id.*

374. DSL-Book also teaches of synchronizing communications on the network by broadcasting a beacon message. DSL-Book refers to one type of beacon message known as a "pilot tone." DSL-Book teaches that "[t]he clock synchronization between a DMT transmitter and a DMT receiver is maintained through a timing recovery circuit in at least one transmission direction." *Id.*, 443. DSL-Book then explains that "[t]he timing recovery circuit of a DMT system involves **the transmission of a pilot tone** at the clock source end and the recovery of the pilot tone at the other end." *Id.*

375. A POSITA would have been familiar with pilot tones, as further explained above in my prior discussion of claim 2, and a POSITA would have understood that the pilot tone of DSL-Book could function as the beacon signal of claim 2. The teachings of DSL-Book support this understanding, as DSL-Book indicates that its pilot tone is a beacon message by describing it as "a subcarrier **dedicated only for the purpose of timing recovery**" where "[t]he transmit power … may actually be more than the nominal transmit power of the information bearing subcarriers." *Id.*, 443-44.

376. For the reasons discussed above, Amit-Jacobsen-DSL-Book therefore renders obvious claims 2, 9, and 17.

8) Dependent Claims 3 and 7

3. The signal distribution network of claim 2, 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 caused by the reflections from the filter.

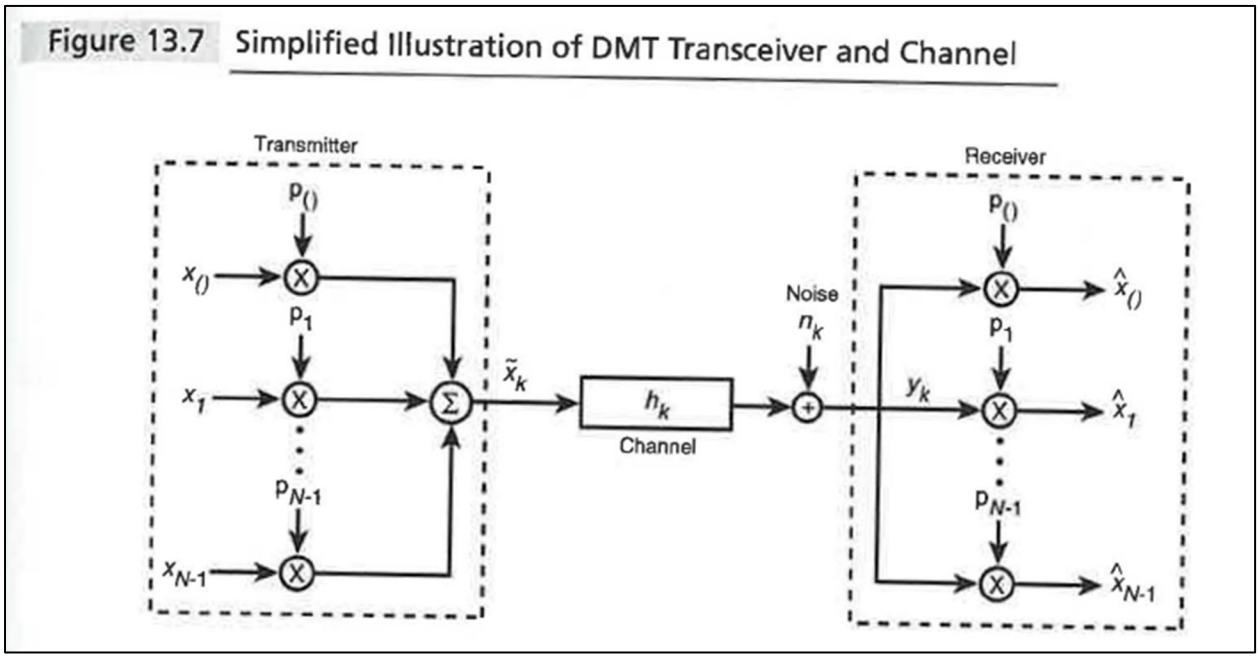
7. The broadband local area network of claim 5, wherein the power level of each OFDM carrier is adjusted according to the signal loss at each OFDM carrier frequency to overcome frequency selective channel impairments present in the coaxial building wiring caused by the reflections from the filter.

