

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Anton Monk et al.
U.S. Patent No.: 7,295,518 Attorney Docket No.: 45035-0025IP1
Issue Date: November 13, 2007
Appl. Serial No.: 10/322,834
Filing Date: December 18, 2002
Title: BROADBAND NETWORK FOR COAXIAL CABLE
USING MULTI-CARRIER MODULATION

**DECLARATION OF TIM A. WILLIAMS, PH.D. IN SUPPORT OF DISH'S
PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 7,295,518**

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CHALLENGED CLAIMS

Claim Language – Claim 1	
[1pre]	1. A data communication network comprising:
[1a.i]	at least two network devices,
[1a.ii]	each network device comprising a multi-carrier modulator for modulating data, an up converter for translating the modulated data to an RF carrier frequency, a down converter for translating an RF signal, and a multi-carrier demodulator for demodulating the translated RF signal to produce data; and
[1b]	cable wiring comprising a splitter with a common port and a plurality of tap ports, and a plurality of segments of coaxial cable connecting between the splitter tap ports and the network devices;
[1c]	whereby network devices communicate with each other through the cable wiring using multi-carrier signaling;
[1d.i]	wherein network devices transmit probe messages through the cable wiring and analyze received probe message signals to determine channel characteristics
[1d.ii]	and bit loading is selected based on the determined channel characteristics.

Claim Language – Claim 3	
[3a]	The data communication network of claim 1 wherein the network shares the cable wiring with a cable television service
[3b]	and the network device up converter translates the modulated data to an RF carrier frequency above the frequency used by the cable television service.

EXHIBIT LIST

DISH-1001	U.S. Patent No. 7,295,518 to Monk et al. (“the ’518 Patent”)
DISH-1002	Excerpts from the Prosecution History of the ’518 Patent (“the ’518 Patent Prosecution History”)
DISH-1005	Tim A. Williams’s Curriculum Vitae and Case History
DISH-1006	Declaration of June Munford
DISH-1007	U.S. Patent App. Pub. No. 2002/0069417 to Kliger et al. (“Kliger”)
DISH-1008	U.S. Provisional Application No. 60/229,263 to Kliger et al. (“’263-Provisional”)
DISH-1009	U.S. Provisional Application No. 60/230,110 to Kliger et al. (“’110-Provisional”)
DISH-1010	U.S. Provisional Application No. 60/275,060 to Kliger et al. (“’060-Provisional”)
DISH-1011	U.S. Provisional Application No. 60/291,130 to Kliger et al. (“’130-Provisional”)
DISH-1012	U.S. Provisional Application No. 60/297,304 to Kliger et al. (“’304-Provisional”)
DISH-1013	Int’l Pub. No. WO 1998/010545 to Isaksson et al. (“Isaksson”)
DISH-1014	U.S. Patent No. 7,127,734 to Amit et al. (“Amit”)
DISH-1015	U.S. Provisional Application No. 60/128,810 to Amit et al. (“Amit-Provisional”)
DISH-1016	Jacobsen et al., <i>An Efficient Digital Modulation Scheme for Multimedia Transmission on the Cable Television Network</i> ,

43rd Annual National Cable Television Association Convention and Exposition, New Orleans, LA. 1994 (“Jacobsen”)

- DISH-1017 Excerpts from Robert M. Gagliardi, *Introduction to Communications Engineering*, 2d ed., 1988 (“Gagliardi”)
- DISH-1018 U.S. Patent No. 5,822,372 to Emami (“Emami”)
- DISH-1019 Excerpts from Shlomo Ovadia, *Broadband Cable TV Access Networks*, 1d ed., March 2001 (“Ovadia”)
- DISH-1020 U.S. Patent No. 5,488,632 to Mason et al. (“Mason”)
- DISH-1021 Excerpts from Walter Y. Chen, *DSL: Simulation Techniques and Standards Development for Digital Subscriber Lines*, 1998 (“DSL Simulation Techniques”)
- DISH-1022 Excerpts from Dennis J. Rauchmayer, *ADSL/VDSL Principles*, 1999 (“ADSL/VDSL Principles”)
- DISH-1023 Jacobsen, Krista S., *Synchronized Discrete Multi-Tone (SDMT) Modulation for Cable Modems: Making the Most of the Scarce Reverse Channel Bandwidth*, WESCON/97 Conference Proceedings, Santa Clara, CA, USA, 1997 (“Jacobsen2”)
- DISH-1024 U.S. Patent No. 6,771,706 to Ling et al. (“Ling”)

DECLARATION OF TIM A. WILLIAMS

I, Tim A. Williams, declare:

I. QUALIFICATIONS AND BACKGROUND INFORMATION

1. I am an independent consultant. All of my opinions stated in this declaration are based on my own personal knowledge and professional judgment. In formulating my opinions, I have relied upon my knowledge, training, and experience in the relevant art.

2. I am over 18 years of age, and, if I am called upon to do so, I would be competent to testify as to the matters set forth herein. Although my qualifications are stated more fully in my curriculum vitae (DISH-1005), I provide below a brief summary of my qualifications.

3. I earned a Bachelor of Science degree in Electrical Engineering (BSEE) from Michigan Technological University in 1976. In 1982, I earned a Master's degree, also in Electrical Engineering (MSEE), from the University of Texas at Austin. I earned a Doctor of Philosophy (Ph.D.), also from the University of Texas at Austin, in 1985. My doctorate dissertation was "Digital Signal Processing Techniques for Acoustic Log Data." In 1991, I earned a Master of Business Administration degree from the University of Texas at Austin as well.

4. I have over 40 years of professional experience in wireless communications and telecom technology, including roles in large corporations as well as start-ups and consulting work.

5. For example, from 1979 through 1991, I held the positions of Senior Engineer, Senior Member of the Technical Staff, and Member of the Technical Staff at Motorola, Inc. My work at Motorola included serving as business manager, project leader, and senior technical member for projects relating to the development of various cellular modems, transceivers, and transcoders.

6. As another example, in 1991, I co-founded Wireless Access, Inc., a start-up company focused on the Narrow Band PCS equipment market and which developed the over-the-air protocols, subscriber equipment, and integrated circuits to deploy 2-way paging services. I held the positions of Co-Founder, Chief Technical Officer, Vice President of Engineering, and Vice President of Business Strategy at Wireless Access until it was sold to Glenayre Electronics in 1998.

7. As another example, between 1998 and 2000, I was the Chief Technology Officer and Advisory Board Member of Picazo Communications, which built and sold software PBXs Telephony equipment using VoIP and Circuit Switched Technologies.

8. As another example, in 2004, I founded DoceoTech Inc., which provides training for engineers in Wireless, Networking, and Telephony technologies. Since 2004, I have served as DoceoTech's Chairman.

9. I hold over 25 United States patents in wireless and signal processing technology, as well as numerous patent applications in the same field.

Additionally, I am a Patent Agent registered with the U.S. Patent and Trademark Office since January 2002. Further, I have served as a technical expert in multiple patent proceedings.

10. These and other professional experiences, as well as other qualifications are described in my CV (DISH-1005).

11. I have been retained on behalf of DISH to analyze and offer technical opinions relating to U.S. Patent No. 7,295,518 ("the '518 patent") and prior art references relating to its subject matter. In forming my opinions, I read and considered the '518 patent, its prosecution history, and the exhibits cited in the Exhibit List.

12. I have no financial interest in any party to this proceeding or in the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis. My compensation is not dependent on the outcome of these proceedings or the content of my opinions.

13. For any testimony I may give in this matter, I may use some or all of the documents and information cited to, referred to, and identified in this declaration, as well as any additional materials that are entered into evidence in this proceeding. Figures that appear within this document have been prepared with the assistance of Counsel and present my understanding of the '518 Patent and the prior art discussed below.

II. LEGAL PRINCIPLES

A. Obviousness

14. 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 (A) the scope and content of the prior art, (B) the differences between the prior art and the claims, (C) the level of ordinary skill in the art, and (D) 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.

15. I understand that the application that would issue as the '518 patent was filed on December 18, 2002 and that that application claims priority to several provisional applications, the earliest of which was filed on August 30, 2001.

16. For purposes of my analysis and because I know of no indication from the patent owner or others to the contrary, I have applied a date of August 30, 2001, as the date of invention in my obviousness analyses, although in many cases the same analysis would hold true even at an earlier or later time than August 30, 2001.¹

17. 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.

¹ The earliest-filed application to which the '518 patent claims priority, U.S.

Provisional Application No. 60/316,820, was filed on August 30, 2001.

DISH-1001, Cover.

18. I have been informed that a claim can be obvious if the prior art contained a base device, system, or method upon which the claim can be seen as an improvement; the prior art contained a known technique that is applicable to the base device, system or method; one of ordinary skill in the art would have been capable of applying the known technique to the base device, system, or method that was ready for improvement; and the results of applying the known technique to the base device, system or method would have been predictable to one of ordinary skill in the art.

III. OVERVIEW OF CONCLUSIONS FORMED

19. Based on my review of the materials considered and my knowledge and experience in the telecommunications field, it is my opinion that a person of ordinary skill in the art (“POSITA”) would have found claims 1 and 3 of the ’518 patent obvious at the time of the alleged invention.

20. It is my opinion that a POSITA would have found claims 1 and 3 obvious over Kliger and Isaksson.

21. It is also my opinion that a POSITA would have found claims 1 and 3 obvious over Amit, Jacobsen, and Isaksson.

IV. LEVEL OF ORDINARY SKILL IN THE ART

22. 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 ’518

Patent as of August 30, 2001 would have a degree in electrical engineering, computer engineering, or a related field and experience working in signal processing and/or communication systems/networks, e.g., a bachelor's and three or more years of experience; a master's and at least one year of experience; or a doctorate and some work experience. Additional education could substitute for professional experience, or *vice versa*.

23. For at least the reasons I explained in the sections about my qualifications, I would consider myself to have qualified as a POSITA as of the earliest possible priority date for the '518 patent of August 30, 2001.

V. CLAIM CONSTRUCTION

24. 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).

25. Because I do not know at what date the invention as claimed was made, I have used the earliest possible priority date of the '518 patent as the point in time for claim interpretation purposes. That date is August 30, 2001.²

VI. THE '518 PATENT

A. Summary of the Patent

26. The technology of the '518 patent “relates to broadband communication networks and specifically to communications using coaxial cable building wiring.” *Id.*, 1:27-29. The patent explains that “[a] broadband local area data network uses coaxial cable wiring for interconnection of terminal devices.” *Id.*, Abstract. The network uses multi-carrier modulation “with bit loading ... to overcome channel impairments and provide a path for terminal devices to transmit to and receive from other terminal devices.” *Id.* “Probe messages are sent between devices to characterize the communication channel and determine optimum bit loading.” *Id.*

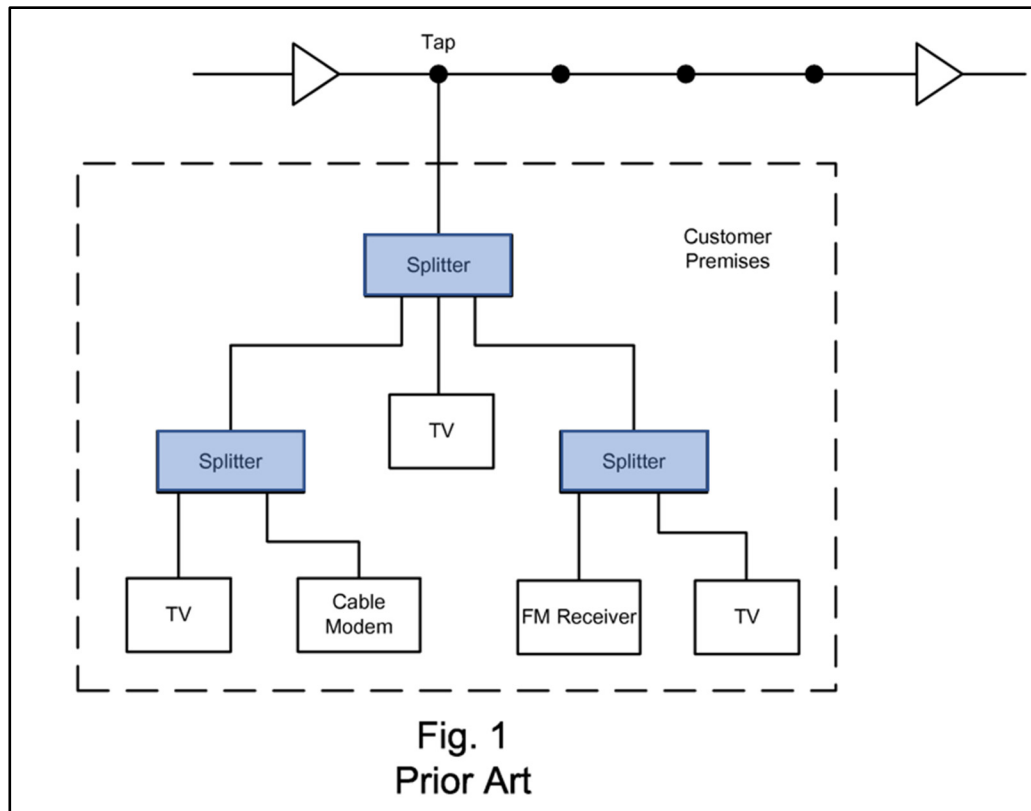
27. It is my opinion that before the priority date of the '518 patent, there were many patents and publications that implemented or described the functionalities claimed in the '518 patent. As a result, the system and methods of the '518 patent were well-known in the art. Moreover, to the extent there was any problem to be

² I understand that DISH is not conceding that this is the priority date of the '518 patent.

solved in the '518 patent, it had already been solved in the prior art before the priority date of the '518 patent.

28. The title of the '518 patent is “Broadband network for coaxial cable using multi-carrier modulation.” *Id.*, Cover. The patent describes how to implement a broadband local area network (LAN) in a residential cable television (CATV) network.

29. Figure 1 of the '518 patent illustrates a conventional CATV network.



'518 Patent, Fig. 1.³

³ Annotations and color added unless otherwise noted.

30. In addition to coaxial cables, the CATV infrastructure includes splitters (blue) that “distribute downstream signals from the point of entry (POE) to the various terminals in the home.” *Id.*, 1:33-45. 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.*, 1:54-57.

31. The ’518 patent recognizes, however, that “signal reflections and tap port isolation of splitters existing in a typical cable TV wiring configuration presents [sic] a problem to shared usage of the cable for a LAN system.” *Id.*, 4:25-28. In particular, the “isolation attenuates signals communicating between tap ports” (*id.*, 2:28-31), while the signal reflections produce “a multipath signal in some or all wiring branches that creates inter-symbol interference (ISI)” (*id.*, 3:7-10). These signal impairments “restrict the ability of terminal devices to communicate with each other.” *Id.*, 4:44-47.

32. As shown in Figure 2, the ’518 patent proposes overcoming the signal impairments by incorporating into the CATV infrastructure network devices (orange) that employ the techniques of multi-carrier modulation and bit-loading. *See id.*, 4:35-47, 8:1-3, Fig. 2.

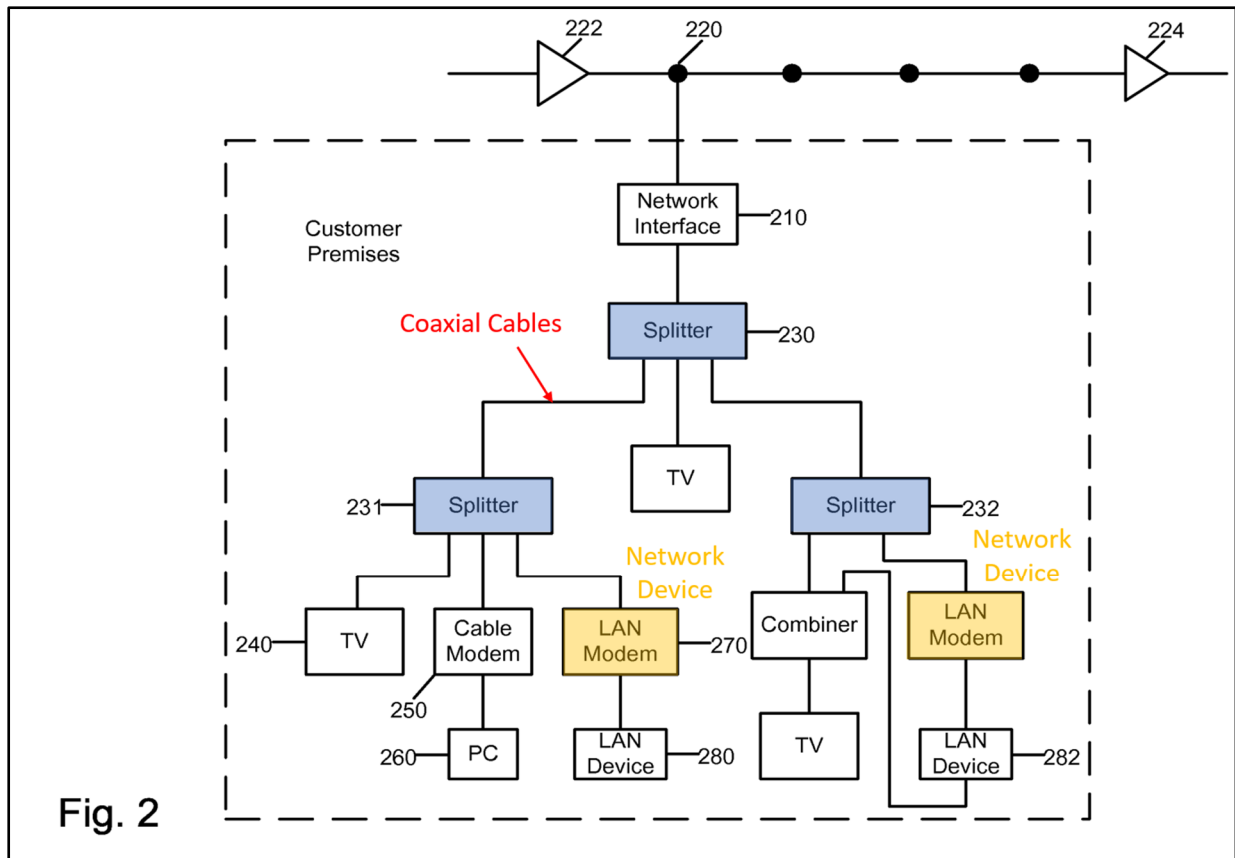


Fig. 2

'518 Patent, Fig. 2.

33. As I explain below, as recognized by the '518 patent itself, multi-carrier modulation and bit-loading were well known in the art before the priority date of the '518 patent. The '518 patent, which also refers to multi-carrier modulation as multi-tone modulation, describes discrete multi-tone (DMT) and orthogonal frequency division multiplexing (OFDM) as example multi-carrier modulation techniques. *See id.*, 7:22-27.

34. Starting with multi-carrier modulation, the '518 patent explains that “[m]ulti-tone modulation uses a set of modulating carriers” for carrying data bits.

Id., 7:22-24; *see also id.*, 7:37-39. For example, “OFDM utilizes quadrature phase shift keying (QPSK) and multi-level quadrature amplitude modulation (QAM) wherein each OFDM carrier can be modulated by an amplitude/phase-varying signal.” *Id.*, 7:27-30. To perform the modulation, “data bits are encoded into a number of ... QAM constellations, which then modulate the respective carriers.” *Id.*, 7:36-38. The modulated carriers are summed together for transmission over the channel. *Id.*, 7:38-40.

35. The number of QAM constellations refers to the number of unique amplitude/phase combinations that are available for a carrier. The number of combinations, in turn, specifies the number of data bits that can be modulated onto the carrier. For example, 16-QAM, which has 16 constellations, can be used to modulate up to 16 bits onto a carrier.

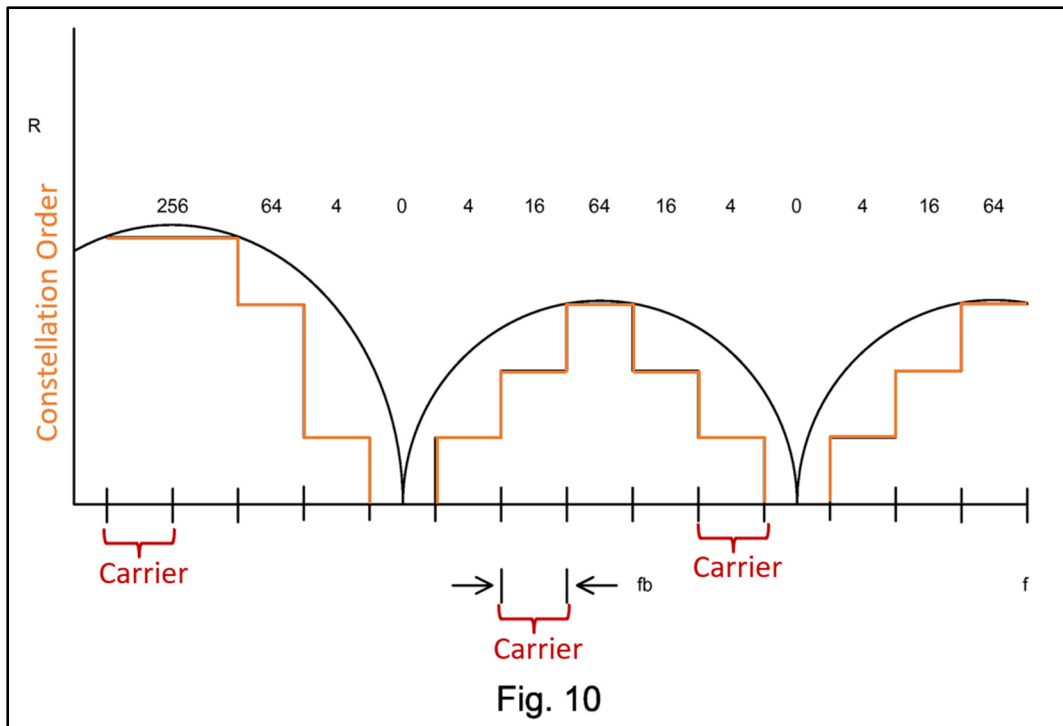
36. Bit-loading is a technique that can be used with multi-carrier modulation. The technique “allocate[es] a higher order signal constellation to carriers that have higher signal to noise ratio and a lower order constellation to carriers that have lower signal to noise ratio.” *Id.*, 8:9-12. “Higher SNR channels can support higher data capacity.” *Id.*, 8:12-13. Thus, “[f]requency bins occupying parts of the channel where the SNR is high can be used to transmit more bits.” *Id.*, 8:13-15. “Each carrier may be modulated with a different order constellation, where higher

SNR frequencies can bear a higher order constellation” (*id.*, 8:15-17), and “[f]requencies with the lower SNR use lower order constellations” (*id.*, 8:18-19).

37. To estimate the channel characteristics, including SNR, “[c]hannel probing messages are transmitted between network devices.” *Id.*, 9:35-41. In particular, “[t]he channel probe uses a predetermined bit sequence which in [sic] known by the receiving device. By passing a known data sequence through the channel, the response of the channel can be determined, including ... SNR profile.” *Id.*

38. As recognized by the ’518 patent itself, as I describe below, these techniques were well known in the art before the priority date of the ’518 patent.

39. The ’518 patent depicts in Figure 10 a bit-loaded OFDM waveform. *Id.*, 10:61, Fig. 10. In Figure 10, each carrier (maroon) is encoded with a constellation order (orange) of 4, 16, 64, or 256 points. *Id.*, 10:65-66. “The level of response through the channel at each frequency bin, which corresponds to the SNR, determines the order of modulation used.” *Id.*, 10:66-11:1. For example, “the higher the channel response in a particular bin, the more information is encoded by using a higher density constellation.” *Id.*, 11:1-3. Further, “[f]requencies [sic] bins located at deep nulls may have insufficient SNR to support a useful signal and are not used. No signal is transmitted in these bins.” *Id.*, 11:3-6.



'518 Patent, Fig. 10.

B. Applicant Admitted Prior Art (AAPA)

40. Throughout the '518 patent, Applicant described the state of the art by referencing and incorporating nearly 20 prior art references. It is my opinion that the AAPA establishes that the '518 patent claims conventional components and functionality. Some of the claimed concepts covered by the AAPA include RF-conversion circuitry, multi-carrier modulation, bit-loading, and probe messaging for channel characterization.

RF-Conversion Circuitry

41. The '518 patent admits to several prior art references that use the claimed RF-conversion circuitry:

U.S. Pat. No. 5,371,548 “System for transmission of digital data using orthogonal frequency division multiplexing”, incorporated herein by reference, issued to Williams discloses an OFDM system for data transmission during the vertical blanking interval of a television signal. U.S. Pat. No. 5,488,632 “Transmission and reception in a hostile interference environment”, incorporated herein by reference, issued to Mason discloses additional techniques for implementing an OFDM modulator and demodulator.

Id., 4:8-19.

Multi-Carrier Modulation

42. The '518 patent recognizes that OFDM system architecture (i.e., multi-carrier 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. *See id.*, 9:28-33. The '518 patent also admits to many prior art

references that use the claimed multi-carrier modulation for signaling on wired

networks, including coaxial networks:

Langlais [U.S. Pat. No. 6,091,932] discloses a two-way data transmission system for communicating between an upstream and downstream unit using OFDM.

U.S. Pat. No. 6,091,932 “Bidirectional point to multipoint network using multicarrier modulation”, incorporated herein by reference, discloses various techniques for implementing OFDM communication. This reference discloses the use of OFDM for communicating between a terminal device and the cable head-end.

U.S. Pat. No. 6,292,651 “Communication system with multicarrier transport distribution network between a head end terminal and remote units” incorporated herein by reference discloses communication between a cable head end and remote units and discloses techniques using OFDM for such communication. U.S. Pat. No. 5,959,967 “Digital transmission system”, incorporated herein by reference, issued to Humphrey discloses an OFDM transmission system used to communicate over a twisted pair loop. U.S. Pat. No. 5,371,548 “System for transmission of digital data using orthogonal frequency division multiplexing”, incorporated herein by reference, issued to Williams discloses an OFDM system for data transmission during the vertical blanking interval of a television signal. U.S. Pat. No. 5,488,632 “Transmission and reception in a hostile interference environment”, incorporated herein by reference, issued to Mason discloses additional techniques for implementing an OFDM modulator and demodulator. U.S. Pat. No. 3,488,445 “Orthogonal Frequency Multiplex Data Transmission System”, incorporated herein by reference, issued to Chang and U.S. Pat. No. 3,511,936 “Multiply Orthogonal System for Transmitting Data Signals Through Frequency Overlapping Channels”, incorporated herein by reference, disclose OFDM data transmission techniques.

Id., 3:52-4:18.

Bit-loading with Multi-Carrier Modulation

43. The '518 patent admits to several prior art references that disclose multi-carrier modulation with bit-loading on wired networks. Like the claimed bit-loading of the '518 patent, these references describe selecting bit-loading parameters based on channel characteristics (e.g., SNR):

U.S. Pat. No. 6,438,174 “Multi-carrier transmission systems” incorporated herein by reference, discloses discrete multi-tone modulation and a technique for bit loading applied to point-to-point twisted pair wiring. U.S. Pat. No. 6,259,746 “Method for allocating data and power in a discrete multi-tone communication system”

discloses a technique for bit loading applied to discrete multi-tone modulation.

Id., 8:19-26.

Channel Probing

44. The '518 patent concedes that “[d]etermination of a channel response, multipath, and SNR profile from a known signal is well known in the art.” *Id.*, 10:12-14. The '518 patent cites to the following reference to support this admission:

Schmidl, et al. “Robust Frequency and Timing Synchronization for OFDM”, IEEE Transactions on Communications, vol. 45, No. 12, pp. 1613-1621 (1997) ... describe[s] techniques for forming and processing sequences to synchronize receivers to data transmissions over frequency-selective channels.

Id., 10:21-28.

C. Overview of the Prosecution History

45. The '518 patent's inventors are Anton Monk, Brett Bernath, Itzhak Gurantz, Ladd El Wardani, and Ron Porat. *Id.*, Cover; DISH-1002, 71-72.

46. The application that issued as the '518 patent is Application No. 10/322,834 ('834 application), and it was filed on December 18, 2002. DISH 1001, Cover.

47. The examination of the '834 application was short as the application was allowed without an office action being issued. *See generally* DISH-1002.

48. Following a restriction requirement (*id.*, 15-20) and election of claims by Applicant (*id.*, 9-12), the Examiner indicated that the claims would be allowable if claim 1 were amended to incorporate the subject matter of dependent claim 2 (*id.*, 9). Claim 2 recited:

2. The data communication network of claim 1 wherein network devices transmit probe messages through the cable wiring and analyze received probe message signals to determine channel characteristics and bit loading is selected based on the determined channel characteristics.

Id., 10.

49. Applicant accepted the offer and the application was allowed. *Id.*, 2-9. In the Notice of Allowance, the Examiner stated:

The prior art of record, Dodds et al. (US 6,886,181) and an article “*Multicarrier Modulation for Data Transmission; An idea Whose Time has Come*”, by John A.C. Bingham, IEEE, alone or in combination, fails to disclose a network device for communicating data to other network devices by utilizing unique method step of **determining channel characteristics and a bit loading profile used to transmit data by analyzing received probe message signals** (claims 1 and 10).

DISH-1002, 6.⁴

50. As I explained, the ’518 patent admitted that both the feature of determining channel characteristics by analyzing probe messages (i.e., known signals) and the

⁴ All emphasis added unless otherwise stated.

feature of selecting bit-loading based on channel characteristics, e.g., SNR, were well known in the art.

VII. GROUND 1 – KLIGER IN VIEW ISAKSSON

A. Kliger Provisionals

51. Kliger is entitled “Home network system and method.” DISH-1007, Cover. Kliger is a publication of a U.S. patent application that was filed on August 30, 2001 and claims the benefit of five provisional applications (“Kliger Provisionals”), all of which predate the Critical Date of the ’518 patent. *Id.* The earliest provisional, U.S. Provisional Appl. No. 60/229,263, was filed on August 30, 2000, which is 12 months before the priority date of the ’518 patent. *Id.* I list the Kliger Provisionals and their associated filing dates in the following table.

Provisional Application	Filed
’263-Provisional (DISH-1008)	August 30, 2000
’110-Provisional (DISH-1009)	September 5, 2000
’060-Provisional (DISH-1010)	March 12, 2001
’130-Provisional (DISH-1011)	May 15, 2001
’304-Provisional (DISH-1012)	June 11, 2001

52. I have been informed that a patent or published patent application is available as prior art as of the filing date of its related provisional application, for

the subject matter described in the provisional, so long as the provisional application provides clear and unambiguous support for at least one claim of the patent or published patent application. It is my opinion that the Kliger Provisionals provide such support at least for Kliger’s independent claims 1 and 27. The table below provides an element-by-element analysis of Kliger’s claims 1 and 27, and identifies for each claim element, exemplary disclosure from the Kliger Provisionals that is relevant to and plainly supportive of the corresponding element of Kliger’s claims 1 and 27. Additionally, I cite to the relevant portions of the Kliger Provisionals for all of the Kliger subject matter in the claim analysis section to show that those relevant portions of the provisionals support Kliger’s disclosures.

Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
1. A home network, comprising:	DISH-1008, p. 5 (“a ‘no-new-wires’ home-network”), <i>see also</i> pp. 6-7 (“The home network operates in parallel to the cable TV services, leaving the legacy cable TV signals and devices (set top boxes and cable modems) un-touched”); DISH-1009, pp. 4-6 (“Home Network Method and

Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
	Apparatus,” “In another embodiment of the home network, the home network uses frequencies in the forward channels frequency range”); DISH-1010, pp. 4-5 (“In one embodiment of the home network, the home network uses frequencies that are above the frequency band that is used by the Cable TV, i.e. at frequencies above 850 MHz.”); DISH-1011, p. 4 (“This addendum is related to the transmission of IEEE-1394 signals over “no new wires” home networks. By “no new wires” we mean any home networking media that exists in the house, and does not require high quality wires, such as Category-5 twisted pair, plastic optical fiber etc ... that cannot be found often in existing homes. Power lines, telephone lines, existing coax cables and wireless are examples for “no new wires” media.”), <i>see also</i> pp. 6-7; DISH-1012, p. 5

Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
	(“Detailed information on how splitters are supported in order to implement a network over existing coax cable infrastructure in houses”).
a network backbone;	DISH-1008, p. 5 (“the existing in-house cable TV coax wiring,” “The system and method enables the following key functionalities: ...4) providing an Intra-room backbone for a ... network over the existing in house coax cable.”), <i>see also</i> pp. 6-7; DISH-1009, p. 8 (“The system exploits the ubiquitous in-house coax wires; an infrastructure that is by far the most suitable media for high-speed transmission among the alternatives in the home. The system uses the existing in-house cable TV coax wires as a data and audio/video network, and an intra-room backbone for IEEE 1394 standard (Fire Wire) transmission.”), <i>see also</i> pp. 9-11; DISH-1010, p. 5 (“The table refers to signals

Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
	that are carried over the coax wires”); DISH-1011, p. 6 (“It sends an ACK_pending message to the source node and forward the message to the backbone.”), <i>see also</i> pp. 7-8; DISH-1012, p. 6 (“In a home network over coax wiring that includes splitters”).
a plurality of modules connected to the network back-bone,	DISH-1008, p. 10 (“The Data Module (DM)”); p. 11 (“The Audio/Video Module (AVM)”); <i>see also</i> pp. 6-7; DISH-1009, p. 8 (“The system includes a residential gateway unit (TRG) and in-room modules: an A/V Module (AVM) and a Data Module (DM)”); DISH-1010, p. 4 (Figure 1); DISH-1011, p. 5 (Figures 1-2), p. 7 (“a home network embodiment consisting of several local buses and a backbone network.”); DISH-1012, pp. 5-6 (Figure 4).
each module being connected	DISH-1008, p. 10 (“The DM is connected

Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
between the network backbone and a local bus, and	between the Coax outlet and a data port of a data device”); p. 11 (“a bridge unit”), <i>see also</i> pp. 6-7; DISH-1009, p. 13 (“Bridge devices to other type of home networks also can be connected to the system.”); DISH-1010, p. 4 (Figure 1); DISH-1011, p. 7 (“A logical diagram of a home network embodiment consisting of several local buses and a backbone network is depicted in Figure 3.”), <i>see also</i> p. 9 (Figure 5); DISH-1012, p. 6 (Figure 4).
a demarcation point unit	DISH-1008, p. 7 (“residential gateway (TRG)”); DISH-1009, p. 9 (“The TRG is installed in the demarcation point of the cable TV network”); DISH-1010, p. 4 (Figure 1); DISH-1011, p. 5 (Figure 2); DISH-1012, p. 6 (“The home network over coax employs an embodiment residing at the demarcation point of the coax”).
receiving a home network	DISH-1008, p. 10 (“Each of the network devices

Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
signal from one of the modules over the network backbone and passing the home network signal to the plurality of modules.	... [can] connect one to the other through the hub located in the TRG”); DISH-1009, p. 12 (“The DM receives a data stream from a data device through its data port and converts it to a modulated analog signal over the coax cable”); DISH-1010, p. 4 (“The circuit uses a diplexer to separate the Cable TV signals from the home network signal”); DISH-1011, p. 4 (“This addendum is related to the transmission of IEEE-1394 signals over “no new wires” home networks”); DISH-1012, p. 6 (“Signals that flow from point A into the house are called Forward Signals. They include TV (video), data, voice, management and other signals that arrive from the Cable operator Headend to the house and are distributed in the various rooms.”).
27. A demarcation point unit	DISH-1012, p. 6 (“The home network over coax

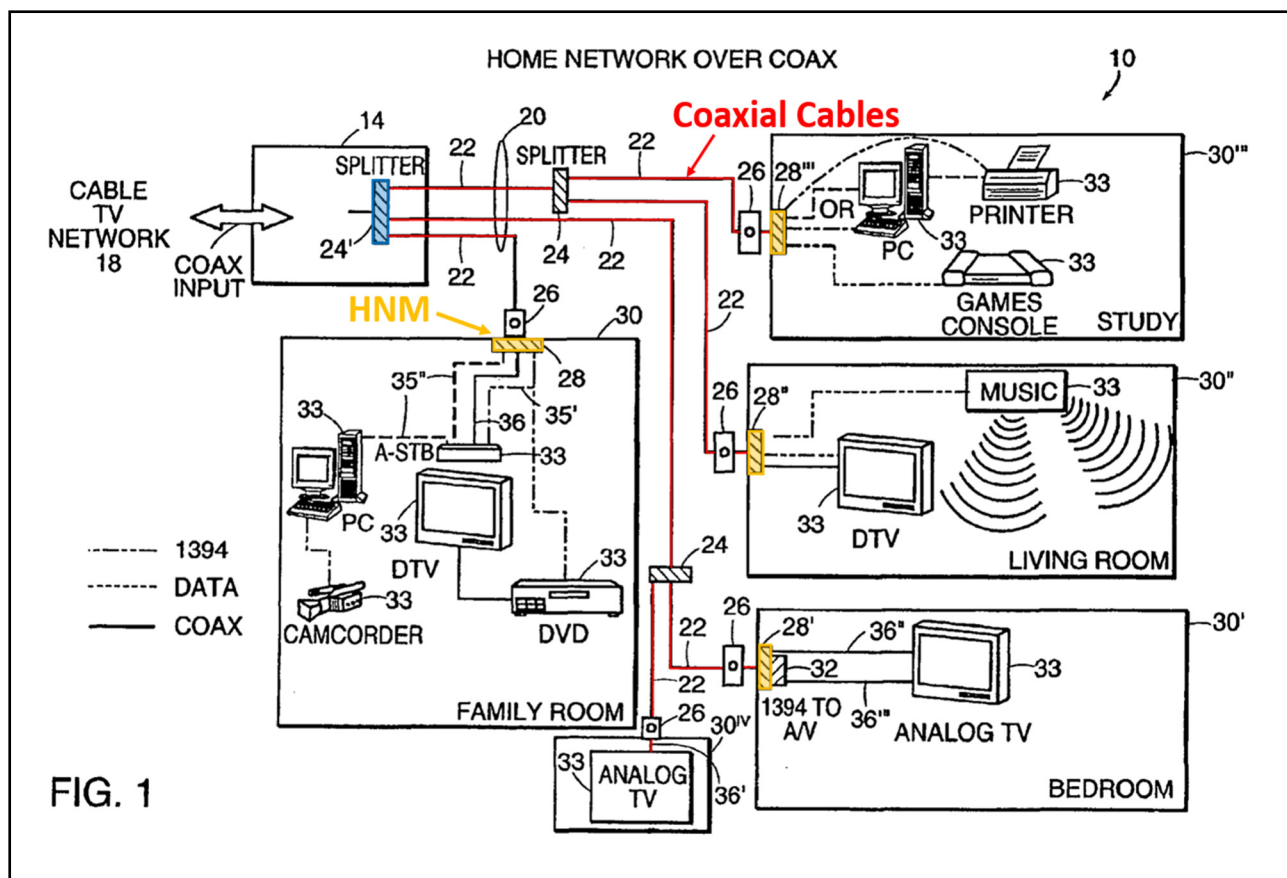
Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
connected between a home network backbone and an external network, the demarcation point unit comprising:	employs an embodiment residing at the demarcation point of the coax ... named Demarcation unit or DU. The DU has three functions... 2. It separates the home network signals from the outside cable plant.”).
a diplexer receiving a home network signal from the home network backbone and an external signal from the external network, the diplexer separating the home network signal from the external signal; and	DISH-1012, p. 7 (Figure 5 showing a block diagram of the DU that includes a diplexer (DIP) that receives a home network signal from “In home wires” and an external signal from “outside plant.” The DIP separates the in-home signal from the outside plant signal by routing the in-home signal to the “Home Network Reflector Unit”).
a signal reflector unit receiving the home network signal from the diplexer and returning the home network	DISH-1012, p. 7 (The “Home Network Reflector Unit” receives the home-network signals [from the DIP] and reflects them back into the house,” and specifically to the in-home wires).

Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
signal back to the home network backbone.	

B. Overview of Kliger

53. Kliger discloses a home network that is implemented on “cable TV equipment that is typically already installed in many homes for accessing the cable TV network 18 or the Internet.” DISH-1007, ¶0041, FIG. 1; DISH-1008, 6-7; DISH-1010, 4; DISH-1011, 7; DISH-1012, 5-6.

54. Kliger is interested in home networking because “[a]s the number of electronic devices in the home has increased there has been a demand for a way to permit those devices to communicate between themselves and with external networks.” DISH-1007, ¶0003; DISH-1008, 10-11. Kliger observes that “a large number of homes are presently equipped with coaxial cable,” but that the evolving standards on device communication over wiring modalities do not take into account this installed base of coaxial cable. DISH-1007, ¶¶0003-0004; DISH-1008, 10-11. Kliger’s home network meets the “demand for interconnectivity without the necessity of changing the physical wiring present in the home.” DISH-1007, ¶0005; DISH-1008, 10-11.



Kliger, FIG. 1; *see also* DISH-1008, 7.

55. As shown in Figure 1, Kliger's home network 10 includes "a demarcation point unit (DPU) 14 located at the entry point into a home." DISH-1007, ¶0040; DISH-1008, 7; DISH-1012, 6. The DPU 14 "operates as the interface between the home network 10 and an external network 18, such as a cable television (TV) network or the Internet." DISH-1007, ¶0040; DISH-1008, 7; DISH-1012, 6. Additionally, the "DPU 14 is in communication with a plurality of home-network modules (HNM) 28, 28', 28'', 28''' (generally 28)." DISH-1007, ¶0040; DISH-1008, 7; DISH-1011, 6-7. Kliger discloses that its HNM can provide Internet

access using a cable modem or DSL services. DISH-1007, ¶¶0043, 0050; DISH-1008, 5, 9; DISH-1012, 6.

56. Each of Kliger's HNMs 28, which are shown above in orange, is an "interface between devices in a room (e.g., home entertainment devices and computer devices) and the DPU 14." DISH-1007, ¶0040; DISH-1008, 6-7, 10-11; DISH-1011, 5; DISH-1012, 6. Kliger's HNMs 28 communicate with the DPU 14 and with each other over standard cable equipment that includes coaxial cables 22 (red), splitters 24 (blue), and cable TV outlets 26. DISH-1007, ¶0041; DISH-1008, 6-7, 10-11; DISH-1010, 5; DISH-1012, 5-7. "With this existing coax cable equipment, the home network 10 joins various computer devices, such as personal computers and peripherals (printer, scanner, CD etc.), and entertainment equipment, such as set top boxes (STB), televisions, video cassette recorders, personal video recorder (PVR), etc., located throughout the home into one network. By this one network, various computer devices in different rooms can share access to the Internet, and video or audio sources played in one room can be enjoyed in another room of the home." DISH-1007, ¶0042; DISH-1008, 5-7, 10-11; DISH-1010, 5; DISH-1012, 5-7.

57. "In each room 30 having a device 33 that the resident of the home wants to make available for intra-room communication, there is located a HNM 28 that connects that device 33 to the backbone 20." DISH-1007, ¶0044; DISH-1008, 6-7,

10-11; DISH-1010, 5. In Kliger's system, "[e]ach HNM 28 communicates with the DPU 14 and each other HNM 28 on the backbone 20 with analog signals and converts analog signals received from the DPU 14 and the HNMs 28 into digital signals for delivery to devices 33 connected to that HNM 28." DISH-1007, ¶0047; DISH-1008, 10-11. In their inter-modem signaling, the HNMs 28 use "an efficient modulation scheme, like ... OFDM[] or ... DMT." DISH-1007, ¶0073; DISH-1009, 6; DISH-1010, 4.

C. Overview of Isaksson

58. Isaksson is a PCT patent application entitled "Improvements in, or relating to, multi-carrier transmission systems." DISH-1013, Cover. Isaksson published on March 12, 1998 and I understand qualifies as prior art at least under §102(b).

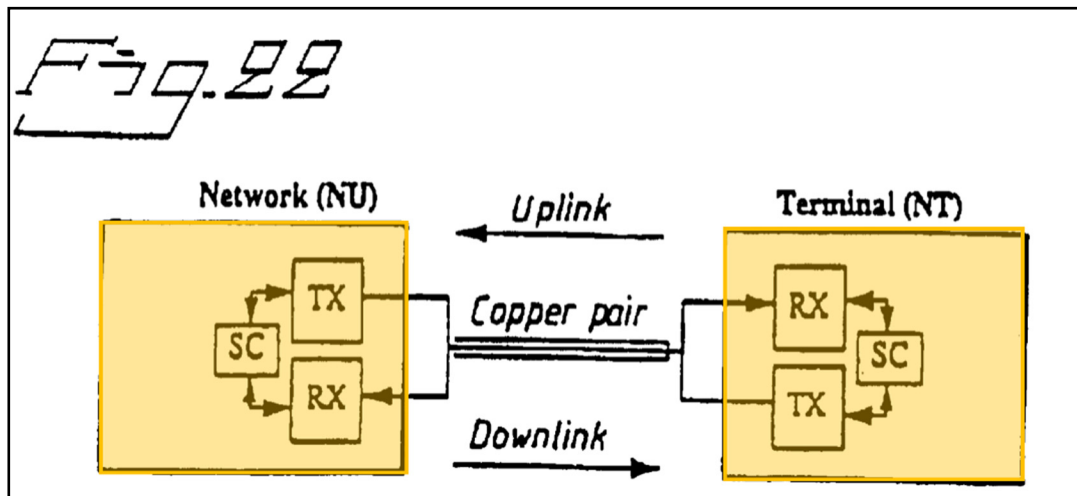
Id.

59. Isaksson describes "multi-carrier transmission systems having the facility to dynamically change carrier bit-loading." *Id.*, 1:3-7. Like Kliger, Isaksson discusses using multi-carrier modulation as a "modulation system" for high bit-rate traffic transmission schemes, such as Asymmetric Digital Subscriber Lines (ADSL) and Very High Bit-Rate Digital Subscriber Lines (VDSL). *Id.*, 1:8-18. Like the '518 patent, Isaksson's multi-carrier modulation system uses "bit-loading techniques [in which] the number of transmitted bits per symbol is adapted, or

regulated, to the signal-to-noise ratio (SNR) of the current carrier wave.” *Id.*, 3:24-27; DISH-1001, Abstract.

60. Isaksson observes that adapting the number of bits to SNR “dynamically affects, in time, the total bandwidth of the system.” DISH-1013, 3:24-28. “This variation in bandwidth leads to an absolute system requirement for synchronous configuration of the transmitter and the receiver, in terms of the number of coded/decoded bits per symbol and carrier wave. If this requirement is not met, the system will be unable to maintain a connection.” *Id.*, 3:29-34.

61. Isaksson proposes “a multi-carrier transmission system having a first and a second transceiver,” as shown below, where each transceiver (shown in orange) has a receiver and a transmitter. *Id.*, 5:14-6:1.



Isaksson, Fig. 22.

62. In Isaksson's system, "[t]he Signal-to-Noise Ratio is calculated for each carrier." *Id.*, 54:13-24. To do so, each receiver (in each transceiver) "continuously measures and estimates the characteristics and changes of/in the channel," e.g., the uplink and downlink channels. *Id.*, 4:1-8. The "[c]hannel characteristics may be estimated by periodic transmission, by one of said transceivers, of a base sync frame having a predetermined content and comparing, in the other of said transceivers, the received sync frame with a reference frame." *Id.*, 16:8-12. Specifically, "[b]y transmitting a frame with predetermined content," which each receiver "can compare, on detection, with a reference frame," each receiver "can estimate the characteristics of the channel, over which the frame is transmitted, in terms of attenuation, phase shift and variance." Then, each "individual carrier's [SNR] is calculated on the receiver side." *Id.*, 26:12-15; *see also id.*, 62:24-26. Each receiver sends information related to the measurements to the transmitter in the uplink transceiver. *See id.*, 77:21-79:4.

63. "Based on the Signal-to-Noise Ratios, bit-loading factors are calculated for each carrier." *Id.*, 54:13-21; *see also id.*, 5:14-6:1. That is, "[t]he number of bits each carrier carries, depends on their respective Signal-to-Noise Ratios (SNR)." *Id.*, 54:13-21. Then, the "multi-carrier system is adapted to synchronously update, at said first and second transceivers, the bit loading parameters associated with each channel." *Id.*, 5:14-6:1; *see also id.*, 54:13-21. "These bit-loading factors are

calculated in an initial training session and can be updated if required.” *Id.*

Isaksson’s multi-carrier system achieves high-speed communication on wired networks to support broadband multimedia services. *See id.*, 1:3-18, 24:8-13.

D. Combination of Kliger and Isaksson

64. The Kliger-Isaksson combination incorporates Isaksson’s techniques for synchronized bit-loading in modems of a multi-carrier transmission system into Kliger’s home network, which includes modems, i.e., Kliger’s HNMs, that use multi-carrier modulation for inter-modem signaling. As I explain in more detail below, Isaksson’s techniques enable Kliger’s HNMs to overcome signal impairments that affect the inter-modem signaling on Kliger’s home network. Isaksson’s techniques also allow Kliger’s HNMs to determine carrier availability for the inter-modem signaling. As I also explain below, Kliger and Isaksson are in the same field of endeavor of wired networks, and both teach techniques for high-speed communication on wired networks to support broadband services, e.g., Internet services. DISH-1007, ¶¶0043, 0050; DISH-1013, 1:3-18, 24:8-13.

1. Motivation/Rationale

65. It is my opinion that a POSITA seeking to implement Kliger’s home network would have understood that that Kliger’s inter-modem signaling is subject to signal impairments, like interference and noise. Kliger explains that “[r]eflections can occur at the splitter, resulting in inter-symbol interference to the

home network signal.” DISH-1007, ¶0073; DISH-1010, 5 (“These splitters ... have poor signal isolation and return loss performance. This causes reflections at the splitters and results in inter-symbol interference to the home network signals.”).

66. Kliger’s inter-modem signaling is also subject to noise from other sources. Kliger’s ’060-Provisional describes examples of signals that are sources of noise on the coaxial cables of Kliger’s home network. As explained by the ’060-Provisional, these signals are carried over the coaxial cables of Kliger’s home network or interact with the coaxial cables due to ingress, i.e., “radiation leakage into the home network due to external radiofrequency sources.” The external signals include Direct Broadcast Satellite (DBS), cellular phones, or other aerial or wireless signals that are used in the house, or in its close vicinity. Jacobsen corroborates the understanding that interference from other signals contributes to signal degradation in coaxial networks. Jacobsen explains that “[a] second source of signal degradation in CATV networks is interference from other signals.” The leaks that allow the external signals to enter the coaxial network are caused by poorly shielded consumer devices or system hardware.

67. A POSITA would also have understood that Kliger’s network conditions are dynamic due to the addition/removal of network devices and/or changing external conditions. Kliger contemplates the addition/removal of network devices to the home network. *See* DISH-1007, ¶0084 (“registering new HNMs 28”); *see also*

DISH-1011, 17 (“Reset procedure- Network update”). The dynamic nature of the network conditions means that the carriers used in the multi-carrier signaling are subject to variable conditions. As a result, a carrier that was once clear of noise can later become severely affected by interference.

68. It is my opinion that, in view of these concerns, a POSITA would have been motivated to improve Kliger’s multi-carrier signaling using Isaksson, which addresses the dynamic nature of multi-carrier signaling on wired networks.

69. As I explained previously, Isaksson is directed to multi-carrier transmission systems that use DMT. DISH-1013, Abstract, 1:8-18. Isaksson recognizes and addresses overcoming losses and noise using multi-carrier modulation. *See id.*, Abstract. Isaksson explains that “[a] multi-carrier modulation technique, such as DMT, handles frequency dependent loss and noise ... in an efficient manner.” *Id.*, 26:4-20. Specifically, Isaksson’s multi-carrier systems handle frequency dependent loss and noise using bit-loading where the “allocated transmission power for the individual carriers depends on the noise power and the transmission loss in each band.” *Id.* As such, “[i]f a carrier has a high SNR, up to 12 bits are placed on that carrier,” “[f]or carriers with low SNR values, fewer bits are placed on the carrier,” and “[c]arriers affected by narrowband interferers are turned off.” *Id.* Isaksson also describes using a “system margin” in calculating the

number of bits transmitted on each carrier “to compensate for non-modelled losses, impulse noise etc.” *Id.*, 54:25-55:10.

70. Isaksson recognizes that regulating bit-loading, i.e., the number of bits per carrier, based on “signal-to-noise ratio (SNR) of the current carrier wave ...

dynamically affects, in time, the total bandwidth of the system.” *Id.*, 3:24-34.

“This variation in bandwidth leads to an absolute system requirement for

synchronous configuration of the transmitter and the receiver, in terms of the number of coded/decoded bits per symbol and carrier wave. If this

requirement is not met, the system will be **unable to maintain a connection.**” *Id.*

Isaksson teaches a solution “in which synchronism between two transceivers is maintained during dynamic system reconfiguration of bit-loading factors.” *Id.*, 4:21-25.

71. It is my opinion that a POSITA would have been motivated to use these multi-carrier teachings of Isaksson to improve the multi-carrier signaling in Kliger’s home network. Isaksson’s multi-carrier techniques enable Kliger’s HNMs to avoid signal impairments, determine carrier availability for the inter-modem signaling, and maintain inter-modem connectivity. Additionally, Isaksson’s multi-carrier techniques would also establish a specific time for the bit allocations to be changed in the HNMs, thereby allowing for a more efficient dynamic bit allocation environment.