377. It is my opinion that the combination of Amit-Jacobsen-DSL-Book renders obvious these claims.

378. As I explained above with respect to claim element [5.a.ii], Amit-Jacobsen renders obvious that each terminal device communicates with other

terminal devices using OFDM modulation.

379. DSL-Book similarly teaches of using OFDM. DSL-Book teaches of using "Discrete MultiTone (DMT) line code to improve the transmission performance under the crosstalk and impulse noise environment." DISH-1008, 428. DSL-Book explains that "[t[he DMT line code is a multi-carrier system," where "[t]he spectrum of a DMT signal consists of many narrow bandwidth QAM-like carriers with different and equally distributed carrier frequencies," as shown in Figure 13.7 below. *Id.*, 436-37.



380. DSL-Book further teaches that the power level of each OFDM carrier is adjusted according to the signal loss at each OFDM carrier frequency. DSL-Book explains that "[b]ased on the Signal to Noise Ratio (SNR) of each subchannel, the number of bits that can be transmitted through each subchannel for

certain error probability can be calculated as follows:"

$$b_j = \log_2\left(1 + \frac{SNR_j}{\Gamma}\right)$$

381. According to DSL-Book, "[t]he SNR_j is expressed in power ratio," where "Γ for an error rate of 10^{-7} is 9.8 dB or 9.55 in terms of power ratio." *Id.*, 442. DSL-Book teaches that "[o]ne way to **improve the transmission efficiency** with integer number of bits is to **assign a different signal power for each subchannel**." *Id.*, 443. By assigning different signal power for each subchannel, DSL-Book explains that "[u]p to 1 dB of performance improvement can be achieved by using these advanced loading algorithms." *Id.*

382. As I also explained above, the '249 patent explains that carriers or frequency channels used in multicarrier modulation are sometimes referred to as frequency bins. DISH-1001, 8:42-43. A POSITA would have therefore understood that the subchannels referred to in DSL-Book are the same as the carriers of the '249 patent.

383. As I explained above with respect to claim element [10.c.iii], Amit and Jacobsen each recognize how the reflections from the filter can cause frequency selective channel impairments. As described in the paragraphs above, Amit-Jacobsen-DSL-Book teaches how to overcome these impairments by adjusting the power level of each OFDM carrier according to the signal loss at

each OFDM carrier frequency.

384. For the reasons discussed above, Amit-Jacobsen-DSL-Book therefore renders obvious claims 3 and 7.

9) Dependent Claim 15

15. The network of claim 14 wherein the terminal devices use forward error correction to recover the transmitted signals without errors.

385. It is my opinion that the combination of Amit-Jacobsen renders obvious this claim.

386. A POSITA would have understood that two common types of forward error correction are Reed-Solomon error correction and convolutional coding error correction. This is further supported by the ’249 patent, which teaches that “[v]arious types of forward error correction can be applied to transmitted data blocks, such as Reed-Solomon and convolutional coding.” DISH-1001, 8:44-47.

387. As I explained above, Amit teaches of using forward error correction. Like the ’249 Patent, Amit teaches that “FEC (Forward Error Correction) MUST support R-S (Reed Salomon [*sic*]) T=0,10” and “MAY support R-S (Reed Salomon) T=0, . . . ,10.” DISH-1005, 8:40-44.

388. Similarly, DSL-Book teaches that “Trellis and forward error correction coding techniques had been introduced in conjunction with the Discrete MultiTone (DMT) line code to improve the transmission performance under the crosstalk and impulse noise environment.” DISH-1008, 428. According to DSL-

Book, “FEC of ADSL employs Reed-Solomon,” and “[t]o accommodate maximum flexibility for the providers and end users of ADSL services, it was recommended that FEC be selectively applied to 32 kbps increments of the composite data streams to, or from, the Central Office.” *Id.*, 446.

389. For the reasons discussed above, Amit-Jacobsen-DSL-Book therefore renders obvious claim 15.

VIII. ADDITIONAL REMARKS/CONCLUSION

390. I currently hold the opinions expressed in this Declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

391. I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code. I declare under penalty of perjury that the foregoing is true and correct.

Dated: 01-16-2024



Scott Acton