72. **First**, a POSITA would have improved Kliger's HNMs by implementing Isaksson's bit-loading in the multi-carrier signaling between the HNMs. Here, Kliger's HNMs would divide the available bandwidth "into a plurality of sub-channels each with a small bandwidth." *Id.*, 1:19-2:4. Then, Kliger's HNMs would place more bits on carriers that have higher SNR, place fewer bits on carriers with lower SNR, and turn off carriers affected by interferers. *Id.*, 26:4-20. Because Isaksson's bit-loading controls the number of bits transmitted in each carrier based on that carrier's SNR, using Isaksson's bit-loading in the multi-carrier signaling between Kliger's HNMs helps the HNMs handle frequency dependent loss and noise (e.g., from narrowband interferers). *Id.*

73. **Second**, a POSITA would have further improved Kliger's HNMs by implementing Isaksson's synchronized bit-loading, i.e., synchronizing the updating of bit-loading parameters between modems. *Id.*, 1:3-7. Implementing Isaksson's synchronized bit-loading in Kliger's HNMs would help the HNMs maintain connections between one another. *Id.*, 3:24-34. Isaksson's synchronized bit-loading synchronizes the bit-loading parameters between the HNMs, thereby updating the bit-loading such that the HNMs are aware of the bit-loading parameters assigned to the carriers. This would prevent the connections between the HNMs from failing due to one HNM sending more/fewer bits per carrier than expected by another HNM. Additionally, synchronizing the bit-loading between

HNMs would enable the HNMs to determine carrier availability for the inter-modem signaling.

74. As I explained previously, Isaksson's bit-loading technique determines the number of bits each carrier carries based on each carrier's respective channel characteristics. *Id.* Accordingly, Kliger's HNMs would determine each carrier's channel characteristics to determine the number of bits to transmit on each carrier. To do so, each Kliger HNM — as a transmitter — would transmit base sync frames having predetermined content to the other HNMs over respective channels between the HNMs. The other HNMs — as receivers — would analyze the received base sync frames to determine channel characteristics of the respective channels. The transmitter HNM would obtain information about the channel characteristics, e.g., SNR, from the receiver HNMs and select the bit-loading parameters for the respective channels based on the received information. The transmitter HNM would communicate the bit-loading parameters to the receiver HNMs and would implement the bit-loading parameters in the transmitter HNM's multi-carrier signaling with the receiver HNMs. Similarly, the receiver HNMs would implement the bit-loading in their respective communications with the transmitter HNM.

75. A POSITA would have considered the Kliger-Isaksson combination to be an example of: (1) use of known techniques (Isaksson's techniques for synchronized

bit-loading that involve modems transmitting, receiving, and analyzing base sync frames for determining channel conditions to select bit-loading parameters) to improve similar devices (both Isaksson and Kliger's modems communicate over a wired network) in the same way (like Isaksson's modems, Kliger's HNMs would overcome interference and maintain connections with other HNMs); (2) a teaching, suggestion, or motivation in Isaksson that would have led a POSITA to implement Kliger with Isaksson's techniques for synchronized bit-loading; and (3) combining prior art elements (Isaksson's techniques for synchronized bit-loading) according to known methods to yield predictable results (Kliger's HNMs using Isaksson's synchronized bit-loading with multi-carrier signaling to overcome interference and maintain connections with other HNMs).

76. Additionally, a POSITA would have understood that both Kliger and Isaksson are analogous art to the '518 patent because they are from the same field of endeavor as the '518 patent and because they are reasonably pertinent to the particular problem at issue in the '518 patent.

77. **First**, Kliger and Isaksson are analogous art because both Kliger and Isaksson are in the same field of endeavor as the '518 patent (i.e., wired communication networks). DISH-1001, Abstract; DISH-1007, ¶0041, FIG. 1; DISH-1008, 6-7; DISH-1013, 1:8-18.

78. **Second**, both Kliger and Isaksson are analogous art because they are reasonably pertinent to the particular problem at issue in the '518 patent. The '518 patent contends that “signal reflections and tap port isolation of splitters existing in a typical cable TV wiring configuration present[] a problem to shared usage of the cable for a LAN system.” DISH-1001, 4:25-28. In particular, the “isolation attenuates signals communicating between tap ports” (*id.*, 2:28-31), while the signal reflections produce “a multipath signal in some or all wiring branches that creates inter-symbol interference (ISI)” (*id.*, 3:7-10). These signal impairments “create[] a multipath environment ...[which] impairs the ability to achieve high data rates in a communication network ...[and] presents a problem to shared usage of the cable for a LAN system.” *Id.*, 4:19-29. Simply put, the particular problems at issue in the '518 patent are wired network signal impairment issues, namely multipath environment issues.

79. Both Kliger and Isaksson are reasonably pertinent to addressing multipath environment issues. As I explained previously, Kliger also recognized that multipath environment issues cause problems in wired networks and provided solutions to address these problems to achieve high data rates. Kliger states, “[r]eflections can occur at the splitter, resulting in inter-symbol interference to the home network signal.” DISH-1007, ¶0073; DISH-1010, 5 (“splitters are frequency limited ... and have poor signal isolation and return loss performance. This causes

reflections at the splitters and results in inter-symbol interference to the home network signals”). Kliger proposes the use “use of efficient bandwidth modulation[],” which “achieves higher data rates for a specific frequency band [and] produces less cross talk between potentially interfering signals.” DISH-1007, ¶0073, DISH-1009, 6; DISH-1010, 4 (“to allow better frequency efficiency, the home network signal may use efficient line modulation schemes like ... Multi QAM ... OFDM ... or ... DMT.”).

80. Isaksson also addresses signal impairments on wired networks. Isaksson is concerned with the “need to transmit high bit rate traffic over copper pairs.”

Isaksson identifies “inter pair interference in copper pair cables ... [when] data is transmitted in both directions,” “frequency dependent loss and noise,” and “inter-symbol interference (ISI)” as signal impairments affecting wired networks.

Isaksson provides solutions that address these impairments. Because a POSITA would have understood that these impairments result from a multipath environment, it is my opinion that a POSITA would have consulted Isaksson and applied its teachings when faced with the multipath environment issues of the ’518 patent.

2. Reasonable Expectation of Success

81. It is my opinion that a POSITA would have had a reasonable expectation that the Kliger-Isaksson combination would produce a successful outcome. Kliger

already teaches multi-carrier modulation, so at least for that reason, a POSITA would have a reasonable expectation of success in implementing Isaksson's improvements to multi-carrier systems into Kliger's home network. Indeed, a POSITA would have a reasonable expectation of success in implementing Isaksson's improvements on wired networks in Kliger's wired home network. As I explained above, although Isaksson describes a non-coaxial wired network that uses copper pairs, Isaksson expressly extends its communication protocols to coaxial wired networks (like Kliger's network). *See* DISH-1013, 72:5-8. A POSITA would have known that copper pairs were some of the most commonly installed communication wiring, and that coaxial cables were generally used for shorter distances, both media types allowed for duplex communication systems.

82. Moreover, when contemplating Kliger's wired home network, a POSITA would have been familiar with references like Isaksson, which discusses similar networks capable of delivering high-speed data and the methods of implementing such networks. A POSITA would also have looked to resources about the high-speed wired networks that are explicitly mentioned by Kliger, including the wired telephone networks described in Isaksson. DISH-1007, ¶¶0003-0004.

83. Given that Kliger's home network already uses multi-carrier modulation techniques, including DMT used by Isaksson, a POSITA would have reasonably expected Isaksson's teachings of improvements to multi-carrier systems to work in

the context of Kliger's network. It is my opinion that would have been within the skill level of a POSITA to implement the multi-carrier system details of Isaksson because multi-carrier modulation (and similar modulation techniques) is used in many applications and taught in a variety of engineering and/or math courses that a POSITA would have taken. Indeed, Isaksson discloses generic multi-tone transceivers in Figures 4 and 5 that would be applicable in Kliger's home network. Further, it is my opinion that the combination of Kliger and Isaksson would require only minor modifications without undue experimentation.

84. As I explained above, using Isaksson's synchronized bit-loading teachings in Kliger's network would have predictably resulted in improved multi-carrier signaling between Kliger's HNMs. Additionally, using Isaksson's synchronized bit-loading teachings in Kliger's network would predictably result in an improved multi-carrier system in which Kliger's HNMs maintain connectivity between them.

E. Claim 1

1. Preamble/Element 1pre

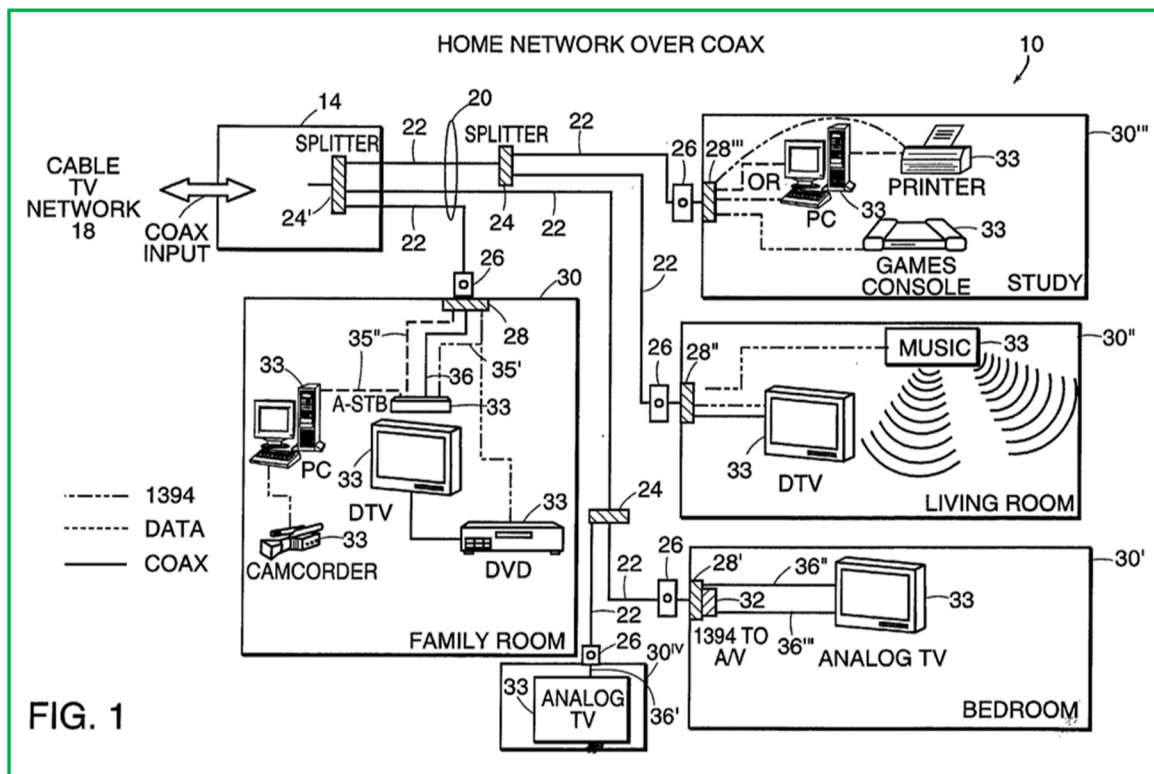
[1pre] A data communication network comprising:

85. I have been asked to consider whether the combination of Kliger-Isaksson 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 the Kliger-Isaksson combination renders this limitation obvious.

86. Kliger discloses a “**network[]**” suitable for use in residential buildings.”

DISH-1007, ¶0002; DISH-1008, 5 (“The invention relates to a system and method of providing residential users with broadband access to the Internet and data & entertainment network using a single platform.”). Kliger’s Figure 1, which is shown below in green, depicts Kliger’s home network 10. DISH-1007, ¶0002, ¶0040; DISH-1009, 9 (“The following is a schematic diagram that describes the architecture of the solution”).



Kliger, FIG. 1; *see also* DISH-1008, 7.

87. In the home network 10, “[t]he HNMs 28 **communicate** with the DPU 14 and **with each other over standard cable equipment.**” DISH-1007, ¶0041; DISH-1008, 5 (“connecting all PCs and peripherals (printer, scanner, CD etc.) using an in-home data network over the existing in home coax cable”), 7, (“All wires are standard in-house coax;” “Providing a data home-network with each cable outlet serving as a network port, and the TRG serving as a hub/router”), 10 (“The Data Module (DM) is the device that enables the multi-room networking of data devices such as PC, PC peripheral and Web TV”).

88. “**Each HNM 28 communicates** with the DPU 14 and each other HNM 28 on the backbone 20 with analog signals and converts analog signals received from the DPU 14 and the HNMs 28 into **digital signals for delivery to devices 33 connected to that HNM 28.**” DISH-1007, ¶0047; DISH-1008, 8 (“in house data networking between data devices (like PCs and computer peripherals, Web TV etc. ... [and] functionality that enables the seamless connection between existing internal devices like set top boxes and cable modems”), *see also* 10-11.

Specifically, “the HNM 28 receives a signal from a device 33 through **a data port** and converts that signal into a modulated analog signal over the backbone 20, combined with the Cable TV signal.” DISH-1007, ¶0065; DISH-1008, 5-6, 10 (“The DM receives a data stream from a data device through its data port and converts it to a modulated analog signal over the coax cable, combined with the

Cable TV stream.”), 11 (“The AVM receives a digital A/V stream, from entertainment A/V devices (i.e. DVD, VCR etc.) through 1394 interface and converts it to a modulated analog signal over the coax cable, combined with the Cable TV stream.”).

89. “In the other direction, the HNM 28 receives an analog signal over the backbone 20 and converts the analog signal into **a data signal.**” DISH-1007, ¶0065; DISH-1008, 5-6, 10 (“In the other direction the DM receives an analog signal over the coax cable and converts it into a data signal.”), 11 (“On the other direction the AVM receives an analog signal over the coax cable and converts it into IEEE Standard-1394 signals.”). Thus, “devices 33 can communicate with devices 33 in other rooms 30 of the home” via the HNMs 28. DISH-1007, ¶0048, *see also id.*, ¶0050; DISH-1008, 6 (“With the described invention, the 1394 network standard can be delivered between rooms over existing wiring.”).

90. “For example, the personal computer (PC) in room 30 can print a document on the printer or share a file with the personal computer in room 30”, or access the Internet.” DISH-1007, ¶0050; DISH-1008, 5 (“The system and method enables the following key functionalities: 1) sharing the Internet access by many devices throughout the home, 2) connecting all PCs and peripherals (printer, scanner, CD etc.) using an in-home data network over the existing in home coax cable”).

Therefore, the home network 10 is a “***data communication network.***”

91. As a result, it is my opinion that the Kliger-Isaksson combination renders the preamble obvious.

2. Element 1a.i

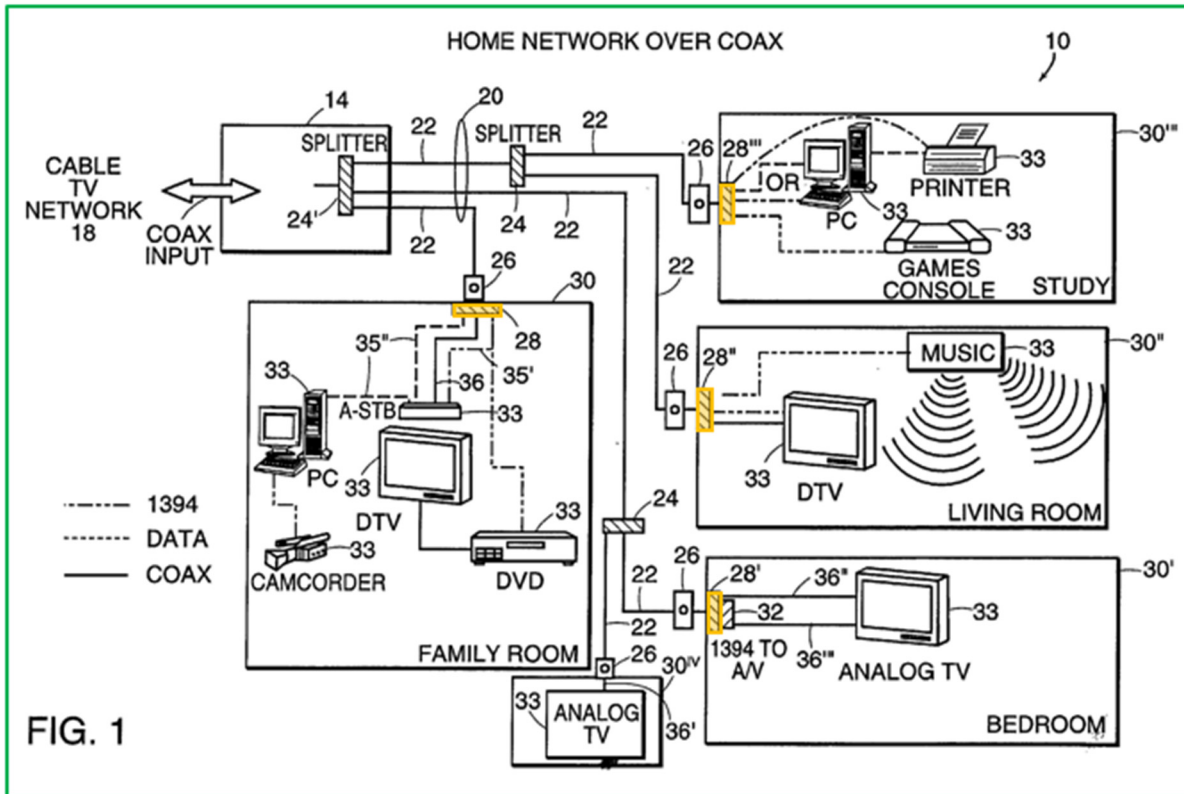
[1a.i] at least two network devices;

92. It is my opinion that the Kliger-Isaksson combination renders obvious this limitation.

93. Kliger describes “a home network including a demarcation point unit and a **plurality of modules.**” DISH-1007, ¶0010; DISH-1008, 7 (“The TRG is installed in the demarcation point of the cable TV network”), 10 (“Each of the network devices is automatically assigned a specific address that is internal to the in-home network.”), 11 (“The Audio/Video Module (AVM) is the device that enables the multi-room networking of entertainment devices.”). Each of the plurality of home-network modules 28, i.e., at least two network devices, “is connected to the demarcation point unit by one or more coax cables and to a device by a local bus.” DISH-1007, ¶0010; DISH-1008, 7 (“The following is a schematic diagram that describes the architecture of the solution”), 10 (“The Data Module (DM) is the device that enables the multi-room networking of data devices ... A DM is located in each room where data devices are used. The DM is connected between the Coax outlet and a data port of a data device.”); DISH-1011, 7 (“A logical diagram of a home network embodiment consisting of several local buses and a backbone

network is depicted in Figure 3. Each local bus is connected to the network via a Universal Module (UM).”).

94. Kliger’s Figure 1 depicts a home network 10 (shown below in green) that includes a plurality of home-network modules (HNM) 28, 28', 28", 28''' (shown below in orange). DISH-1007, ¶0043, FIG. 1; DISH-1008, 7 (“The following is a schematic diagram that describes the architecture of the solution”), 10 (“A DM is located in each room where data devices are used. The DM is connected between the Coax outlet and a data port of a data device”), 11 (“An AVM is located in each room where entertainment devices are used. The AVM is connected between the coax outlet and an IEEE Standard-1394 input of an entertainment device”); DISH-1011, 7 (“A logical diagram of a home network embodiment consisting of several local buses and a backbone network is depicted in Figure 3. Each local bus is connected to the network via a Universal Module (UM).”).



Kliger, FIG. 1; *see also* DISH-1008, 7.

95. Each HNM 28 serves as an “interface between devices in a room (e.g., home entertainment devices and computer devices) and the DPU 14 [i.e., the “demarcation point unit”].” DISH-1007, ¶0040; DISH-1008, 10 (“A DM is located in each room where data devices are used. The DM is connected between the Coax outlet and a data port of a data device”); DISH-1009, 4 (“the CM [Cable Modem] provides the Internet access to devices throughout the house and is connected to the home network via a Data Module (DM) or an Audio Video Module (AVM).”); DISH-1011, 9 (Figure 5).

96. “In operation, each HNM 28 permits those devices 33 connected to that HNM 28 to communicate with other devices 33 in different rooms 30, to receive programming from the cable television, and to have broadband access to the Internet.” DISH-1007, ¶0050; DISH-1008, 10 (“Each of the network devices is automatically assigned a specific address that is internal to the in-home network, so that multiple devices can simultaneously connect to the Internet using a single Internet account, as well as to connect one to the other.”); DISH-1009, 4 (“the CM provides the Internet access to devices throughout the house and is connected to the home network via a Data Module (DM) or an Audio Video Module (AVM).”).

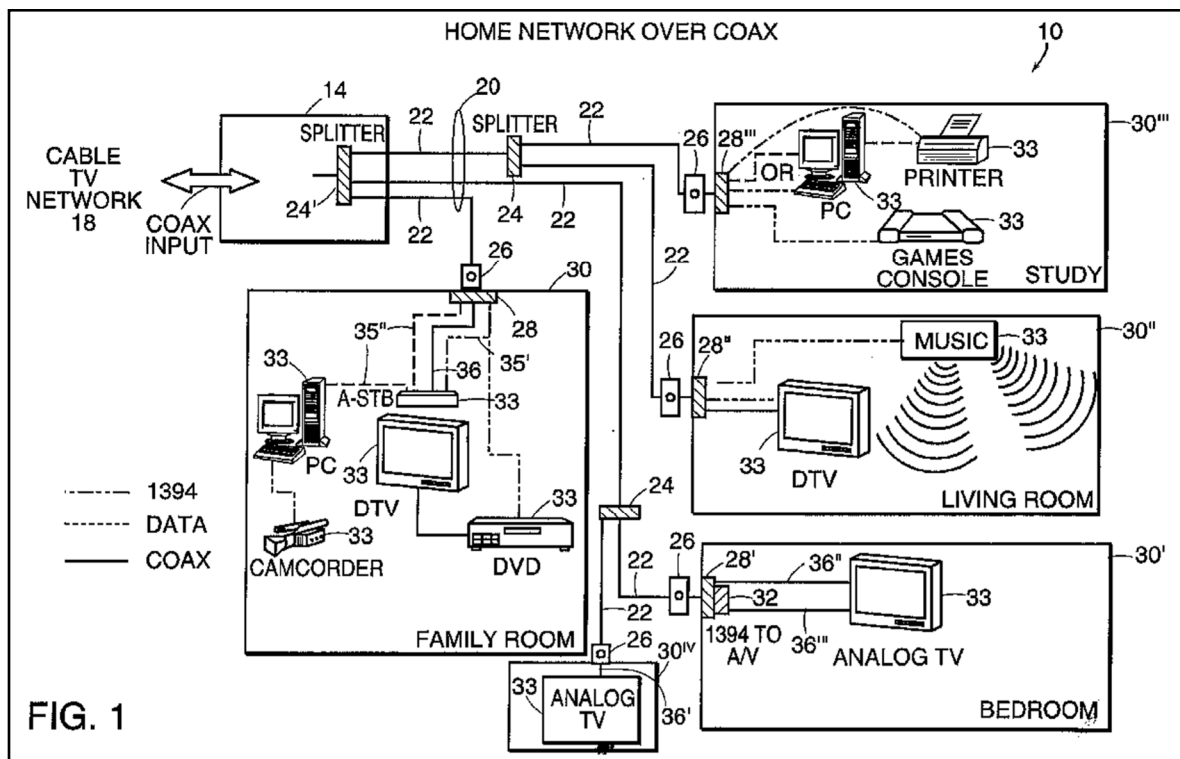
97. As a result, it is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

3. Element 1a.ii

[1a.ii] each network device comprising a multi-carrier modulator for modulating data, an up converter for translating the modulated data to an RF carrier frequency, a down converter for translating an RF signal, and a multi-carrier demodulator for demodulating the translated RF signal to produce data; and

98. It is my opinion that the Kliger-Isaksson combination renders obvious this limitation.

99. As I discussed above, Kliger discloses a data communication network 10 shown below in Figure 1 where the HNMs 28 use inter-modem signaling to communicate with each other to deliver data.



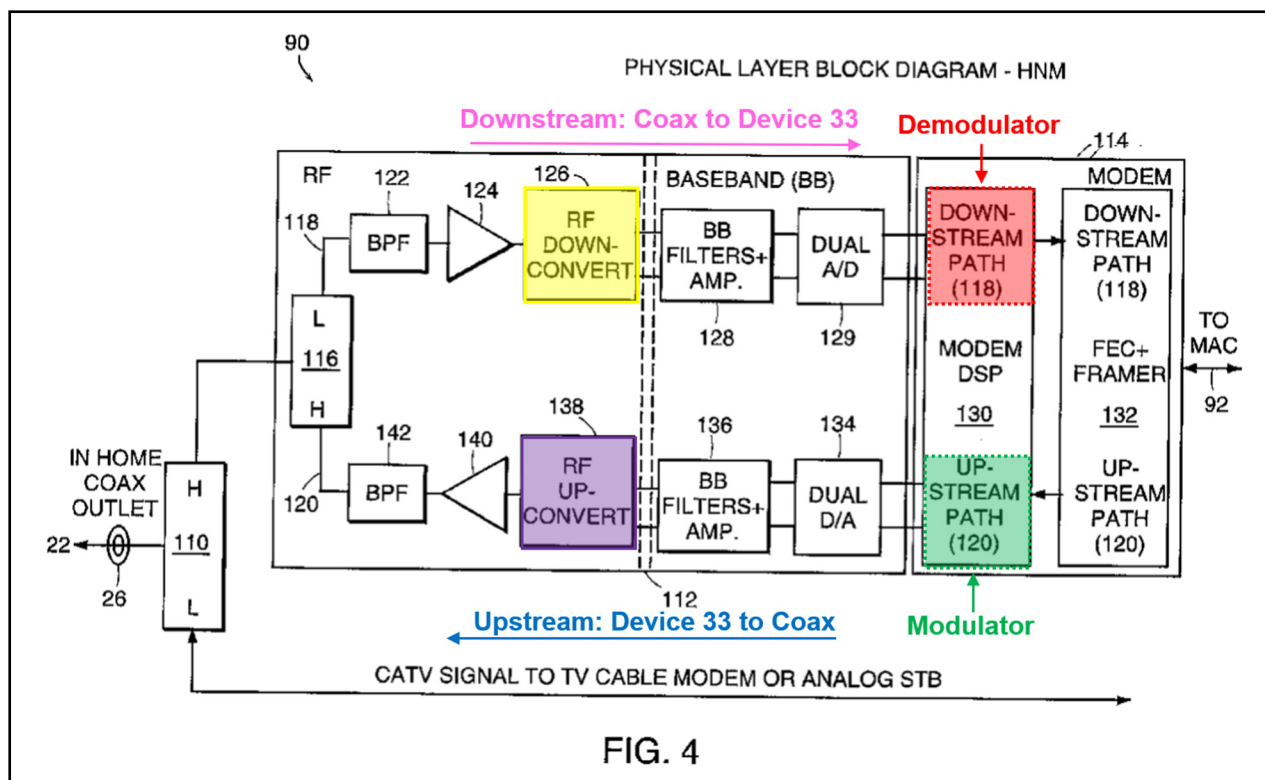
Kliger, FIG. 1; *see also* DISH-1008, 7.

100. For an HNM 28 to transmit data upstream (e.g., to another HNM 28), “the HNM 28 receives a signal from a device 33 through a data port and converts that signal into a modulated analog signal” for transmission “over the backbone 20.” DISH-1007, ¶0065; DISH-1008, 10 (“The DM receives a data stream from a data device through its data port and converts it to a modulated analog signal over the coax cable.”). Kliger discloses that the modulated analog signal is “modulated as a multi-carrier signal.” DISH-1007, ¶¶0073 (the HNM’s modem 114 uses an efficient modulation scheme like OFDM or DMT), 0170 (“...the signal is modulated as a multi-carrier signal”); DISH-1009, 6 (“The signals from each

output port of the hub/router are ... modulated ... [to] QAM [signals], with a programmable constellation size;” “The QAM signal in various embodiments is ... multi-band QAM, which is a summation of several QAM signals with different carrier frequencies. Alternatively, in another embodiment the signal is modulated as a multi-carrier signal with approximately the same available throughput”), 12 (“The modulation scheme is same as that of the TRG”); DISH-1010, 4 (“[T]o allow better frequency efficiency, the home network signal may use efficient line modulation schemes like ... Multi QAM ... OFDM ... [and] DMT.”).

101. And to receive data downstream (e.g., from another HNM 28), the HNM 28 receives the home network signal over the backbone 20 and converts it into a data signal. DISH-1007, ¶0065; DISH-1008, 10 (“In the other direction the DM receives an analog signal over the coax cable and converts it into a data signal.”). Thus, the inter-modem communication between the HNMs 28 uses multi-carrier signaling. As I explain below, a POSITA would have understood that the HNMs 28, therefore, comprise a “multi-carrier modulator for modulating data.”

102. Kliger’s Figure 4 explains how home network signals are transmitted and received at the physical layer 90 of the HNMs 28.



Kliger, FIG. 4; *see also* DISH-1010, 4.

103. In Figure 4, layer 90 includes the upstream path 120 communicating with the backbone 20 via cable 22, and the downstream path 118 receiving signals from the backbone 20. *See* DISH-1007, ¶0070; DISH-1009, 12 (“The DM includes an ISO Physical (PHY)-layer block ... [where] [t]he PHY-layer implements and decodes the actual signals transmitted over the coax”), 13 (“The AVM receives a digital A/V stream, from entertainment A/V devices (i.e. DVD, VCR etc.) through 1394 interface and converts it to a modulated analog signal over the coax cable, combined with the Cable TV stream”); DISH-1010, 4 (“The Digital Signal Processor (DSP) implements all other modem functionalities.”).

104. In the upstream path 120 (blue), the framer 132 receives data bits from the MAC 92. DISH-1007, ¶0080; DISH-1008, 10 (“The DM includes an ISO Physical (PHY)-layer block, a MAC (Media Access Controller) and a Link Layer block.”). The framer 132 passes a data signal including the data bits to the DSP 130, where the data signal is modulated using multi-carrier modulation (i.e., a “multi-carrier modulator for modulating data”). DISH-1007, ¶0078 (“[i]n a second embodiment of the modem 114, I/Q modulation occurs at the DSP 130”); *see also id.*, ¶0073 (the modem 114 uses an efficient modulation scheme like OFDM or DMT); DISH-1009, 6 (“multi-tone modulators provide[] the functionality that allows the co-existence of several data sources over the same cable (networking).”); DISH-1010, 4 (“the home network signal may use efficient line modulation schemes like ... Multi QAM ... OFDM ... [or] DMT”), 5 (“A frequency efficient modem ... multi QAM, OFDM ... can be employed to cope with low quality splitters.”). Because Kliger discloses that the data signal is modulated using multi-carrier modulation in the DSP 130, a POSITA would have understood that the DSP 130 includes the claimed “multi-carrier modulator for modulating data.” DISH-1009, 4, 6, 12-13; DISH-1010, 4-5.

105. Kliger also describes converting the modulated signal to an analog baseband signal. The analog baseband signal “then is up-converted by the RF up conversion circuitry 138 to the upstream frequency band,” *i.e.*, the claimed “an up converter

for translating the modulated data to an RF carrier frequency.” DISH-1007, ¶0075; DISH-1009, 5, (“Up/Down Converter”), 6 (“The output-modulated signals are optionally up-converted (depending on its frequency allocation).”); DISH-1010, 4 (“A block diagram of a circuit employs this method is shown in Figure 1. An RF circuit is used to up convert and down convert the home network signals”). The RF up conversion circuitry 138 is shown above in Kliger’s Figure 4 in purple. Kliger discloses the frequency band being “in the 960 to 1046 MHz frequency range.” DISH-1007, ¶0061; DISH-1010, 4-5 (“the home network uses frequencies that are above the frequency band that is used by the Cable TV, i.e. at frequencies above 850 MHz;” Table 1).

106. A POSITA would understand that the frequency — within the aforementioned frequency band — at which the RF signal is transmitted is an “RF carrier frequency.” The RF up-converted signal is combined with the CaTV signal for transmission over the backbone 20. *See* DISH-1007, ¶0075; DISH-1009, 6 (“The output-modulated signals are optionally up-converted (depending on its frequency allocation), combined with the external cable TV signal stream and are transmitted over the in-house coax wires to the various rooms.”); DISH-1010, 4 (“An RF circuit is used to up convert and down convert the home network signals”).

107. In Kliger’s downstream path 118, “[t]he diplexer 110 ... separates the CaTV signal (frequencies 5-860 MHz) from the home network signal,” and “[t]he home network signal passes to the RF unit 112.” DISH-1007, ¶0069; DISH-1010, 4 (“The circuit uses a diplexer to separate the Cable TV signals from the home network signal;” “By setting f_c to about 900 MHz, the low pass port transfers TV signals (frequencies of 5-860 MHz), and the high pass port transfers home network signals above 860 MHz”). Furthermore, “[t]he downstream signal,” which is the RF home network signal, “passes through ... RF down-conversion circuitry 126 [yellow],” which “converts the downstream signal to baseband frequencies,” *i.e.*, the claimed “a down converter for translating an RF signal.” DISH-1007, ¶0071; DISH-1009, 5 (“Up/Down Converter”), DISH-1010, 4 (“An RF circuit is used to up convert and down convert the home network signals.”).

108. The baseband signal then travels to the DSP 130, which demodulates the signal to produce data from the transmitted data bits. DISH-1007, ¶0078 (“[i]n a second embodiment of the modem 114, I/Q modulation occurs at the DSP 130”); *see also id.*, ¶0081; DISH-1008, 10 (“In the other direction the DM receives an analog signal over the coax cable and converts it into a data signal”); DISH-1009, 12 (“QAM Transceiver over COAX Cable (Phy)”); DISH-1010, 4 (“A frequency efficient modem ... multi QAM, OFDM ... can be employed to cope with low quality splitters.”).

109. Because the DSP 130 can implement demodulation and because the home network signal is a multi-carrier signal, a POSITA would have understood that the DSP 130 includes a multi-carrier demodulator (red) for demodulating the home network signal to produce data from the data bits in the signal. More specifically, at the transmitter, the information to be conveyed to the receiver is placed onto a carrier by a modulator. Thus, the output of the modulator is a combination of the information and the carrier. A demodulator separates the information and the carrier wave into two outputs. The information is of interest and is subsequently presented to the user. Thus, a POSITA would understand that a demodulator “produces data” as its normal functioning. The data that the demodulator produces may or may not be identical to the information that was originally presented to the modulator at the transmitter. This is due to distortions and impairments that affect the combined information and carrier signal during the process of transmission/reception. In this sense also, the demodulator’s output is “producing data.”

110. Thus, it is my opinion that the DSP 130 includes a multi-carrier demodulator that produces data from the received RF signal, *i.e.*, the claimed “a multi-carrier demodulator for demodulating the translated RF signal to produce data.”

111. As a result, it is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

4. Element 1b

[1b] cable wiring comprising a splitter with a common port and a plurality of tap ports and a plurality of segments of coaxial cable connecting between the splitter tap ports and the network devices;

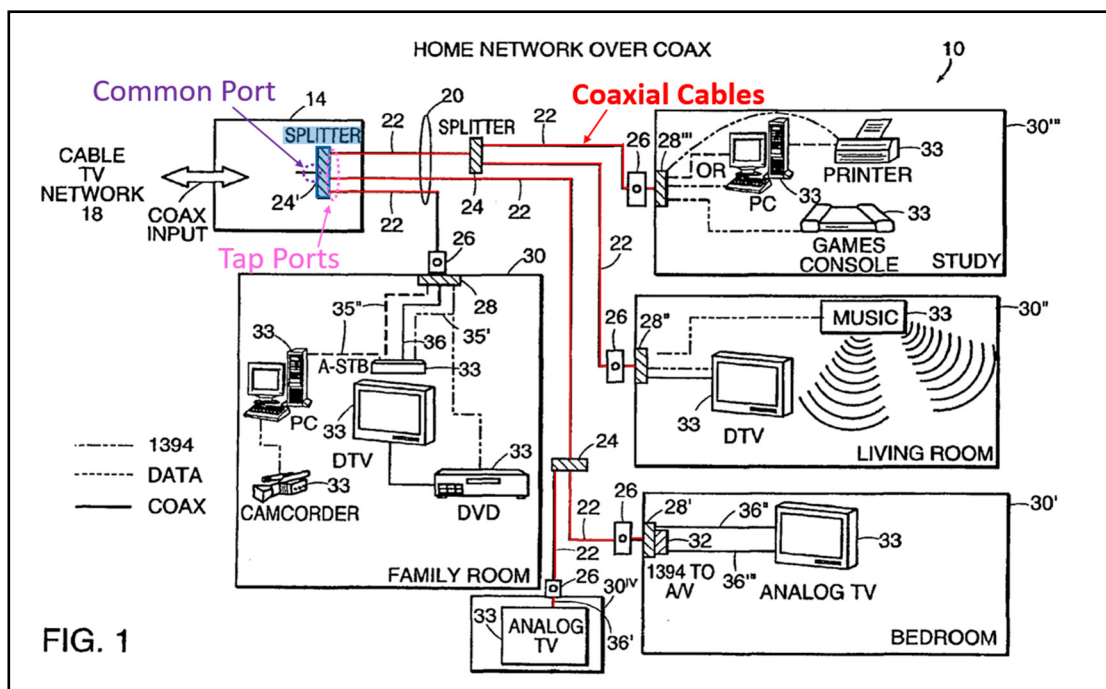
112. It is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

113. As an initial matter, I note that in wired networks splitters are not considered to be part of cable wiring per se. A POSITA would have understood that a splitter is a standalone component that can be connected to segments of cable wiring, e.g., coaxial cables. Indeed, the '518 patent describes “a coaxial wiring system” that includes a splitter and cable segments. DISH-1001, 5:14-16, 12:36-40. Therefore, a POSITA would understand the claimed feature of “cable wiring comprising a splitter ... and a plurality of segments of coaxial cable” to mean a splitter connected to cable wiring.

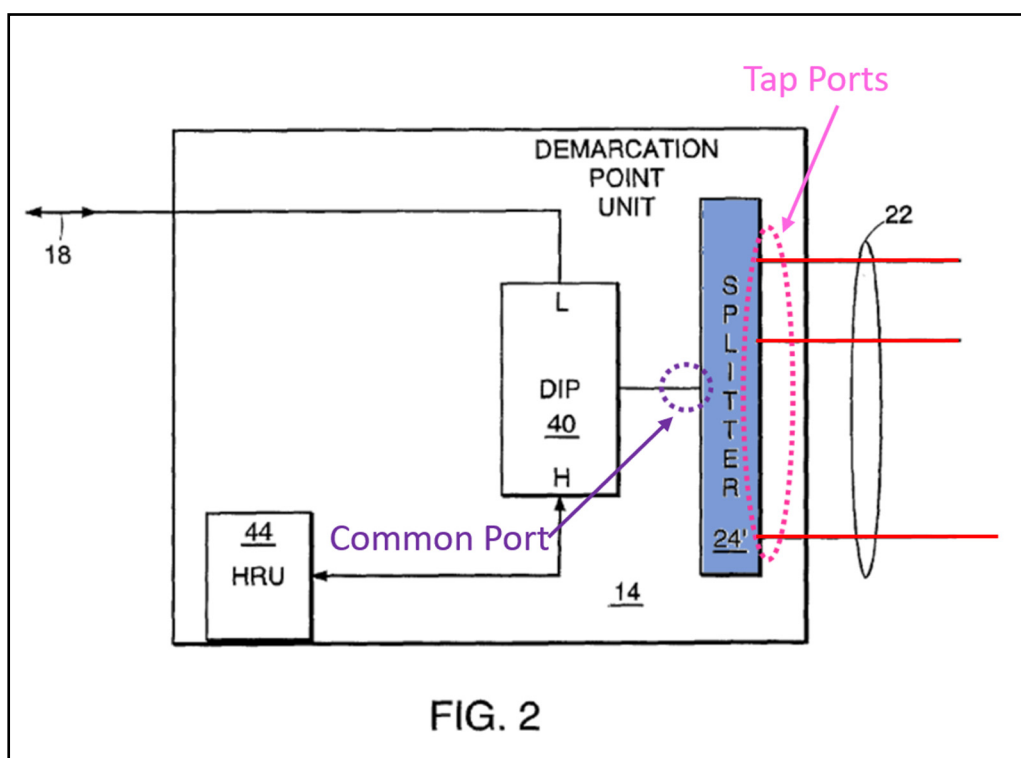
114. Turning to the claimed splitter, the '518 patent explains that “[s]ignal splitters ... have an input port and multiple output ports,” where “[t]he input port can also be considered a common port” and “[t]he output ports can also be considered tap ports.” *Id.*, 1:53-57.

115. Kliger explains that implementing the “home network 10 in the home does not require the rewiring of the cable TV equipment that is typically already installed in many homes for accessing the cable TV network 18 or the Internet.”

DISH-1007, ¶0041; DISH-1008, 6 (“With the described invention, the 1394 network standard can be delivered between rooms over existing wiring, at about 100 Mbps, eliminating the need to re-wire the house. The home network operates in parallel to the cable TV services”). Similar to the network devices of the ’518 patent, Kliger’s “HNMs 28 communicate with the DPU 14 and with each other over standard cable equipment,” which “includes coaxial (or coax) cables 22, splitters (generally 24), and cable TV outlets 26.” DISH-1007, ¶0041; DISH-1008, 7 (“Distributing of the Internet access signals throughout the house over the coax cables, turning every cable TV outlet in the home into an Internet access port”); DISH-1012, 5 (“A typical home architecture of coax cable includes power splitters. Power splitters are used to split the input signal (point A) to two or more outputs (points B and C in Figure 1), as depicted in Figure 1”), 7 (“The splitter splits the coax signal throughout the house.”); DISH-1001, Abstract.



Kliger, FIG. 1; *see also* DISH-1008, 7.



Kliger, FIG. 2; *see also* DISH-1012, Figure 5.

116. Figures 1-2 illustrate that Kliger's DPU 14 includes a splitter 24' that has an input port shown in purple ("common port") and a plurality of output ports shown in pink ("tap ports"). As also shown in Figures 1-2, coaxial cables 22 (red) include a plurality of segments and connect between the output ports ("tap ports") of the splitter 24' and the HNMs 28. Each of the other splitters 24 have similar features. It is my opinion that a POSITA would have understood, at least from Figures 1-2, that a plurality of segments of Kliger's coaxial cables connect between the splitter tap ports and the HNMs 28.

117. As a result, it is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

5. Element 1c

[1c] whereby network devices communicate with each other through the cable wiring using multi-carrier signaling

118. It is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

119. As I discussed previously in element [1a.ii], Kliger's HNMs 28 each include a multi-carrier modulator for generating multi-carrier RF signals and multi-carrier demodulators for processing received multi-carrier RF signals.

120. Additionally, Kliger explains that the "HNMs 28 communicate with the DPU 14 and with each other over standard cable equipment," which "includes

coaxial (or coax) cables 22, splitters (generally 24), and cable TV outlets 26.”

DISH-1007, ¶0041; DISH-1008, 7 (“All wires are standard in-house coax”), 10 (“The DM is connected between the Coax outlet and a data port of a data device. The interface to data device can be either Ethernet or USB or IEEE-1394.”). The “cable equipment operates as a backbone of the home network 10 for conveying intra-room communications.” DISH-1007, ¶0041; DISH-1008, 7; DISH-1009, 8 (“The system uses the existing in-house cable TV coax wires as a data and audio/video network, and an intra-room backbone for IEEE 1394 standard (Fire Wire) transmission”). The backbone 20 “includes a plurality of coax cables 22 that connect the cable TV outlets 26, and thus the HNMs 28, to the DPU 14.” DISH-1007, ¶0043; DISH-1008, 7 (“The following is a schematic diagram that describes the architecture of the solution”); DISH-1011, 8 (“Figure 5 depicts a logical diagram of the Home Network with four 1394 buses. Any number of buses can be supported by the proposed embodiment.”). These coax cables “distribute the signals received from the external network 18 and from the HNMs 28 to the rooms 30.” DISH-1007, ¶0043; DISH-1009, 6 (“The output-modulated signals are optionally up-converted (depending on its frequency allocation).”).

121. Because the HNMs 28 communicate using multi-carrier RF signaling and because the HNMs communicate with each other over cable wiring, a POSITA would have understood that the communication between the HNMs through the

cable wiring of the home network 10 is multi-carrier signaling, *i.e.*, the claimed “network devices communicate with each other through the cable wiring using multi-carrier signaling.

122. Isaksson confirms the understanding that network devices, e.g., modems, capable of multi-carrier signaling and that communicate with each other over cable wiring do so using multi-carrier signaling. In Isaksson’s multi-carrier transmission system implemented on copper pairs (*i.e.*, “cable wiring”), data is transmitted between transceivers (*i.e.*, “network devices”) by modulating said data onto a multiplicity of carrier waves in the form of multi-bit symbols (*i.e.*, “multi-carrier signaling”). DISH-1013, 5:15-36.

123. As a result, it is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

6. Element 1d.i

[1d.i] wherein network devices transmit probe messages through the cable wiring and analyze received probe message signals to determine channel characteristics and

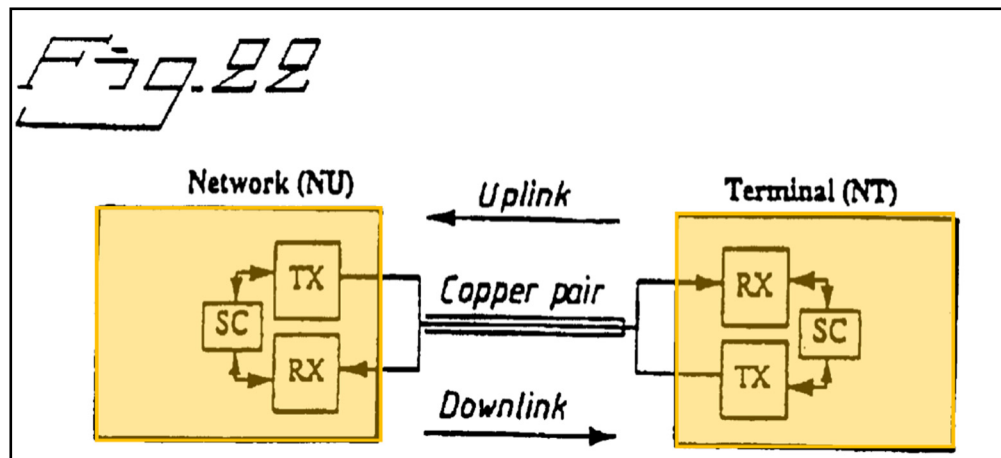
124. It is my opinion that the Kliger-Isaksson combination renders this limitation obvious. *See* paras. 118-123.

125. As an initial matter, it is relevant to understand how the ’518 patent describes using multi-carrier modulation with bit-loading and channel probes. “Bit-loading is a method of allocating a higher order signal constellation to carriers

that have higher signal to noise ratio and a lower order constellation to carriers that have lower signal to noise ratio.” DISH-1001, 8:9-12. The ’518 patent explains that “[p]robe messages are sent between devices to characterize the communication channel and determine optimum bit loading.” *Id.*, Abstract. These probe messages use “a predetermined bit sequence which in [sic] known by the receiving device.” *Id.*, 9:36-39. “By passing a known data sequence through the channel, the response of the channel can be determined, including multipath and SNR.” *Id.*, 9:39-41.

126. As I discussed above, Kliger’s HNMs 28 communicate with one another using multi-carrier signaling.

127. Isaksson similarly describes “a multi-carrier transmission system” that includes two multi-carrier transceivers/modems (i.e., “network devices), shown below in orange, that communicate using multi-carrier signaling. DISH-1013, Fig. 22, 1:1-18. As shown below, each transceiver has a receiver and a transmitter. *Id.*



Isaksson, Fig. 22.

128. In Isaksson's multi-carrier transmission system, the receivers (in both transceivers) "continuously measure[] and estimate[] **the characteristics and changes of/in the channel.**" *Id.*, 4:1-8. The "[c]hannel characteristics may be estimated by **periodic transmission**, by one of said transceivers, of **a base sync frame having a predetermined content** and comparing, in the other of said transceivers, **the received sync frame with a reference frame.**" *Id.*, 16:8-12; *see also id.*, 10:10-14. By having a transmitter (in one transceiver) transmit a base sync frame with predetermined content, which a receiver (in another transceiver) can compare with a reference frame, the receiver "can **estimate the characteristics of the channel**, over which the frame is transmitted, in terms of attenuation, phase shift and variance." *Id.*, 79:5-14. A POSITA would have understood that to estimate the characteristics of a channel using a received base sync frame, a receiver would compare a signal of the received frame to that of a reference frame to determine the attenuation, phase shift, and variance experienced by the signal over the channel.

129. Isaksson describes that the transceivers periodically transmit the base sync frames at a base sync interval (BSI): "base sync frames may be transmitted at intervals, the BSI, and said BSI being locked into said transceivers thereby enabling said transceivers to identify a frame as a sync frame." *Id.*, 16:15-20. In

addition to the periodic base sync frames, “[a]dditional sync frames may be transmitted at intervals between said base sync frames.” *Id.* Therefore, Isaksson’s transceivers transmit and receive multiple base sync frames to one another through the cable wiring.

130. It is my opinion that although Isaksson does not refer to the “base sync frame” as a “probe message,” a POSITA would have understood Isaksson’s base sync frame to be a “probe message” because Isaksson’s definition of “base sync frame” is effectively identical to the ’518 patent’s definition of “probe message.” The ’518 patent describes probe messages as using “a predetermined bit sequence which in [sic] known by the receiving device.” DISH-1001, 9:36-39. “By passing a known data sequence through the channel, the response of the channel can be determined, including multipath and SNR.” *Id.*, 9:39-41. As can be seen by comparing Isaksson’s definition with the ’518 patent’s definition, “base sync frame” and “probe message” are effectively the same as they both use a predetermined sequence to characterize a channel. And as admitted by the ’518 patent, using known predetermined sequences to characterize channels was well known in the art before the priority date of the ’518 patent. *Id.*, 10:12-16. Therefore, it is my opinion that Isaksson’s “base sync frame” is a “probe message” based on the context of the ’518 patent and the understanding of a POSITA.

131. As I explained above, a POSITA would have found it obvious to modify Kliger's system with Isaksson's method of "maintaining synchronism between two transceivers during dynamic system reconfiguration of bit-loading factors." DISH-1013, 4:21-25.

132. Here, each HNM 28 — as an uplink HNM 28 — would periodically transmit base sync frames, *i.e.*, probe messages, having predetermined content to other HNMs 28 — as downlink HNMs 28 — through coaxial cables (*i.e.*, the claimed "network devices transmit probe messages through the cable wiring"). *Id.*, 16:8-12. The downlink HNMs 28 would analyze the received base sync frames by comparing the frames with reference frames to determine channel characteristics. *Id.*, 79:9-14. In particular, the downlink HNMs 28 would analyze the signals of the base sync frames to characterize the channel in terms of attenuation, phase shift, and variance of the signals, *i.e.*, "analyze received probe message signals to determine channel characteristics." *Id.*, 16:15-20.

133. As a result, it is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

7. Element 1d.ii

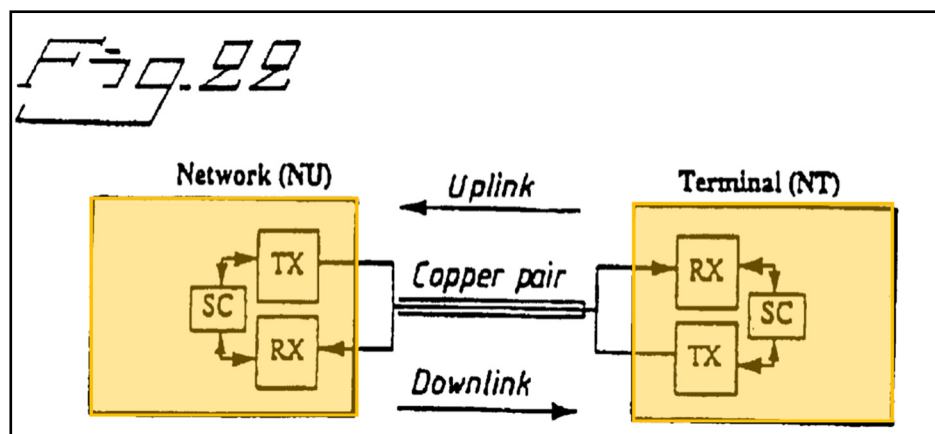
[1d.ii] bit loading is selected based on the determined channel characteristics.

134. It is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

135. As I discussed in the previous limitation, the Kliger-Isaksson HNMs 28 periodically transmit base sync frames through the cable wiring and analyze received base sync frame signals to determine channel characteristics.

136. Isaksson also discloses that bit-loading parameters are selected based on the determined channel characteristics.

137. In Isaksson's multi-carrier transmission system, "[d]ata is transmitted between the two transceivers using a plurality of carriers." DISH-1013, 25:26-26:20, 5:14-6:1. Isaksson teaches its transceivers can "dynamically chang[e] the number of coded/decoded bits per carrier wave." *Id.*, 4:1-20. To do so, each "receiver continuously measures and estimates the characteristics and changes of/in the channel. From this information, performance for each sub-channel (sub-wave) is identified. Then, on the basis of this information, reconfigurations of the transmitted number of bits per symbol for each single carrier wave are decided." *Id.*



Isaksson, Fig. 22.

138. More specifically, Isaksson’s receivers send information about the measured channels to the Isaksson’s transmitter in the uplink transceiver. *See id.*, 77:27-79:14. The transmitter in the uplink transceiver “obtains [the] information about measured channels from the uplink and downlink receivers.” *Id.* Then, the transmitter selects “the bit-loading for each carrier wave” and “transmits the bit-loading constellation (i.e., diagram) to the downlink transceiver.” *Id.* Once the transmitter receives confirmation from the downlink transceiver, the transmitter changes the bit-loading diagram in the uplink transceiver. *See id.*

139. Isaksson discloses that SNR is used to select bit-loading: “In systems that use bit-loading techniques, the number of transmitted bits per symbol is adapted, or regulated, to the [SNR] of the current carrier wave.” *Id.*, 3:24-27. To do so, the “individual carrier’s SNR is calculated on the receiver side.” *Id.*, 26:12-14. Then “the number of transmitted bits per symbol is adapted, or regulated, to the [SNR] of the current carrier wave.” *Id.*, 3:24-27. A POSITA would have understood that

Isaksson would use the aforementioned “determined channel characteristics” of “attenuation, phase shift and variance,” which are measured by the receivers, to calculate SNR and, in turn, select bit loading. *Id.*, 16:15-20. Indeed, Isaksson describes that in some scenarios “the SNR is given by: $SNR_i = W_i$ (4) where W_i is the **estimated interference variance**.” *Id.*, 56:3-8. Additionally, Ling provides the following equation for calculating SNR:

$$SNR_i = \frac{\overline{|x'_i|}^2}{\sigma_{n'}^2} .$$

DISH-1024, 14:5-10. In this equation, the $|x'_i|^2$ variable represents the power of a received signal in a channel (*id.*, 14:13-15)—which is affected by the attenuation in the channel—and the variable $\sigma_{n'}^2$ represents the noise variance in the channel (*id.*, 13:51-53).

140. As I explained above, a POSITA would have found it obvious to modify Kliger’s system with Isaksson’s method of “maintaining synchronism between two transceivers during dynamic system reconfiguration of bit-loading factors.” DISH-1013, 4:21-25. As I also discussed in the previous limitation, each Kliger HNM 28 — as an uplink HNM 28 — would periodically transmit base sync frames to other HNMs — as downlink HNMs 28. *Id.*, 16:8-12. Kliger’s downlink HNMs 28 would analyze the received base sync frames to determine channel characteristics.

Then, Kliger's downlink HNMs 28 would send information about the measured channels, e.g., SNR, to the transmitter HNM 28. *See id.*, 77:27-79:14. The uplink HNM 28 would obtain the information and select the bit-loading parameters for the channels based on the channel characteristics, *i.e.*, the claimed "bit loading is selected based on the determined channel characteristics"). *Id.*, 4:1-20.

141. As I explained previously, it is my opinion that a POSITA would have known how to incorporate Isaksson's method in Kliger's home network so that the bit-loading is synchronously updated across Kliger's HNMs 28. Moreover, a POSITA would have had a reasonable expectation that using Isaksson's method would allow for successful multi-carrier communication between Kliger's HNMs 28, given that Isaksson provides a method of improving multi-carrier communications by adapting bit-loading to the current conditions of the channel.

142. As a result, it is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

F. Claim 3

1. Element 3a

[3a] The data communication network of claim 1 wherein the network shares the cable wiring with a cable television service

143. It is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

144. According to Kliger, “each HNM 28 permits those devices 33 connected to that HNM 28 to communicate with other devices 33 in different rooms 30, **to receive programming from the cable television**, and to have broadband access to the Internet.” DISH-1007, ¶0050; DISH-1008, 10-11 (“The DM receives a data stream from a data device through its data port and converts it to a modulated analog signal over the coax cable, combined with the Cable TV stream”); DISH-1009, 5-6 (“The high speed data hub (or bridge) and routing functionality enables the distribution of externally generated data signals (Internet) to the in house data devices, as well as in house data networking between data devices and/or entertainment devices (like PCs and computer peripherals, DVD, TV”). Kliger gives an example of a digital television in the home network 10 receiving programming from the external cable television network 18. DISH-1007, ¶0050, *see also id.*, ¶0075 (combining the upstream with the CaTV signal for transmission over the home backbone); DISH-1008, 10-11 (“The DM receives a data stream from a data device through its data port and converts it to a modulated analog signal over the coax cable, combined with the Cable TV stream”); DISH-1012, 6 (“It combines the home network signal and the Cable TV signals. The combined signal is carried over the internal coax wires”).

145. As a result, it is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

2. Element 3b

[3b] and the network device up converter translates the modulated data to an RF carrier frequency above the frequency used by the cable television service.

146. It is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

147. As I discussed in element 1a.ii, Kliger discloses an up-converter that translates the modulated data to an RF carrier frequency.

148. Kliger discloses that the “CaTV signal (including the signal from Internet providers) is in the frequency range of 5 to 860 MHz.” DISH-1007, ¶0061; DISH-1010, 4-5 (“TV signals (frequencies of 5-860 MHz”). Conversely, “[t]he home network signal transmitted over the home network backbone 20 is in the 960 to 1046 MHz frequency range, but other frequency bands above the CaTV signals can be used.” DISH-1007, ¶0061; DISH-1010, 4-5 (“In one embodiment of the home network, the home network uses frequencies that are above the frequency band that is used by the Cable TV, i.e. at frequencies above 850 MHz;” “It should be noted that the frequency band between 960 MHz and 1200 MHz is allocated by FCC for aviation services. This makes it ideal for home networking, since no coexistence is expected with aviation signals.”).

149. As a result, it is my opinion that the Kliger-Isaksson combination renders this limitation obvious.

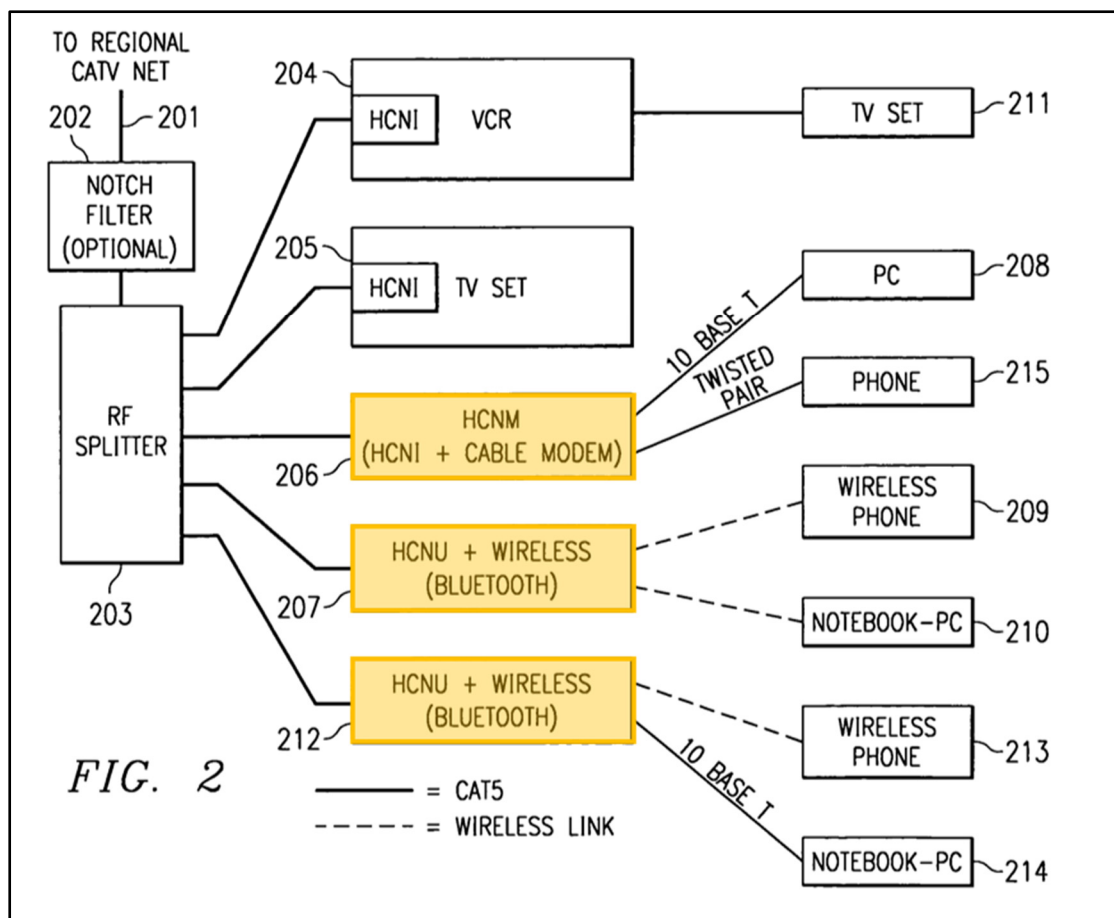
VIII. GROUND 2 – AMIT IN VIEW OF JACOBSEN AND ISAKSSON

A. Overview of Amit

150. Amit is a U.S. Patent that is entitled “System and Methods for Home Network Communications.” DISH-1014, Cover. Amit was filed on April 12, 2000 and I understand qualifies as prior art at least under §102(e). *Id.*

151. Amit describes “a system and methods for communication between subscribers’ devices over cable infrastructure designed to carry video signals.” *Id.*, 2:34-36. Amit, like the ’518 patent, explains how to provide “home networking over coaxial TV cables.” *Id.*, 2:39-40; *see* DISH-1001, Abstract. This networking “is based on direct communications between two subscribers’ devices, without transferring the data via a headend.” DISH-1014, 2:63-67.

152. Amit depicts the home network, called Home Cable Network (HomeCN or HCN), in Figure 2. *Id.*, FIG. 2. Also like the ’518 patent, Amit’s HomeCN incorporates network devices, which are shown below in Figure 2 in orange, into the CATV infrastructure to enable networking over coaxial TV cables. *See id.*, 3:10-12; *see* DISH-1001, 4:35-47, Fig. 2, 8:1-3.



Amit, FIG. 2.

153. Note that there are a few typos in Figure 2. First, the figure legend reads “CAT5,” but it should read “CATV” instead. Amit explains that the home signals in Figure 2 propagate “in the CATV wires” and does not mention “CAT5” wires at all when describing the HomeCN. *See* DISH-1014, 6:59-60. Additionally, Figure 1 of Amit’s provisional application, U.S. Provisional Appl. No. 60/128,810, which corresponds to Figure 2 of Amit, identifies the solid lines as “CATV” wires (and not as CAT5 wires). DISH-1015, 9. Second, Amit defines the HCNM as “[a] component that include[s] **HCN-U and [a] cable modem.**” DISH-1014, 6:15.

Therefore, instead of reading “HCNI + CABLE MODEM,” box 206 should read **“HCNU + CABLE MODEM.”**

154. Amit’s home network devices include Home Cable Networking Units (HCNUs). *Id.*, 6:7-16. Amit explains that the HCNU is “a component that suppl[ies] connection to the Home Cable Networking. This component is a separate unit that contains one or more interfaces to the home equipment (e.g. 10BaseT, USB, wireless). This component does bridging or routing between the HCN to the other interfaces (networks) [207,212].” *Id.*, 6:7-13. Amit also explains that “[t]he HCNU devices are capable of transmitting and receiving digital communications signals between them. These signals propagate in the CATV wires and are reflected by the RF splitter [203].” *Id.*, 6:57-60. In particular, the devices “communicate directly (not via the headend) using RF signaling over the coax cable.” *Id.*, 3:19-21.

155. Amit’s home network devices also include a Home Cable Networking Modem (HCNM), which Amit explains is “[a] component that include[s] [an] HCN-U and [a] cable modem (e.g. DOCSIS cable modem).” *Id.*, 6:3-23. The HCNUs and the HCNMs are also referred to as HCN devices. *See id.*, claim 13.

156. Amit explains that home networking “is a key technology for the evolving home infotainment market.” *Id.*, 1:16-18. “Home networks will connect between computing devices (personal computers, palm computers, network computers,

etc.), entertainment devices (TV, VCR, DVD player, video camera, audio systems, etc.), I/O devices (printer, scanner, head-sets, keyboards, remote controls, mouse, loud-speakers, etc.), home appliances, and modems (such as cable modems, DSL modems, and PSTN modems) that connect the home outside.” *Id.*, 1:18-26. These home networks will “enable a wide range of application[s] such as internet sharing, peripheral sharing, file and application sharing, and home automation.” *Id.*, 1:26-28. To that end, Amit’s “disclosed system will allow very high-speed digital and analog communications within the home and from the home to external devices or networks using low cost devices.” *Id.*, 2:40-43.

B. Overview of Jacobsen

157. Jacobsen is a paper entitled “An Efficient Digital Modulation Scheme for Multimedia Transmission on the Cable Television Network.” DISH-1016, 305. Jacobsen was published on September 19, 1995 and, thus, was publicly available no later than September 19, 1995. I understand Jacobsen qualifies as prior art under at least §102(b). DISH-1016, Cover; DISH-1006, ¶9.

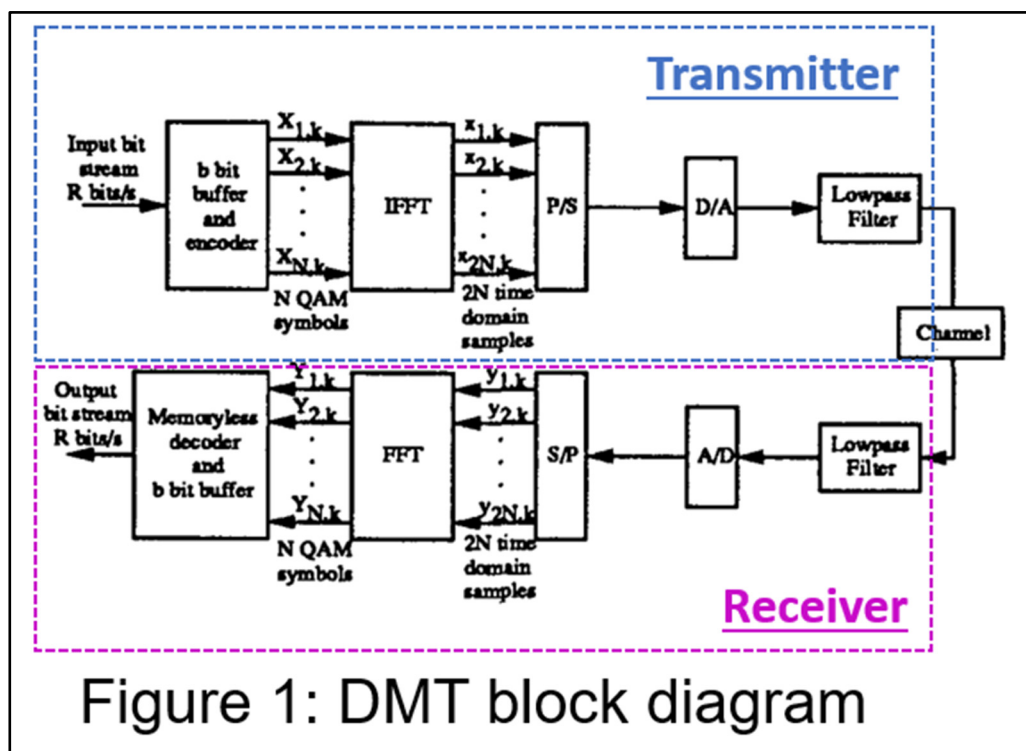
158. Jacobsen studies “[t]he feasibility of offering high-speed interactive data services to customers on CATV networks or similar broadband coaxial networks.” DISH-1016, 305. Jacobsen recognizes that “there are several electrical transmission problems that must be overcome before these services can be supplied reliably over CATV networks.” *Id.* For example, Jacobsen explains 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.* Jacobsen also explains 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.* Jacobsen recognizes that “[w]ithout some scheme to combat ISI, a receiver would make detection errors.” *Id.*

159. Jacobsen “discuss[es] two candidate techniques for multimedia transmission on the CATV network: single-carrier quadrature amplitude modulation (QAM) with equalization and multicarrier modulation” for addressing the signal impairment problems. *Id.*, 306. Jacobsen concludes that “multitone modulation is more computationally efficient than single-carrier modulation ... for the transmission of digital data over CATV channels.” *Id.*, 312. Additionally, multicarrier modulation “is able to reduce the effects of various distortions on a CATV network, including microreflections.” *Id.*, 305.

160. Jacobsen proposes using multi-carrier modulation for the transmission of digital data over a CATV network, which is like the solution proposed by the ’518 patent. *Id.* For example, like the ’518 patent, Jacobsen proposes using “[d]iscrete multitone modulation (DMT), a common form of multicarrier modulation.” *Id.*, 306; *see* DISH-1001, 7:22-27.

161. In Figure 1, Jacobsen Figure 1 illustrates a block diagram of a DMT transmitter (blue) and receiver (purple). DISH-1016, 307.



Jacobsen, Figure 1.

162. Jacobsen discusses multimedia transmission on CATV networks because of the potential for “offering high-speed interactive data services to customers on CATV networks or similar broadband coaxial networks.” *Id.*, 305. “With over 92% of the homes in the United States passed by cable,” Jacobsen explains that “the CATV network is a potential supplier of these interactive data services.” *Id.*

C. Combining the References

163. As I explain below, the Amit-Jacobsen combination improves Amit’s coaxial HomeCN by incorporating Jacobsen’s techniques for multi-carrier

signaling on coaxial cables into Amit's HCN devices. Jacobsen's multi-carrier signaling provides several improvements. First, Jacobsen's multi-carrier signaling is more computationally efficient over coaxial cables than Amit's single-carrier modulation. Second, Jacobsen's multi-carrier signaling also reduces the effects of distortions, e.g., reflections, and other potential signal impairments on coaxial cables. Jacobsen² explains these benefits of multi-carrier signaling:

DMT ... 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-1023, 375.

164. In my opinion, a POSITA would have further combined Amit-Jacobsen's HCN devices with Isaksson's synchronized bit-loading, i.e., synchronizing the number of bits-per-carrier across modems in a multi-carrier system. As I explain in more detail below, Isaksson's techniques would have helped avoid the multi-carrier signaling between Amit-Jacobsen's HCN devices failing, perhaps, due to a transmitter HCN device sending more or fewer bits-per-carrier than a receiver HCN device expects. Additionally, Isaksson's techniques would achieve a dynamic and synchronized communication channel for bit-loading configurations between Amit-Jacobsen's HCNs. This in turn would assist in the correct setting of bits-per-channel configurations at each HCN device in Amit-Jacobsen's HomeCN.

1. Motivation/Rationale

165. In the Amit-Jacobsen combination, a POSITA seeking to implement Amit's coaxial HomeCN would have understood that there can be "houses where there is a problem with reflection" (DISH-1014, 20:42-43) even though "coax cable is an excellent communication medium" (*id.*, 2:51-53). Indeed, Amit identifies "[t]he 'hidden nodes' problem" and "[h]igh reflection" as "some RF challenges in designing the HomeCN components." *Id.*, 13:54-14:1. Moreover, Amit recognizes that the "channel conditions" in a network can vary and necessitate the network implementing different communication techniques based on those conditions. *Id.*, 8:30-32.

166. Jacobsen observes similar potential problems in coaxial networks. For example, Jacobsen remarks that standard coaxial network equipment, such as, "[t]aps, amplifiers, and splitters," "can all cause signals to be reflected at their insertion points." DISH-1016, 305. The resulting "[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.* "Depending on the absolute deviations of the channel magnitude response (which are determined by the magnitudes of impedance mismatches on a CATV system) and the frequency with which those deviations occur in the frequency response (which depends on the length of coaxial cable between mismatches), a given symbol could

interfere significantly with a large number of adjacent symbols.” *Id.* Simply put, impedance mismatches cause reflections, which in turn cause ISI. Jacobsen also observes that “[a] second source of signal degradation in CATV networks is interference from other signals.” *Id.*, 306.

167. Jacobsen describes techniques for overcoming these potential signal impairments in coaxial networks. *See id.*, 305-306. In particular, Jacobsen “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. Jacobsen finds that multi-carrier modulation “is able to reduce the effects of various distortions on a CATV network, including microreflections and interference” (*id.*) and “can easily adapt to a variety of channel degradations” (*id.*, 312). Additionally, Jacobsen determines that multi-carrier modulation “is more computationally efficient than single-carrier modulation with equalization for the transmission of digital data over CATV channels.” *Id.* Jacobsen concludes that “multicarrier modulation appears to be better equipped than single-carrier modulation” for achieving a reliable digital communication system on a coaxial CATV network. *Id.*

168. A POSITA would have been motivated to improve Amit-Isaksson’s HomeCN using Jacobsen’s multi-carrier modulation. Indeed, Amit recognizes that “signals will typically propagate between the devices via reflections from other

devices in the line” (DISH-1014, 3:19-23) and that there can be “houses where there is a problem with reflection” (*id.*, 20:42-43). 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 signal reflections in the coaxial network and result in ISI. DISH-1016, 305.

169. More specifically, a POSITA implementing Amit-Isaksson’s coaxial HomeCN would have been motivated to solve Amit’s “RF challenges” using techniques from analogous coaxial networking publications that address broadband coaxial networks, including Jacobsen. Specifically, a POSITA would have been motivated to improve Amit-Isaksson’s coaxial HomeCN using Jacobsen’s teachings of multi-carrier modulation. As I explained, Amit acknowledges that there is a desire to avoid signal impairments in coaxial networks, such as high reflections, and Jacobsen teaches techniques for overcoming those potential impairments using multi-carrier modulation. DISH-1014, 3:19-23, 20:42-43; DISH-1016, 305.

170. A POSITA would have been motivated to combine the teachings of Amit, Isaksson, and Jacobsen because they each deal with developing coaxial networks for digital communications and overcoming potential signal impairments that could impede that goal. Specifically, a POSITA would have understood that implementing Jacobsen’s techniques in Amit’s HomeCN would help achieve

Amit's goal of overcoming potential signal impairments in its coaxial network.

Both Amit and Jacobsen also recognize that providing high-speed data services on existing coaxial wiring, *e.g.*, CATV infrastructure, is a motivator for implementing broadband coaxial networks. *See* DISH-1014, 2:40-43; DISH-1016, 305.

171. Amit briefly discusses modulation techniques that can be used in its HomeCN. Amit states that “[v]arious types of modulation can be used” by the HCN devices. DISH-1014, 25:1-2. The modulation types can be “QPSK, QAM 16, QAM 64 or QAM 256 according to the channel conditions, and according to the equipment capabilities.” *Id.*, 8:30-33.

172. A POSITA would have understood that Amit's modulation schemes are single-carrier modulation schemes. A POSITA would have reached this understanding based on several statements by Amit. First, Amit states “2. Home Networking Channel. The Home Networking channel (**a single channel** that is used for sending and receiving information).” *Id.*, 15:26-28. Second, the Amit-Provisional states that “[t]he TV cable can supply wide spectrum connectivity. Therefore, it can be used to transfer some group of channels simultaneously. Our solution is based on adding **a specific channel** for home networking.” DISH-1015, 22. This understanding is also supported by DSL Simulation Techniques, which identifies QAM — a modulation scheme disclosed by Amit — as a single-carrier system, and Jacobsen², which identifies QPSK — another modulation

scheme disclosed by Amit — as a single-carrier system. DISH-1021, 208 (“Discrete MultiTone (DMT) ... [uses] multiple numbers of carriers. QAM and CAP are called single-carrier systems.”); DISH-1023, 375 (“Practical single-carrier transceivers, such as QPSK...”).

173. A POSITA would have understood that Jacobsen teaches that single-carrier modulation depends on the average or overall capacity of the channel to be able to deliver the desired data rate. DISH-1016, 310. As a result, reflections, distortions, interference will degrade a single-carrier system more than a multi-carrier system. *Id.*, 312. Based on Amit’s suggestion that “there is a problem with reflection,” a POSITA would have understood that implementing Jacobsen’s multi-carrier techniques into Amit-Isaksson’s HCN devices would address the issues Amit seeks to solve. DISH-1014, 20:42-43. In view of Jacobsen’s findings that multi-carrier modulation is superior to single-carrier modulation for digital communications over a CATV network, a POSITA would have been further motivated to use the multi-carrier teachings of Jacobsen to modify Amit-Isaksson’s HCN devices to use multi-carrier signaling. *See* DISH-1016, 312.

174. I note that Amit briefly addresses a solution to echoing in its network by mentioning a “two-frequency mode [that] exists to eliminate the echo problem in some of the homes in the single frequency mode.” DISH-1014, 20:15-31. “In the Dual Frequencies Mode the Transponder module is required to be added in the

entrance to the home ... The transponder module changes the signal frequency from the US frequency to the DS frequency and transmits it to the home.” *Id.* In this mode, information is transmitted in a specific frequency range (e.g., 900–906 MHz) and received in a different frequency range (e.g., 910–916 MHz). *See id.* This solution is at best an alternative to using multi-carrier modulation. It is my opinion that Amit’s alternative does not teach away from using multi-carrier modulation because Amit teaches that this alternative is *only* viable in *some* particular instances (i.e., in “some of the homes in the single frequency mode”). Thus, it does not rise to the level required to criticize, discredit, or otherwise discourage using multi-carrier modulation.

175. Jacobsen explains how to implement multi-carrier signaling on coaxial cables, and specifically, how to implement DMT. Jacobsen states that “a channel is divided into N equal-bandwidth subchannels each with its own carrier.” DISH-1016, 306. “Each subchannel ... supports its own QAM constellation.” *Id.*, 307. The number of bits in each subchannel is “originally assigned ... in direct proportion to the subchannel signal-to-noise ratios.” *Id.* “[T]he bit distribution is continuously updated during transmission as the receiver sends the required information to the transmitter.” *Id.* Updating the bit distribution is known as bit-loading. In view of Jacobsen’s description of DMT, Amit-Isaksson’s HCN devices implement multi-carrier modulation with bit-loading.

176. In the combined Amit-Jacobsen-Isaksson HomeCN, Amit-Jacobsen-Isaksson's HCN devices would use multi-carrier signaling with bit-loading to communicate on the coaxial cables of Amit's coaxial HomeCN. A POSITA would have understood that Amit-Jacobsen-Isaksson's HCN devices would overcome the potential channel impairments on the coaxial cables of the HomeCN. In the signaling between Amit's HCN devices, "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.* This "alleviate[s] the problems caused by both frequency-domain ripple and interferers." *Id.* Further, "because the bit distribution is continuously updated during transmission," Amit-Jacobsen-Isaksson's HCN devices can tolerate "even severe and unpredictable interference." *Id.* For instance, "[i]f the noise on a subchannel becomes severe," Amit-Jacobsen-Isaksson's HCN devices "simply assign[] fewer or no bits to that subchannel while the noise persists." *Id.*

177. Isaksson, like Jacobsen, explains that in multi-carrier modulation "the available bandwidth is divided into a plurality of sub-channels each with a small bandwidth." DISH-1013, 1:19-26. Isaksson, also like Jacobsen, recognizes that multi-carrier systems use bit-loading where the number of bits per subchannel is determined based on the SNR of the subchannel. *See id.*, 3:24-34 ("In systems that

use bit-loading techniques, the number of transmitted bits per symbol is adapted, or regulated, to the signal-to-noise ratio (SNR) of the current carrier.”).

178. Isaksson also recognizes that bit-loading “dynamically affects, in time, the total bandwidth of the system.” *Id.* “This variation in bandwidth leads to an absolute system requirement for synchronous configuration of the transmitter and the receiver, in terms of the number of coded/decoded bits per symbol and carrier wave. If this requirement is not met, the system will be unable to maintain a connection.” *Id.* Isaksson teaches a solution for “maintaining synchronism between two transceivers during dynamic system reconfiguration of bit-loading factors.” *Id.*, 4:21-25. As I explained previously, Isaksson’s solution involves the transceivers sending, receiving, and analyzing base sync frames to determine channel conditions based of which bit-loading is selected.

179. A POSITA would have been motivated to combine Amit’s HCN devices with Jacobsen’s multi-carrier signaling and Isaksson’s synchronized bit-loading. As I discuss above, a POSITA would have been motivated to improve Amit’s HCN devices with Jacobsen’s multi-carrier modulation that uses bit-loading. Jacobsen recognizes that the “bits are originally assigned to subchannels just after training during system initialization,” and “the bit distribution is continuously updated during transmission as the receiver sends the required information to the transmitter on secure overhead channels.” DISH-1016, 307. In view of this, a

POSITA would have recognized that Amit-Jacobsen's HCN devices, which are bi-directional communication devices, would need to synchronize "the bit distribution" between the devices. Thus, a POSITA would have been further motivated to implement Isaksson's multi-carrier improvements to maintain connections between Amit-Jacobsen's multi-carrier HCN devices using synchronized bit-loading in which the bit-loading parameters are based on channel characteristics. *Id.*, 3:24-34. Specifically, Isaksson's synchronized bit-loading synchronizes the bit-loading parameters between the Amit-Jacobsen-Isaksson HCN devices such that the HCN devices are aware of the bit-loading parameters assigned to the carriers in the channels between them. This would prevent the connections between the Amit-Jacobsen-Isaksson HCN devices from failing due to one HCN device sending more/fewer bits per carrier than another HNC device expects. As such, a POSITA would have looked to Isaksson for details on how to implement synchronized bit-loading.

180. As I explained previously, Isaksson's bit-loading determines the number of bits each carrier carries based on each carrier's respective channel characteristics. *Id.* Accordingly, Amit's HCN devices would determine each carrier's channel characteristics to determine the number of bits to transmit on each carrier in Jacobsen's multi-carrier modulation. To do so, each Amit-Jacobsen-Isaksson HCN device — as a transmitter — would transmit Isaksson's base sync frames having

predetermined content to the other HCN devices over respective channels between the HCN devices. The other HCN devices — as receivers — would analyze Isaksson's received base sync frames to determine channel characteristics of the respective channels. The transmitter HCN device would obtain information about the channel characteristics, e.g., SNR, from the receiver HCN devices and select the bit-loading parameters for the respective channels based on the received information to use in Jacobsen's multi-carrier signaling. The transmitter HCN device would communicate the bit-loading parameters to the receiver HCN devices and would implement the bit-loading parameters in the transmitter HCN device's multi-carrier signaling with the receiver HCN devices. Similarly, the receiver HCN devices would implement the bit-loading in their respective communications with the transmitter HCN device. This process is performed for each HCN device as each HCN device is communicating with other HCN devices.

181. It is my opinion that a POSITA reading Amit's and Jacobsen's teachings about coaxial networks would have been motivated to improve such networks with methods used in related wired networks, such as Isaksson's copper telephone network. The three references demonstrate the relatedness between coaxial and non-coaxial wired networks. For example, Amit explains the relatedness of its network and VDSL by explaining that, unlike prior networking solutions, its HomeCN does not interfere with VDSL. *See* DISH-1014, 28:67. Indeed, Amit

describes using the home's cable network to connect to non-cable infrastructures, e.g., "access network (xDSL)." *Id.*, 2:24-30. And Isaksson recognizes that its features can extend to coaxial networks. *See* DISH-1013, 1:8-18, 3:4-15. Thus, a POSITA implementing coaxial multi-carrier networks according to Amit and Jacobsen would have been motivated to improve such networks with Isaksson's methods used in related wired networks.

182. It is my opinion that a POSITA would have considered the Amit-Jacobsen-Isaksson combination to be an example of (1) use of known techniques (Isaksson's techniques for synchronized bit-loading that involve modems transmitting and analyzing base sync frames for determining channel conditions to select bit-loading) to improve similar devices (Amit's HCN devices that use multi-carrier signaling with bit-loading) in the same way (overcoming interference and maintain connections with other HCN devices); (2) a teaching, suggestion, or motivation in Isaksson that would have led a POSITA to implement the Amit-Jacobsen combination with Isaksson's techniques for synchronized bit-loading; and (3) combining prior art elements (Isaksson's techniques for synchronized bit-loading) according to known methods to yield predictable results (Amit's HCN devices using synchronized bit-loading with multi-carrier signaling to overcome interference and maintain connections with other HCN devices).

183. Additionally, Amit, Jacobsen, and Isaksson are analogous art to the '518 patent. I previously explained why Isaksson is analogous art. Amit and Jacobsen are similarly analogous art because they are from the same field of endeavor and are reasonably pertinent to the particular problem at issue in the '518 patent.

184. **First**, each of Amit, Isaksson, and Jacobsen are in the same field of endeavor as the '518 patent (i.e., wired networking systems using coaxial cables).

See DISH-1001, Abstract; DISH-1013, 1:9-17; DISH-1014, 1:9-12; DISH-1016,

305. **Second**, Amit, Isaksson, and Jacobsen are reasonably pertinent to the particular problem at issue in the '518 patent. As I explained previously, the particular problem at issue in the '518 patent is a interference caused due to a multipath environment. As I also explained, Isaksson is reasonably pertinent to addressing multipath environment issues. Similarly, both Amit and Jacobsen are also reasonably pertinent to addressing multipath environment issues. Amit recognizes that the “channel conditions” in a network can vary and necessitate the network implementing different communication techniques. DISH-1014, 8:30-32. And Jacobsen addresses the same multipath environment issues discussed in the '518 patent, including signal reflections and interference. DISH-1016, 305-306.

2. Reasonable Expectation of Success

185. A POSITA would have had a reasonable expectation that the Amit-Jacobsen combination would produce a successful outcome. A POSITA implementing

Amit's HomeCN would have been familiar with references describing similar coaxial networks capable of delivering high-speed data and the methods for implementing such networks. Moreover, the POSITA would have looked to these other references, such as Jacobsen, when determining how to implement Amit's high-speed coaxial HomeCN. *See* DISH-1016, 305-306. Due to the similarity in these high-speed coaxial networks, a POSITA would have had a reasonable expectation that the combination would produce a successful outcome.

186. Given Amit's discussions of limited networking resources and varying channel conditions (DISH-1014, 8:30-32, 9:56, 19:32-37), the idea of using Jacobsen's multi-carrier modulation to accommodate communications using signals in different noise environments and with different interferers would have been straightforward to a POSITA. A POSITA would have expected Jacobsen's digital modulation technique of multi-carrier modulation to work in Amit's HomeCN because the HomeCN already employed digital modulation techniques. DISH-1014, 8:30-33, 25:1-2.

187. Moreover, implementing Jacobsen's multi-carrier modulation in Amit's HomeCN would have been within the skill level of a POSITA because it was a well-known technique used in many applications and taught in a variety of engineering and/or math courses that a POSITA would have been familiar with.

Indeed, both single-carrier and multi-carrier modulation were well known in the art at least by the year 2000.

188. Additionally, a POSITA would have had a reasonable expectation that the Amit-Jacobsen-Isaksson combination would produce a successful outcome. The Amit-Jacobsen combination already teaches multi-carrier modulation in wired networks, and therefore, applying Isaksson's multi-carrier teachings would have been using known techniques to improve similar devices in the same way. *See* DISH-1014, 1:9-12; DISH-1016, 305. Indeed, Isaksson states, "[i]t should be emphasised [sic] that the present invention can be used not only with the MUSIC system as herein described, but with other multi-carrier systems." DISH-1013, 72:5-8.

189. Given the teachings of using (single-carrier) modulation in Amit, the concept of building upon modulation and implementing multi-carrier modulation, as described in Jacobsen and Isaksson, would have been straightforward from a POSITA's perspective.

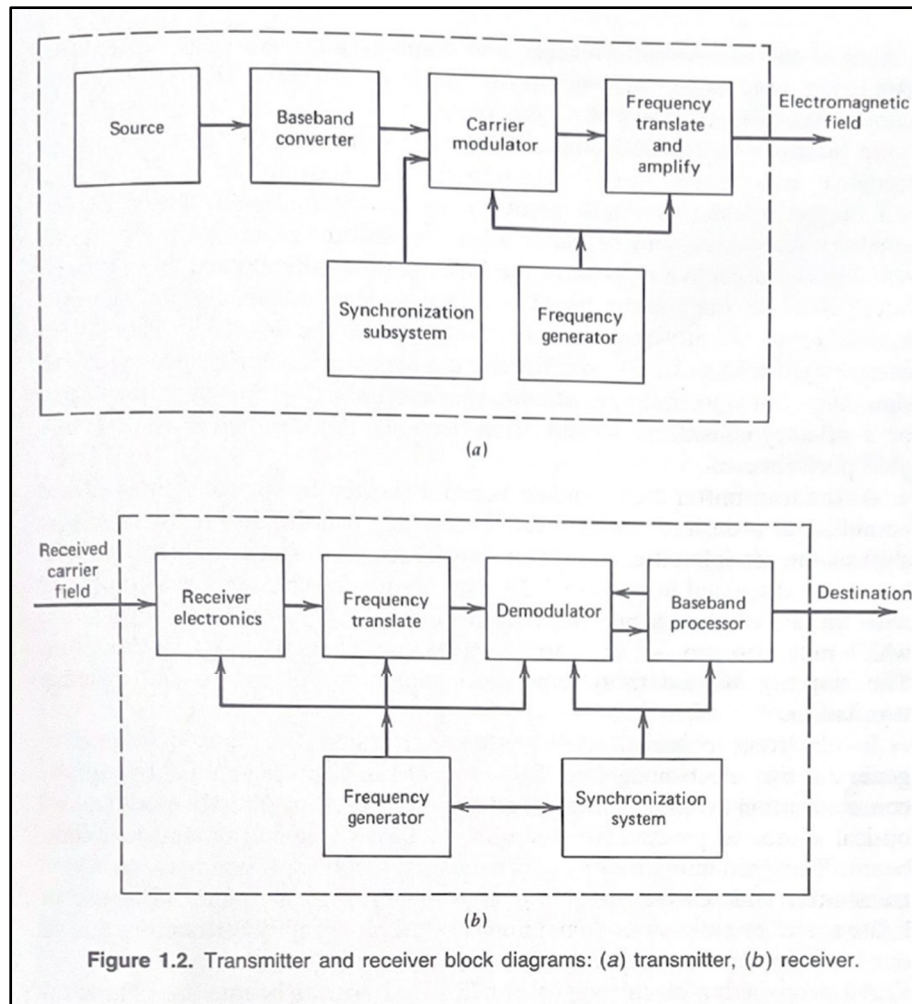
190. The POSITA would have expected Isaksson's teachings of multi-carrier modulation to work in the context of the Amit-Jacobsen network because it already employed multi-carrier modulation and described features similar to Isaksson.

Like Isaksson's system in which the "bit-loading factors are calculated in an initial training" (DISH-1013, 54), Jacobsen also describes that "bits are originally

assigned to subchannels just after training during system initialization” (DISH-1016, 307). And like Isaksson’s system in which “the number of transmitted bits ... is adapted, or regulated, to the [SNR] of the current carrier wave” (DISH-1013, Abstract), “bits are originally assigned to subchannels ... in direct proportion to the sub-channel [SNR]” (DISH-1016, 307).

191. It is my opinion that Isaksson’s method amounts to a straightforward adaptation that permits dynamic adjustments to the bit-loading to maintain connectivity between the Amit-Jacobsen-Isaksson HCN devices on Amit’s HomeCN. DISH-1013, 3:24-34. It is also my opinion that implementing the multi-carrier modulation improvements of Isaksson would have been within the skill level of a POSITA because it and similar modulation schemes were used in a variety of engineering applications and taught in engineering courses that a POSITA would have taken.

192. It was known in the art that a POSITA could modify single-carrier modulation systems to become multi-carrier modulation systems. As an example, Gagliardi, which is an undergraduate-level textbook authority published in 1988, describes a single-carrier transceiver system and explains that the system can be extended to a multi-carrier system. The transceiver system is shown in Figure 1.2.



DISH-1017, 3.

193. Gagliardi explains that “[t]he system model shown in Figure 1.2 implies that a single carrier is involved.” Further:

In discussing more advanced modern communication systems, however, we extend this basic model to include the case where more than one simultaneous carrier is involved in the transmitting operation. Such a system is called a multiple carrier system, and its analysis requires modification and extension of many of the results to be derived for the single carrier case.

Id., 5.

194. A POSITA would have also understood there to be significant teaching in the prior art that would have led a POSITA to modify Amit and Isaksson with Jacobsen's multi-carrier modulation techniques. For example, DSL Simulation Techniques, which I mentioned previously is a textbook with a copyright date of 1998 that was cited in the '518 patent's specification, describes the relationship between single-carrier and multi-carrier modulation. DSL Simulation Techniques explains:

A baseband line code usually consists of many parity symmetric and equally spaced signal levels. Passband single carrier line codes, such as Quadrature Amplitude Modulation (QAM) and Carrierless AM/PM (CAP), have also been proposed for DSL systems. A passband single carrier line code has a two-dimensional signal. The two-dimensional signal is divided into an in-phase channel and a quadrature channel implemented by the cosine and sine phases of the single carrier, respectively.

...

The Discrete MultiTone (DMT) line code is the standard for ADSL. A DMT line code consists of a multiple of single carriers implemented through the Discrete Fourier Transform (DFT) ... Each carrier of a DMT line code has the same two-dimensional signal as that of a passband single carrier system.

DISH-1021, 116.

195. U.S. Patent No. 5,822,372 (Emami) — filed in 1996 and published in 1998 — highlights that multi-carrier modulation at the time was gaining popularity over single-carrier modulation for the transmission of digital signals, e.g., for its ability to optimize bandwidth. Emami states:

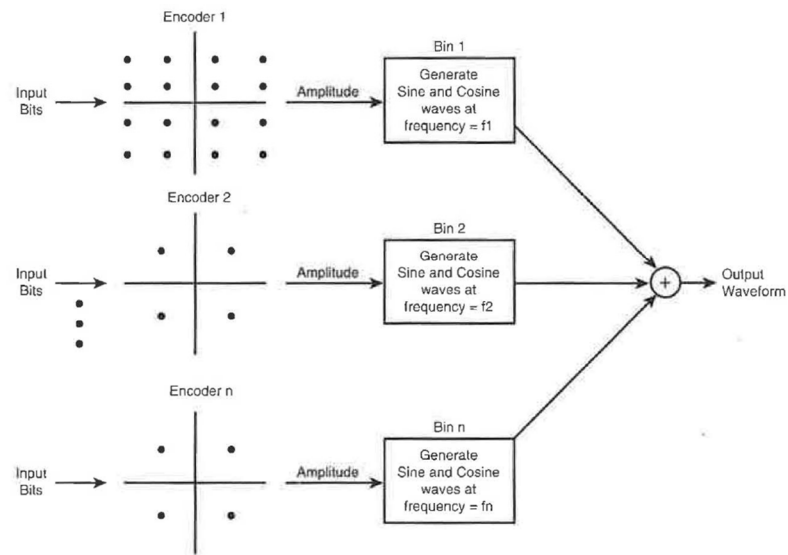
Multicarrier modulation has been gaining popularity over single carrier modulation for the transmission of wireless digital signals in a radio communication system. Multicarrier modulation offers increase flexibility over a single carrier modulation by providing opportunities to optimize transmission bandwidth.

DISH-1018, 1:12-17.

196. ADSL/VDSL Principles, which as I mentioned is a textbook with a copyright date of 1999 that was cited in the '518 patent's specification, describes multi-carrier modulation (also called multi-tone modulation) as follows:

Multi tone modulation is the basis of the DMT version of ADSL as well as some multicarrier versions of VDSL. This type of modulation is sometimes called orthogonal frequency division multiplexing (OFDM). For simplicity, this book simply refers to multitone modulation as DMT. DMT builds on some of the ideas of QAM. Imagine having more than one constellation encoder. Each encoder receives a set of bits that are encoded using a constellation encoder as described in the previous sections. The output values from the constellation encoder are again the amplitudes of cosine and sine waves; however, a different sine and cosine frequency is used for each constellation encoder. All the sine and cosine waves are then summed together and sent over the channel. This waveform is a simple DMT symbol, represented by the diagram in Figure 6.7.

Figure 6.7 Conceptual view of a DMT modulator.



Assuming that one can separate the sines and cosines at different frequencies at the receiver, each set of waveforms can be independently decoded in the same way that a QAM signal can be decoded and the resultant bits output by the constellation decoders. Note that the idea of using different frequencies to transmit information is not unique to DMT. Television and radio have readily employed such techniques. The difference here is that DMT has a “receiver” tuned to all of the channels at once, whereas the others typically tune to only one channel. Some names used for frequency channels in DMT are frequency bins (or bins), tones or DMT tones, and subchannels.

DISH-1022, 166-167.

197. As shown by these references, a POSITA would have understood there to be a reasonable expectation of success in combining Amit-Jacobsen-Isaksson due to the close relationship between single-carrier and multi-carrier modulation, namely that multi-carrier modulation builds upon single-carrier by extending the modulation from a single-carrier to a plurality of carriers.

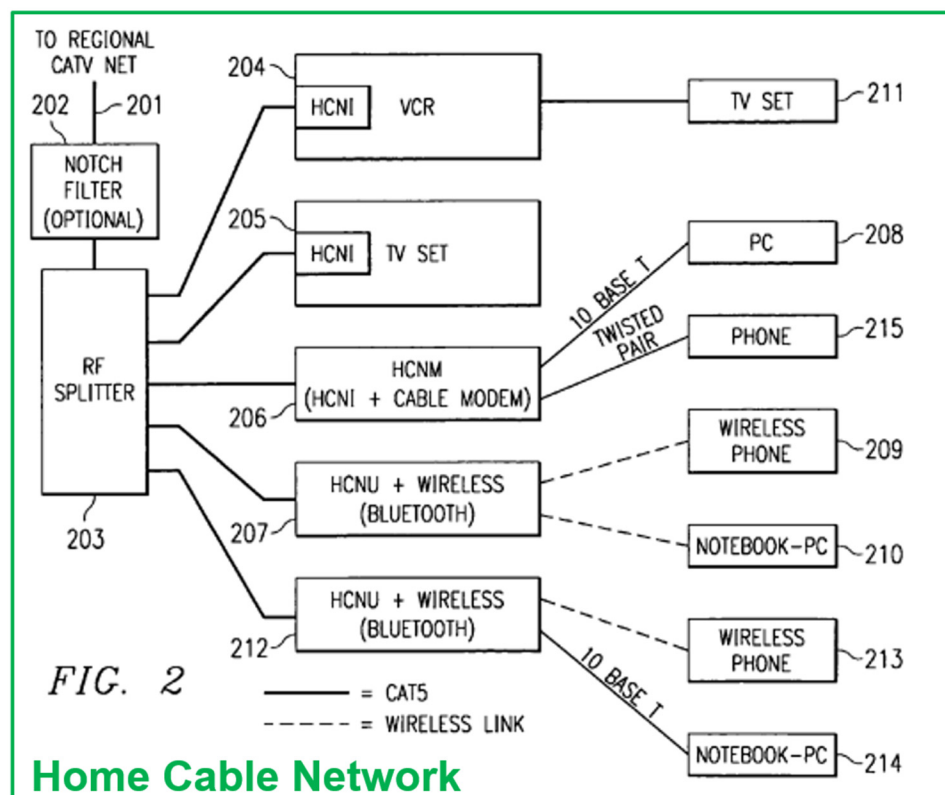
D. Claim 1

1. Preamble/Element 1pre

[1pre] A data communication network comprising:

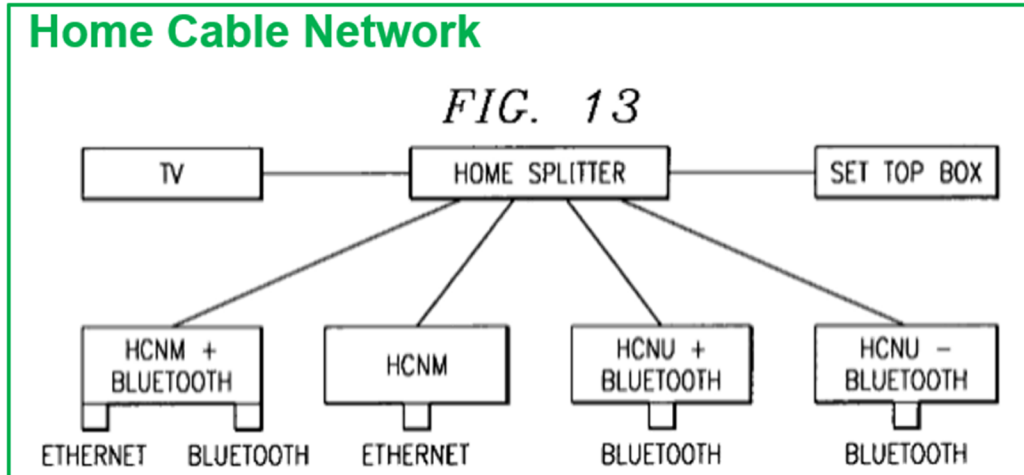
198. I have been asked to consider whether the combination of Amit-Jacobsen-Isaksson renders obvious the preamble of claim 1, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 1 is deemed to be a limitation, it is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

199. Amit “relates to communications systems, and more particularly, to systems and methods for home network communications.” DISH-1014, 1:10-12. Amit’s Home Cable Network (HomeCN or HCN) “allow[s] very high-speed digital and analog communications within the home and from the home to external devices or networks using low cost devices.” *Id.*, 2:40-43. Amit depicts the HomeCN (green), *i.e.*, the claimed “data communication network,” in Figures 2 and 13.



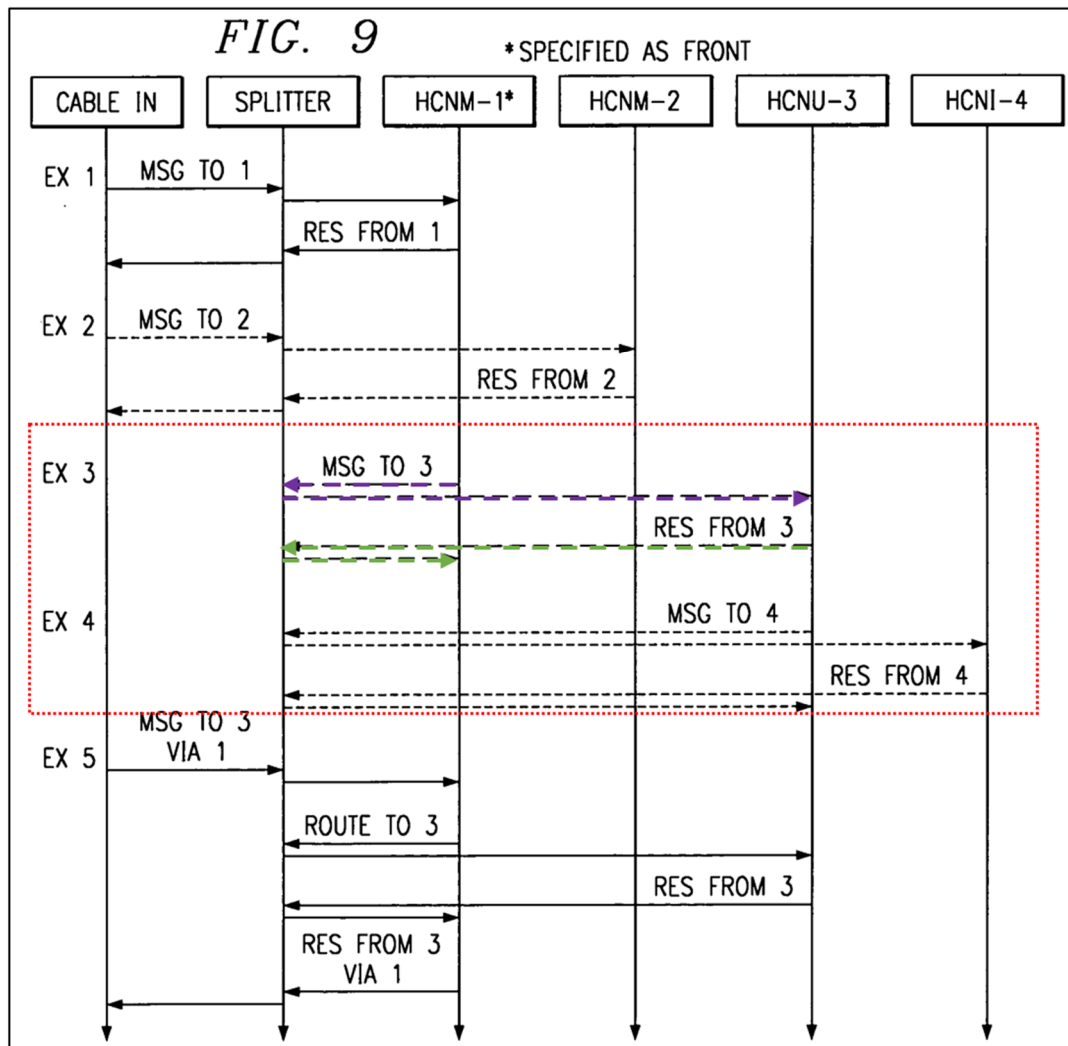
AMIT, FIG. 2.

200. The HomeCN includes devices “connected to different types of nodes of the CATV [network], to enable communication between these nodes.” *Id.*, 3:10-12. The HCN devices “provide[] a way to transfer data between these nodes.” *Id.*, 3:13. Specifically, the “devices are capable of transmitting and receiving digital communications signals between them,” where the “signals propagate in the CATV wires.” *Id.*, 6:58-60. The “devices may communicate directly (not via the headend) using RF signaling over the coax cable.” *Id.*, 3:19-21.



Amit, FIG. 13.

201. Figure 9 presents examples of data communications that occur in the HomeCN. *Id.*, 16:9-10.



Amit, FIG. 9.

202. Ex 3 and Ex 4 (red) are example data communications between devices in the HomeCN. *Id.*, 16:15-17. Amit explains that “messages from the home equipment is [sic] transferred to the splitter, the splitter distributes the energy to the Cable In connector, and to the other output connectors that are connected to the splitter.” *Id.*, 16:18-21. Then, the “destination-component gets the message and returns the response.” *Id.* To illustrate, in Ex 3, HCNM-1 sends a data message

(purple, MSG TO 3) to HCNU-3. After receiving the data message, HCNU-3 sends a response message (green, RES FROM 3) to HCNM-1.

203. As a result, it is my opinion that the Amit-Jacobsen-Isaksson combination renders the preamble obvious.

2. Element 1a.i

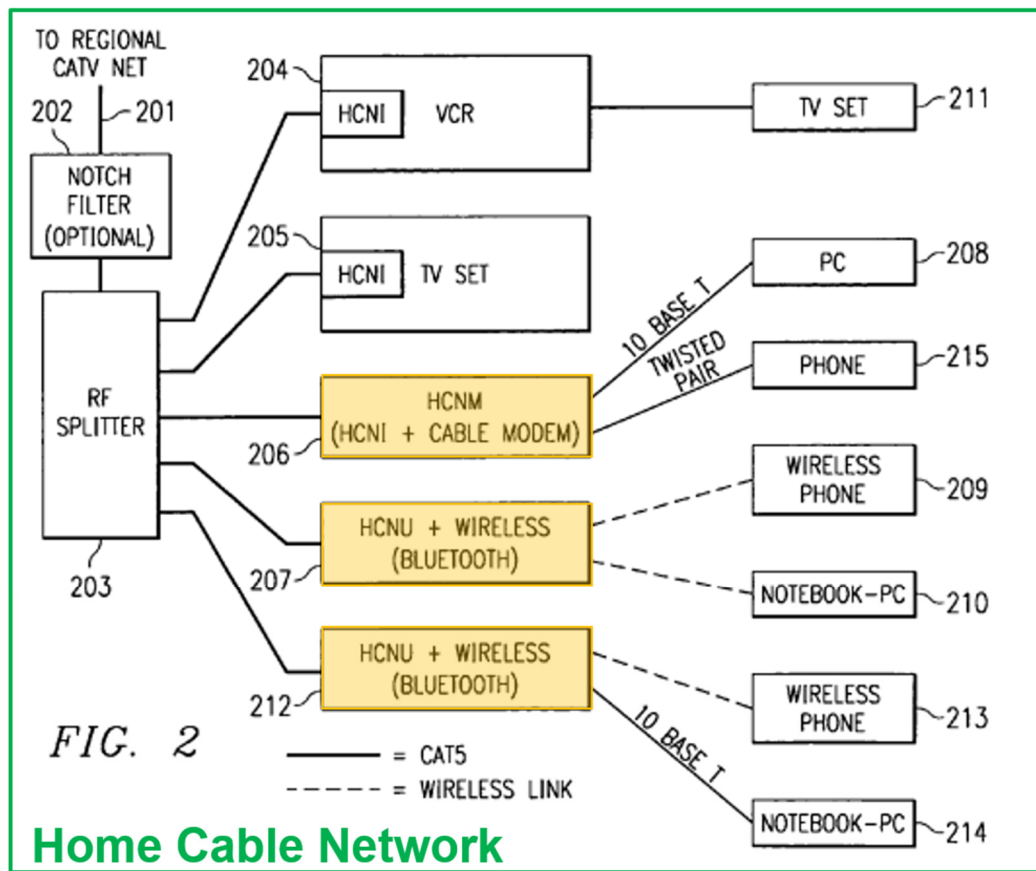
[1a.i] at least two network devices;

204. It is my opinion that the Amit-Jacobsen-Isaksson combination renders obvious this limitation.

205. Amit's HomeCN incorporates at least two HCN devices, *i.e.*, at least two network devices, into the CATV network to enable networking over coaxial cables. *Id.*, 3:10-12. The HCN devices include a Home Cable Networking Unit (HCNU) and/or a Home Cable Networking Modem (HCNM). *Id.*, 6:7-16.

206. Amit's HCNU is "a component that suppl[ies] connection to the Home Cable Networking." *Id.*, 6:7-13. "The HCNU devices are capable of transmitting and receiving digital communications signals between them. These signals propagate in the CATV wires and are reflected by the RF splitter [203]." *Id.*, 6:57-60. And the HCNM is "[a] component that include[s] [an] HCN-U and [a] cable modem." *Id.*, 6:3-23.

207. In Figure 2, Amit “shows a Home Cable networking (HomeCN/HCN)” (green) that includes two HCNUs and an HCNM, *i.e.*, “at least two network devices.” *Id.*, 6:26-29.

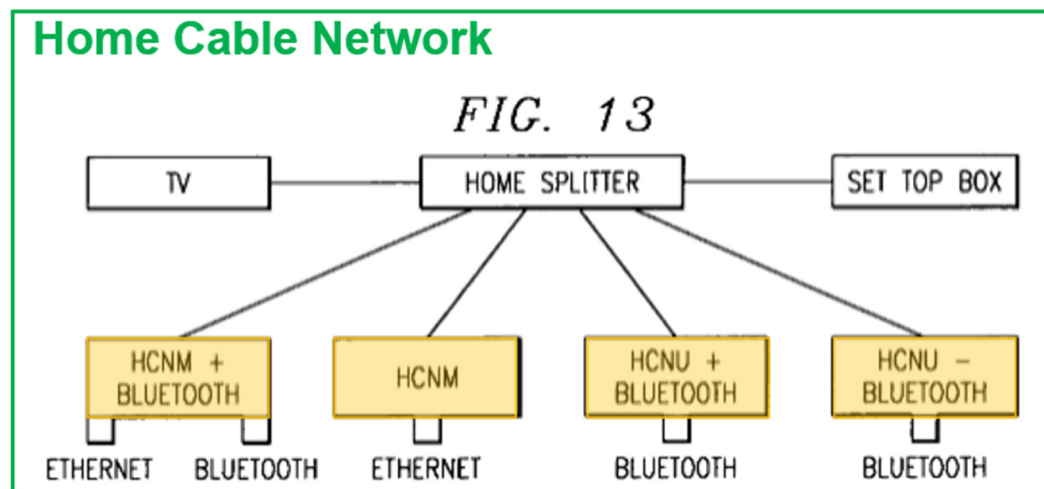


Amit, FIG. 2.

208. As shown in Figure 2, the “Video Cassette Recorder (VCR) [204] and TV set [205] include Home Cable Networking Interface (HCNI) devices.” *Id.*, 6:44-46. “The Personal Computer (PC) [208] is connected to a Home Networking Cable Modem (HNCM) device [206] (that supplies the Home Networking functionality and the Cable Modem functionality).” *Id.*, 6:46-50. Further, the

“HCNU+wireless units [207, 212] are connected to the CATV and has [sic] a wireless output (e.g. Bluetooth, HomeRF or infra-red) which connects to devices within the vicinity of the device [207], such as wireless telephone unit [209, 213], and a notebook computer [210]).” *Id.*, 6:52-57.

209. Figure 13 shows another configuration of the HomeCN (green) that includes at least two network devices (yellow), namely two HCNMs and two HCNUs. *Id.*, FIG. 13.



Amit, FIG. 13.

210. As a result, it is my opinion that Amit renders this limitation obvious.

3. Element 1a.ii

[1a.ii] each network device comprising a multi-carrier modulator for modulating data, an up converter for translating the modulated data to an RF carrier frequency, a down converter for translating an RF signal, and a multi-carrier demodulator for demodulating the translated RF signal to produce data; and

211. It is my opinion that the Amit-Jacobsen-Isaksson combination renders obvious this limitation.

212. As I previously discussed, Amit discloses that the HomeCN is a data communication network in which the HomeCN devices communicate with each other, *e.g.*, to deliver data from one device to another.

213. Claimed “up converter” and “down converter”: Amit discloses that the HCN devices communicate using RF signaling over the coaxial cables of the HomeCN. *Id.*, 3:19-21 (“devices may communicate directly (not via the headend) using RF signaling over the coax cable”). The frequency range of the RF signaling, *i.e.*, the RF carrier frequency, can be 900–960 MHz. *Id.*, 3:24-27, 8:21-29 (“Frequency range ... usually 900–960 MHz”).

214. As an initial matter, a POSITA would have understood that to communicate using RF signaling at the specified RF ranges (*e.g.*, 900–960 MHz) requires frequency converters to translate (baseband) data signals to and from the desired RF. Gagliardi explains that the frequency translation uses frequency converters:

Frequency translation involves a direct shift of the modulated carrier from one frequency band to another. (These bands are discussed in Section 1.2). This frequency shifting is accomplished with the aid of signals produced from devices called frequency generators, which may also provide the carrier waveforms needed for the modulation. The majority of modern systems use some form of transmitter frequency translation.

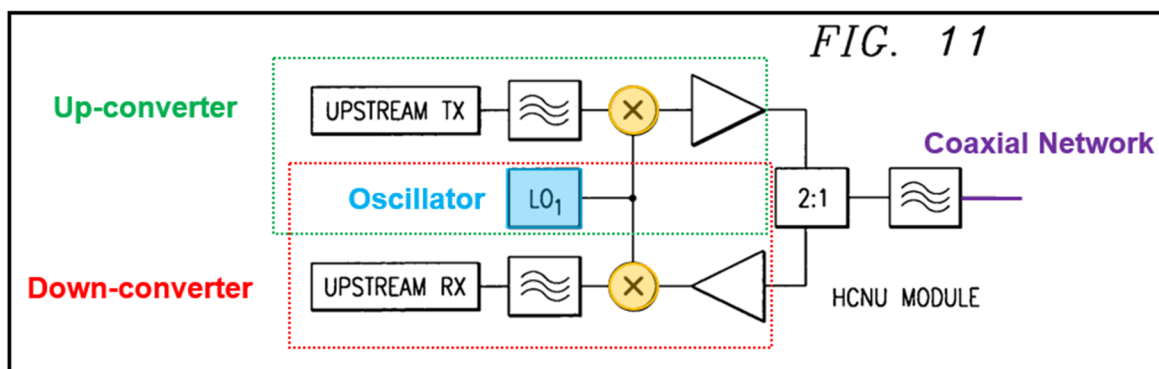
DISH-1017, 4-5.

215. Jacobsen2 also explains that:

If passband transmission is required, the resulting signal, a sum of real time-domain sinusoids, **is then upconverted to the desired carrier frequency and transmitted over the channel.**

DISH-1023, 375.

216. Indeed, a POSITA would have understood that Amit depicts frequency converters of the HCN devices in Figure 11. *Id.*, FIG. 11. A POSITA would have understood that, based on Amit's disclosures and the general knowledge in the art, the figure depicts frequency conversion circuitry. *Id.*, 3:24-30, 11:61-65, 19:32-37. As explained below, a POSITA would have understood that the frequency conversion circuitry includes an up-converter (green) and a down-converter (red), as shown below in the relevant portion of Figure 11. Both the up-converter and the down-converter use a local oscillator (LO) block (blue) that drives multipliers (yellow) that up/down-convert to/from an RF carrier frequency used on the coaxial network (purple).



Amit, FIG. 11.

217. To transmit a signal, Amit's upstream TX block obtains data that originates upstream from a node (*e.g.*, a PC) connected to the HCN device. The upstream TX signal is up-converted by the multiplier/LO blocks, amplified, and transmitted on the coaxial network (*i.e.*, the claimed "translating ... data to an RF carrier frequency"). To receive a signal, Amit's multiplier/LO blocks down-convert an RF signal received over the coaxial network (*i.e.*, the claimed "a down converter for translating an RF signal"), which the upstream RX block then routes to the node. Indeed, Amit describes another device that includes frequency conversion circuitry as having the ability to "translate[] the input frequency to another, whether if it is with an up and down conversion or other technique such as conversion to baseband and back." DISH-1014, 20:32-35.

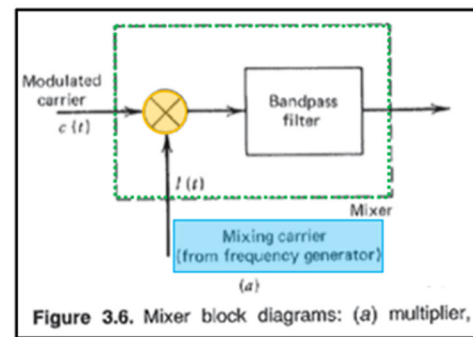
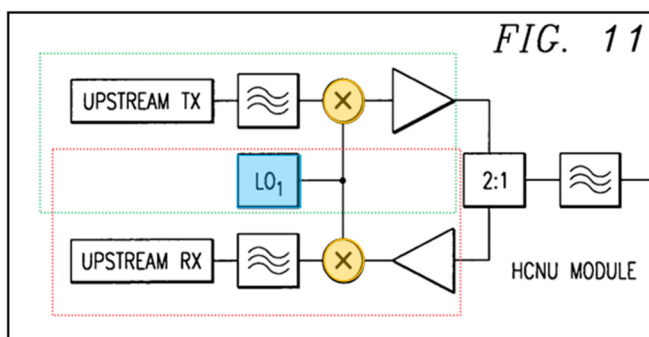
218. The conversion circuitry shown in Amit's Figure 11 was well known in the art such that a POSITA would have understood that the circuitry is frequency conversion circuitry. This circuitry was taught in introductory textbooks in communications engineering. As I discuss below, Gagliardi describes conversion circuitry similar to that of Amit's Figure 11.

219. Gagliardi first explains that "[f]requency conversion (translating [a signal] at one frequency to a band at another frequency) requires additional carrier waveforms, produced from subsystems referred to as frequency generators."

DISH-1017, 93. An oscillator can be used as a frequency generator. *Id.* ("Carrier

tones are generated from oscillator circuits”); *see also id.*, 99 (“an oscillator carrier can be frequency multiplied to form a frequency generator”).

220. Gagliardi then provides an up-converter as an example frequency converter. *Id.*, 99-100. Gagliardi explains that “frequency shifting to a higher frequency band (called upconversion) is accomplished by a mixer circuit.” *Id.* “An ideal mixer (Figure 3.6a) corresponds to an electronic multiplier followed by a bandpass filter.” *Id.* Like in Figure 11, the inputs into the multiplier include the data signal and the carrier mixing signal provided by the frequency generator. *Id.*



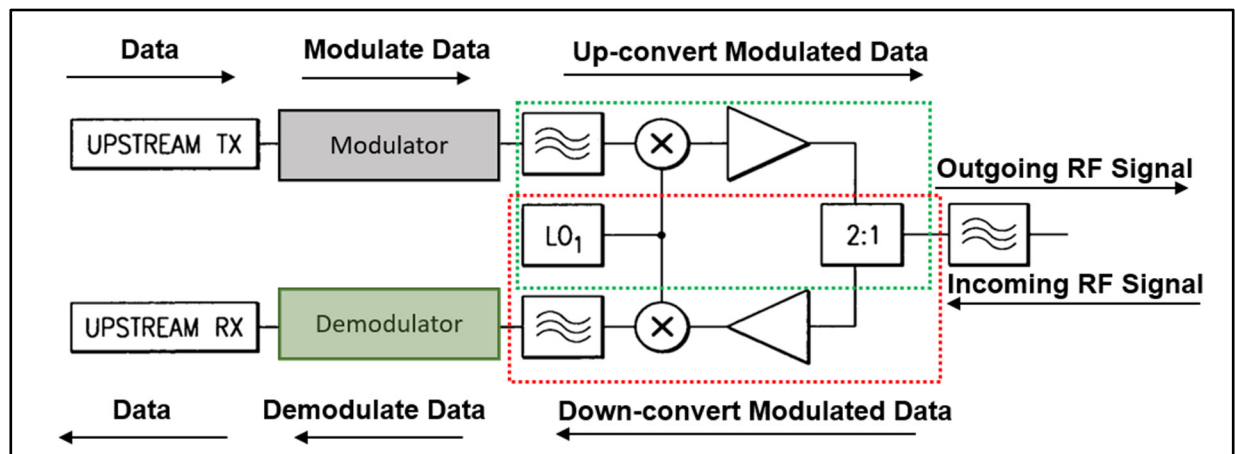
221. Furthermore, each HCN device includes a transmitter (TX) and a receiver (RX) that enable the device to communicate using RF signaling. DISH-1014, 29:19-21 (“[T]he components [that] should exist on the chip: Burst receiver, Burst Transmitter, 900 MHz front end (bi-directional)”), FIG. 19 (depicting the components of HCNU, including a 900 MHz TX+RX front end for the home networking channel), FIG. 18 (depicting the HCNM, which is identical to the HCNU). The chip enables the HCN devices to communicate at the HomeCN

frequency bands. *Id.*, 24:11-67 (for frequencies of “> 860 MHz ... There are some existing chips (low price) that supply two-direction filtering and tuner functionality”).

222. Claimed “modulator” and “demodulator”: Amit discloses that each HomeCN device “employs a new digital modulation scheme.” *Id.*, 3:7-8. In particular, each HomeCN device includes a modulator and demodulator that employ “QPSK, QAM 16, QAM 64 or QAM 256 according to the channel conditions, and according to the equipment capabilities.” *Id.*, 8:30-37. Because Amit’s HCN devices are transceivers that send and receive signals among each other, a POSITA would have also understood that each HCN device includes a demodulator in the receiver circuitry corresponding to the modulator in the transmitter circuitry. *See id.*, FIGS. 18-19 (showing TX/RX circuitry of HCN devices), 3:19-20 (“devices may communicate directly (not via the headend) using RF signaling”), *see also* claim 13 (reciting that an HCN includes circuitry for modulating signals and for demodulating signals). Thus, it is my opinion that Amit discloses or alone renders obvious the claimed “demodulator for demodulating the translated RF signal to produce data”—i.e., to produce a demodulated signal.

223. A POSITA would have understood that Amit’s modulator modulates the upstream TX data to be transmitted on the coaxial network. A POSITA would also have understood that the modulator provides the modulated data to the up-

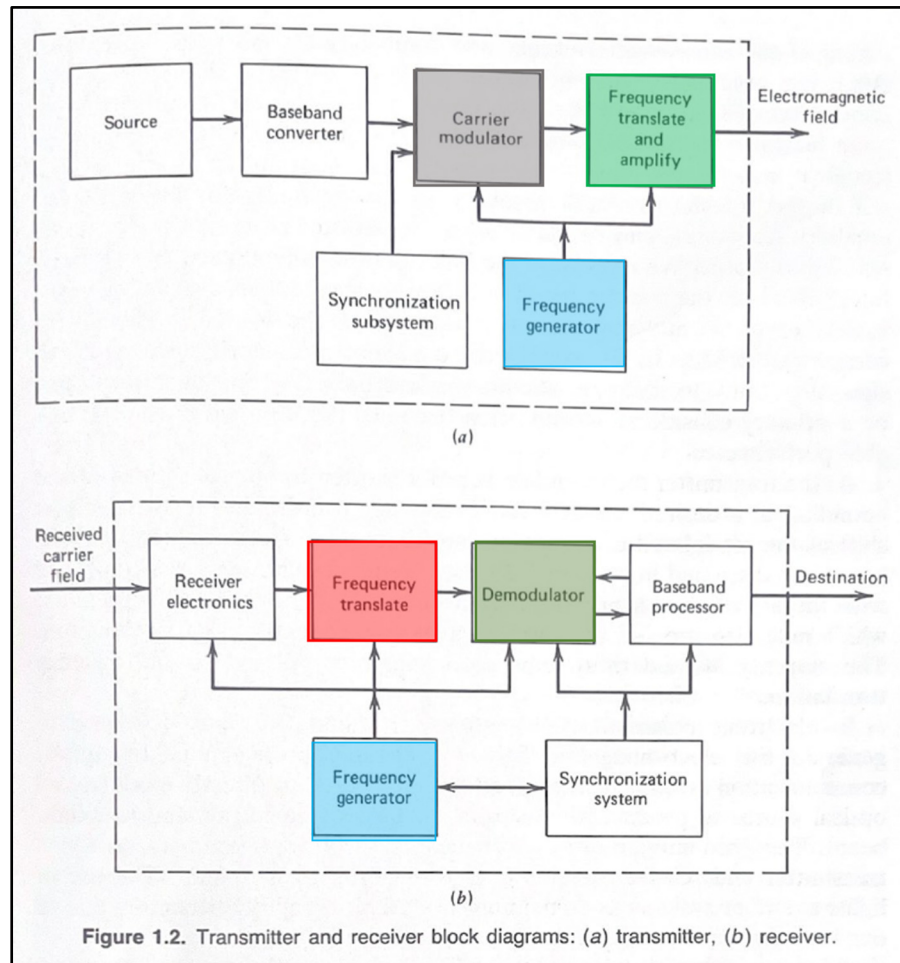
converter to be up-converted to the RF carrier frequency for transmission on the coaxial network. DISH-1001, 9:22-27 (disclosing inverse operations of modulators were “well known in the art”). A POSITA would further have understood that the down-converter performs an inverse of the up-converter operations and the demodulator performs an inverse of the modulator operations.



Amit, FIG. 11 (modified and annotated).

224. A POSITA would have understood these functionalities to be included in Amit because this is how basic RF transmitters and receivers operate in

communication systems. As an example, Gagliardi discloses the following transmitter and receiver block diagrams. DISH-1017, 3.

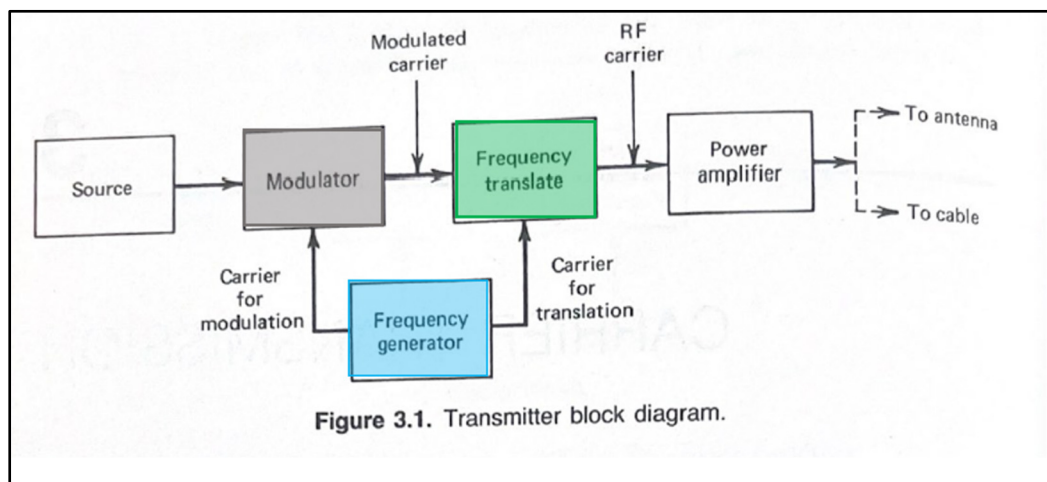


225. Starting with the transmitter block, Gagliardi explains that the information source ... generates the electronic signal to be sent to the receiver.” *Id.*, 2. These “[s]ource signals are generally converted into a baseband waveform to prepare it for the carrier transmission.” *Id.* Then, “[t]he baseband waveform is modulated onto the carrier to form the carrier waveform.” *Id.*, 3. “The basic objective of performing a modulation is to generate a transmission waveform that is best suited for the electromagnetic propagation and communication reception.” *Id.* Then,

“the modulated carrier is often frequency translated,” which “involves a direct shift of the modulated carrier from one frequency band to another.” *Id.*, 4. “The majority of modern systems use some form of transmitter frequency translation.” *Id.*

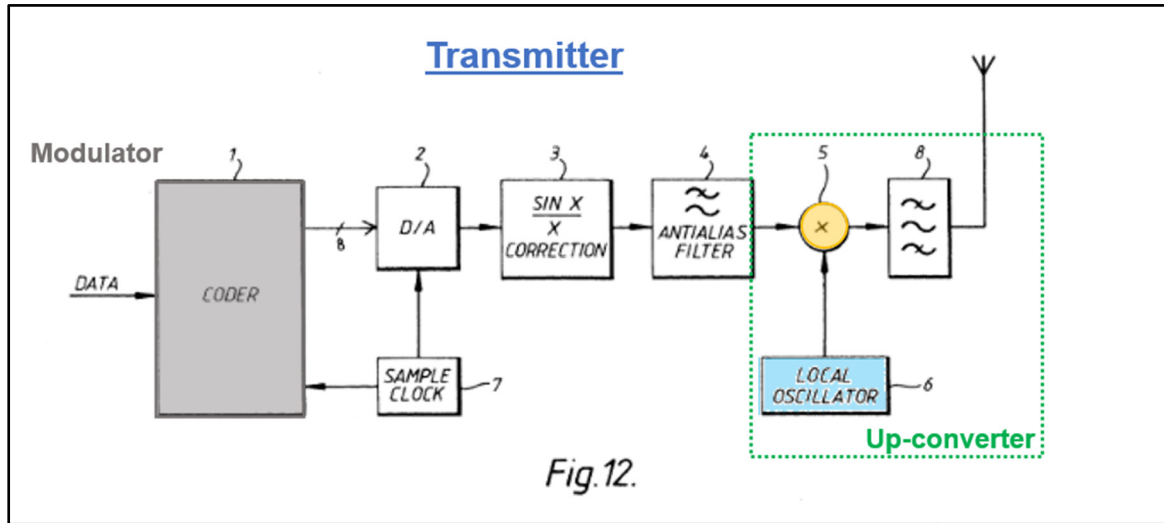
226. In the receiver block, Gagliardi explains that the “received electromagnetic field is ... demodulated to receiver the baseband waveform.” *Id.*, 5. “The recovered baseband is then deconverted to produce the recovered information signal.” *Id.*

227. Gagliardi repeats the transmitter architecture in Figure 3.1 and shows that it can be used for transmitting signals on a cable. *Id.*, 94.



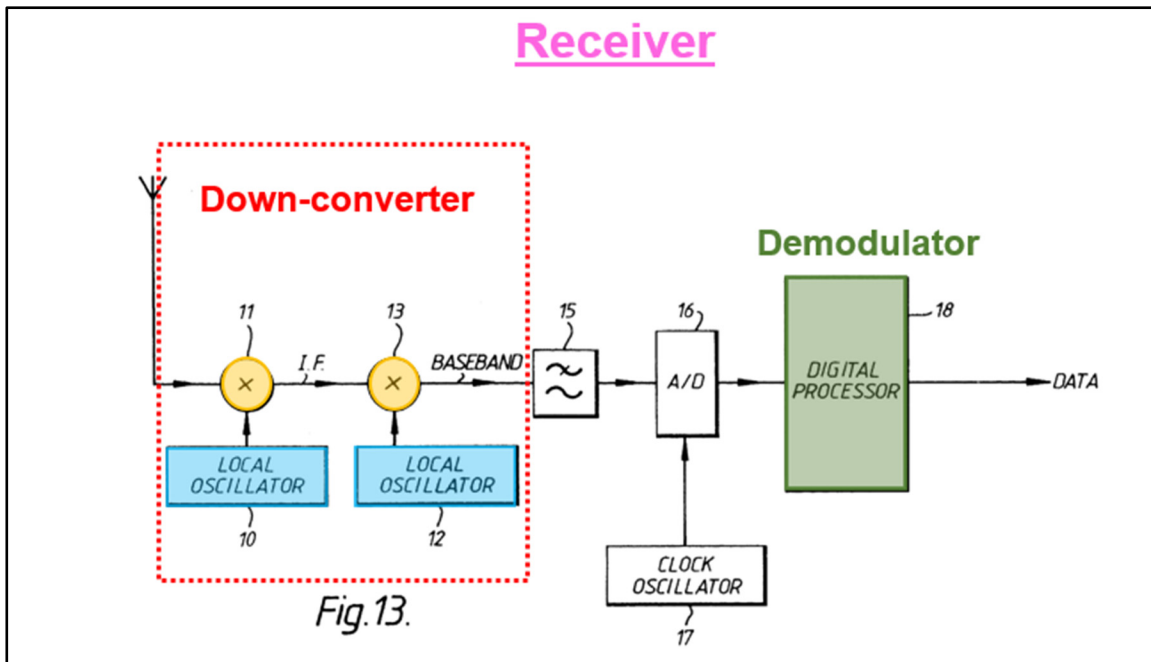
228. Similar architectures are described by Mason, which is described in the '518 patent as disclosing “additional techniques for implementing an OFDM modulator and demodulator.” DISH-1001, 4:8-12. In the transmitter, data is modulated

(grey) then up-converted using an up-converter (green). DISH-1020, Fig. 12. The up-converter includes a mixer (orange) and a local oscillator (blue). *Id.*



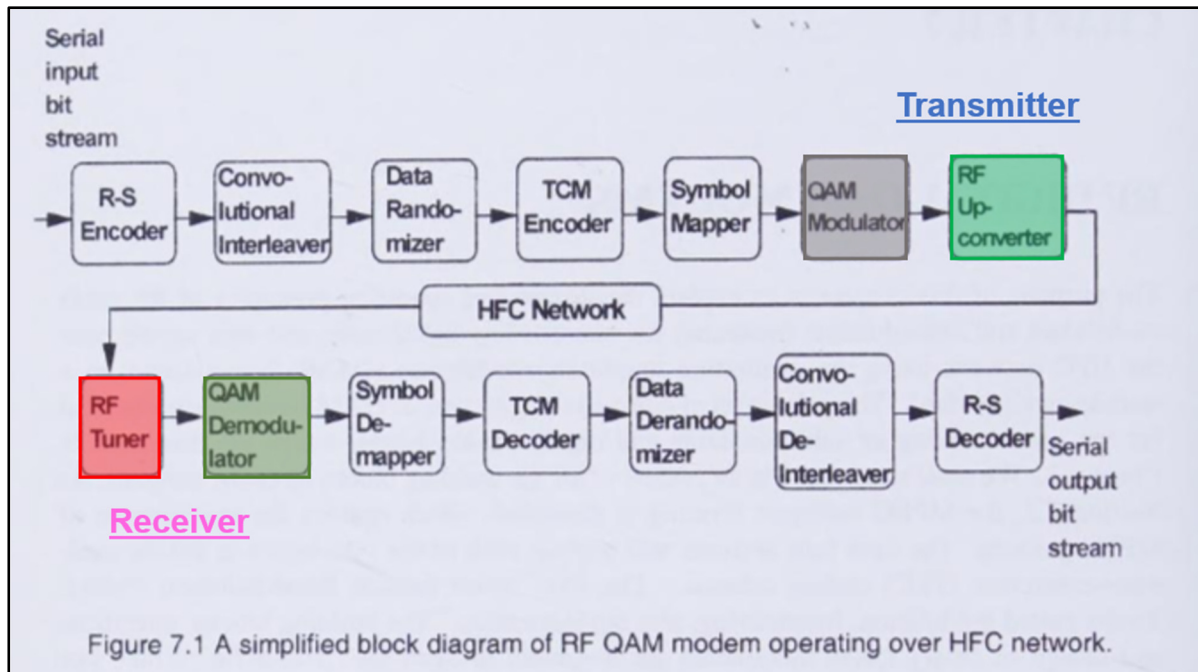
Mason, Fig. 12.

229. In the receiver, an RF signal is down-converted using a down-converter (red) to a modulated baseband signal. *Id.*, Fig. 13. A demodulator (green) demodulates the baseband signal to produce the data signal. *Id.*, Fig. 12.



Mason, Fig. 13.

230. Furthermore, using similar transmitter and receiver architectures in cable modems that operate on a coaxial network was known to a POSITA. For example, Ovadia describes “the design and operation principles of RF cable modulators and demodulators (modems) for transporting digital video and data signals over a [hybrid fiber-coaxial (HFC)] network using the quadrature amplitude modulation (QAM) format.” DISH-1019, 183.

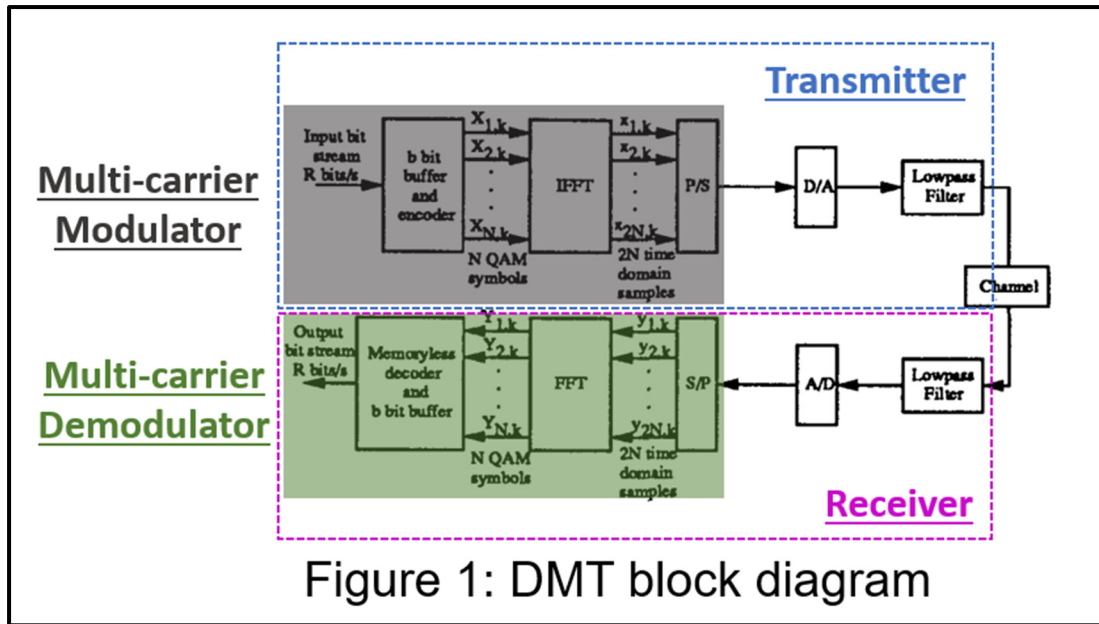


231. “Figure 7.1 shows a simplified block diagram of a QAM transmitter and receiver operating over an HFC network.” *Id.* As shown, the transmitter includes a QAM modulator that modulates an input bit stream and feeds the modulated signal to an RF up-converter. The RF up-converter up-converts the modulated signal to an RF carrier frequency for transmission on the HFC network. The receiver includes an RF tuner that receives the transmitted signal and down-converts the signal to a modulated signal. The RF tuner provides the modulated signal to the QAM demodulator, which demodulates the signal to produce an output bit stream.

232. Thus, for each network device, Amit discloses the claimed “modulator for modulating data” and “demodulator for demodulating the translated RF signal to produce data.”

233. Claimed “multi-carrier” elements: 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.” DISH-1016, 306. Jacobsen assesses multi-carrier modulation using “[d]iscrete multitone modulation (DMT), a common form of multicarrier modulation.” *Id.*

234. Jacobsen’s Figure 1 shows a block diagram of a DMT transmitter and receiver. *Id.*, 307. The transmitter includes a multi-carrier modulator for modulating signals to be transmitted on the coaxial cable channel. And the receiver includes a multi-carrier demodulator for demodulating the modulated signals received on the coaxial cable channel.



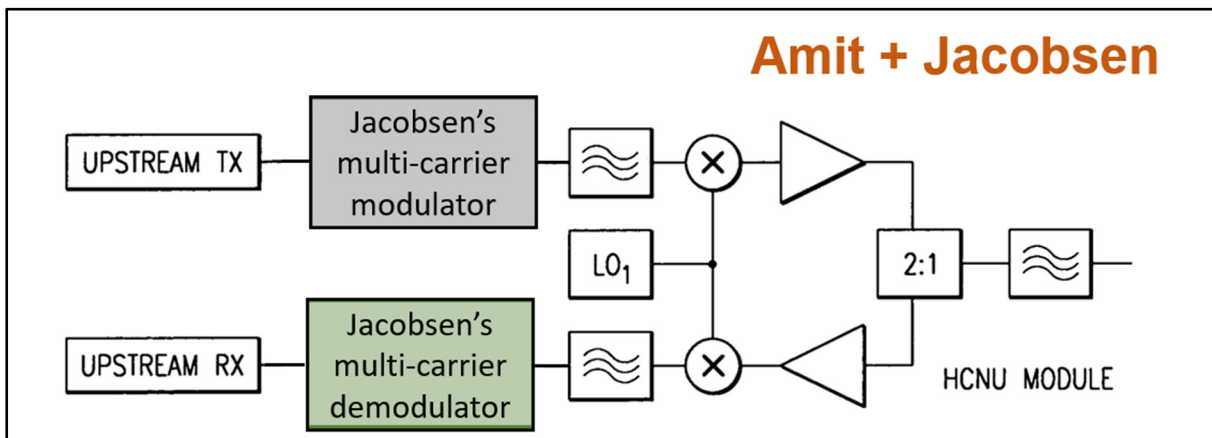
Jacobsen, Figure 1.

235. Jacobsen explains that “multitone modulation is more computationally efficient than single-carrier modulation ... for the transmission of digital data over CATV channels” and “is able to reduce the effects of various distortions on a CATV network, including microreflections.” *Id.*, 305, 312. Jacobsen thus concludes that “multicarrier modulation appears to be better equipped than single-carrier modulation” for a consumer service digital transmission system. *Id.*, 312.

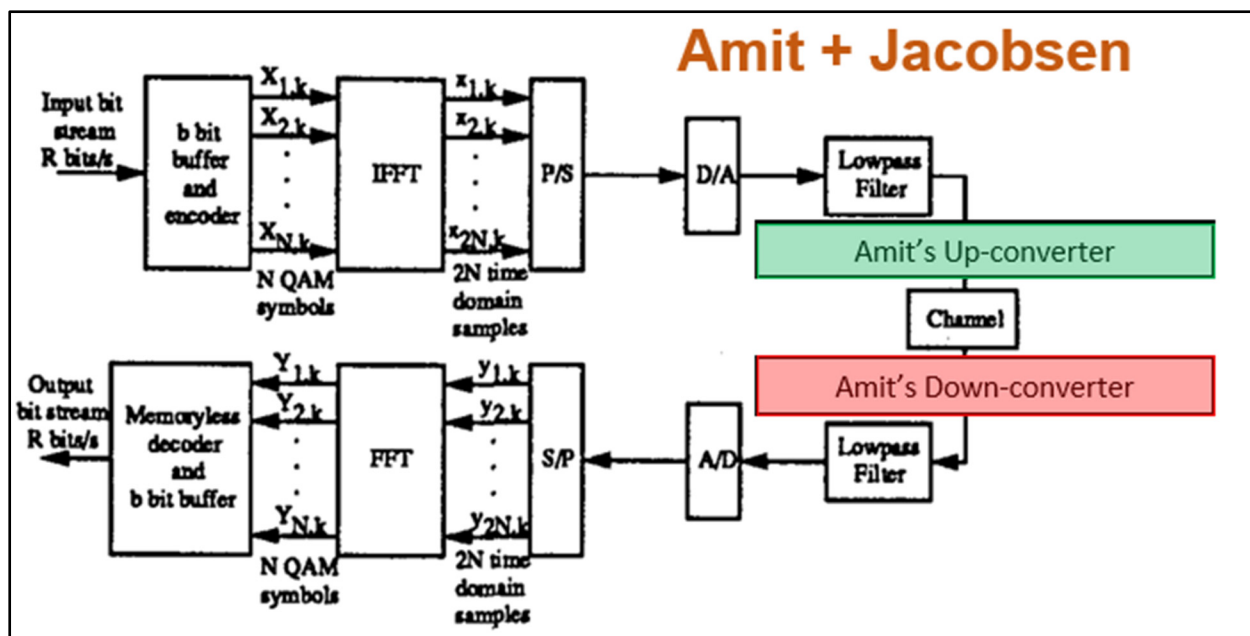
236. In view of Jacobsen’s findings, a POSITA would have found it obvious to implement multi-carrier modulation in Amit’s system. To do so, a POSITA would have ensured that Amit’s modulator was a multi-carrier modulator like Jacobsen’s, and that Amit’s demodulator was a multi-carrier demodulator like Jacobsen’s.

237. Specifically, Jacobsen's modulator would be used in Amit's up-converter, *e.g.*, by connecting the output of Jacobsen's low pass filter in the modulator to Amit's up-converter. The combined circuitry modulates an input bit-stream, which is then up-converted by the up-converter to generate a multi-carrier RF signal for transmission on the coaxial network.

238. Similarly, Jacobsen's demodulator would be used in Amit's down-converter, *e.g.*, by connecting the input of Jacobsen's low pass filter in the demodulator to the output of Amit's down-converter. The combined circuitry down-converts the multi-carrier RF signal received from the coaxial network, which is then demodulated by the demodulator circuitry to produce the output bit-stream (*i.e.*, "to produce data").

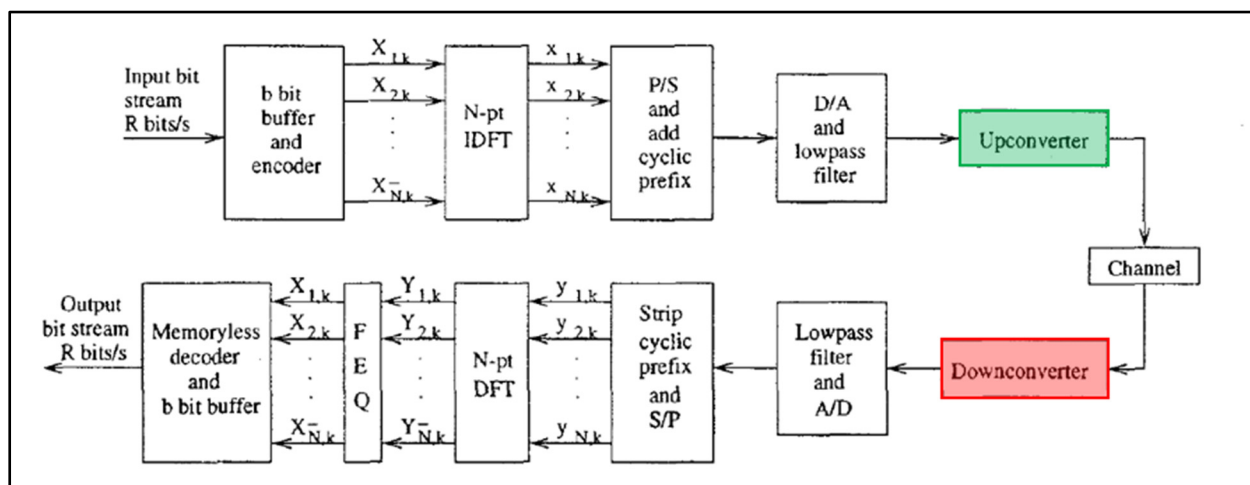


Amit, FIG. 11 (modified and annotated).



Jacobsen, FIG. 1 (modified and annotated).

239. That a POSITA would have combined Jacobsen's DMT with Amit's conversion circuitry as described is confirmed by another reference, Jacobsen2, that Jacobsen authored, which illustrates a DMT coupled to an up-converter and a down-converter. DISH-1023, 376.



Jacobsen2, Figure 2.

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

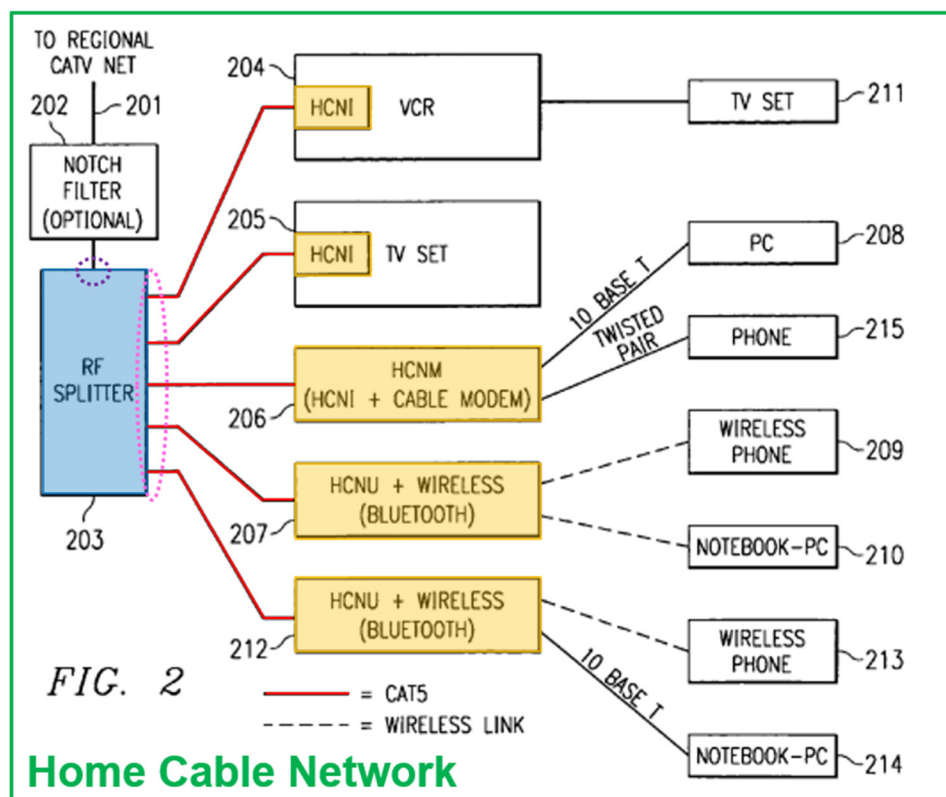
4. Element 1b

[1b] cable wiring comprising a splitter with a common port and a plurality of tap ports and a plurality of segments of coaxial cable connecting between the splitter tap ports and the network devices;

241. It is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

242. Amit discloses that an application of the HomeCN is “home networking over coaxial TV cables.” DISH-1014, 2:38-40. Amit teaches its HCN devices “communicate directly (not via the headend) using RF signaling over the coax cable.” *Id.*, 3:19-21. The RF signals “propagate between the devices via reflections from other devices in the line, e.g. splitters or amplifiers in the line.” *Id.*, 3:21-23.

243. In Amit’s Figure 2, “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.*, 2:36-39.



Amit, FIG. 2.

244. As shown above, the RF splitter [203] has a common port (purple) and a plurality of tap ports (pink). Segments of coaxial cable (red) connect between the splitter tap ports and the HCN devices (yellow). Amit explains how, in its coaxial cable network, “[s]plitters [] get a single wire as [an] input, and some wires as output[s].” *Id.*, 8:66-67.

245. As a result, it is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

5. Element 1c

[1c] whereby network devices communicate with each other through the cable wiring using multi-carrier signaling

246. It is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

247. As I discussed previously, the Amit-Jacobsen HCN devices would each include a multi-carrier modulator for generating multi-carrier RF signals and multi-carrier demodulators for receiving the multi-carrier RF signals.

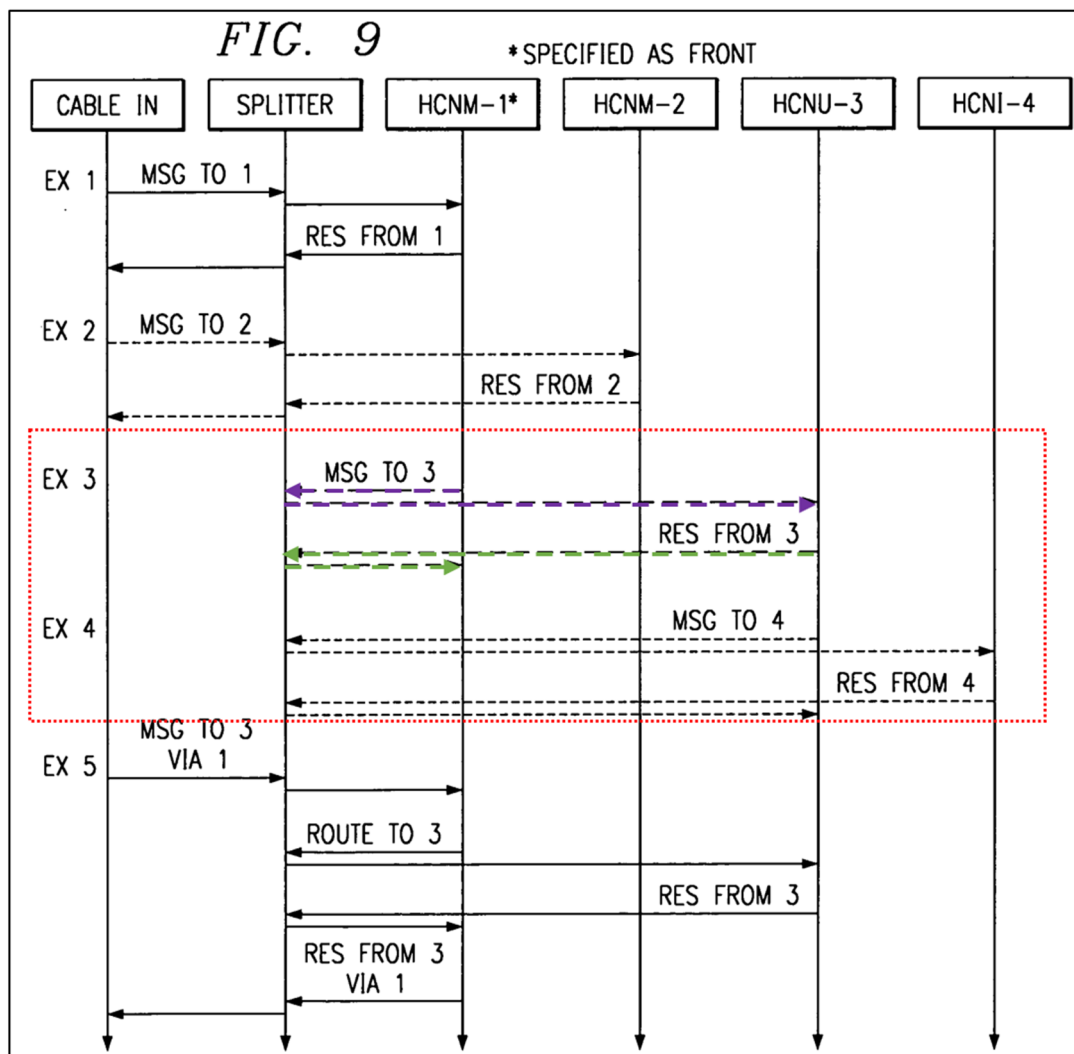
248. Additionally, Amit discloses that HCN devices communicate with each other over cable infrastructure, including coaxial cables—*i.e.*, the claimed

“network devices communicate with each other through the cable wiring.”

Specifically, the “installation of modems, connected to different types of nodes of the CATV... enable[s] communication between these nodes” (*id.*, 3:10-13, 6:57-59), where the “communication ... [occurs] over cable infrastructure designed to carry video signals, using pass-band frequency bands, without transmission through a CATV headend device.” *Id.*, 2:34-38. That is, the HCN devices “communicate directly (not via the headend) using RF signaling over the coax cable.” *Id.*, 3:19-21.

249. In order to do so, “messages from the home equipment is [sic] transferred to the splitter, the splitter distributes the energy to the Cable In connector, and to the other output connectors that are connected to the splitter.” *Id.*, 16:18-21. Then, the “destination-component gets the message and returns the response.” *Id.* For example, in Ex 3 and Ex 4 of Figure 9 (red), HCNM-1 sends a data message

(purple, MSG TO 3) to HCNU-3, after which HCNU-3 sends a response message (green, RES FROM 3) to HCNM-1. *Id.*, 16:9-17.



Amit, FIG. 9.

250. Because the Amit-Jacobsen HCN devices are using multi-carrier modulation, the communication between the devices through the cable wiring of HomeCN is multi-carrier signaling (*i.e.*, the claimed “network devices

communicate with each other through the cable wiring using multi-carrier signaling”).

251. As a result, it is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

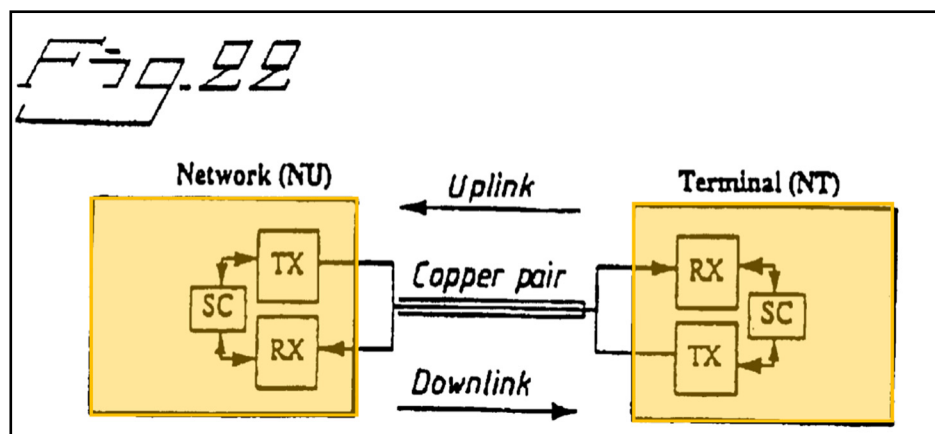
6. Element 1d.i

[1d.i] wherein network devices transmit probe messages through the cable wiring and analyze received probe message signals to determine channel characteristics and

252. It is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

253. As I discussed above, in the Amit-Jacobsen combination, Amit’s HCN devices communicate with one another using multi-carrier signaling.

254. Isaksson similarly describes “a multi-carrier transmission system” that includes two multi-carrier transceivers/modems (i.e., “network devices), shown below in orange, that communicate using multi-carrier signaling. DISH-1013, Fig. 22, 1:1-18. As shown below, each transceiver has a receiver and a transmitter. *Id.*



Isaksson, Fig. 22.

255. In Isaksson’s multi-carrier transmission system, the receivers (in both transceivers) “continuously measure[] and estimate[] **the characteristics and changes of/in the channel.**” *Id.*, 4:1-8. The “[c]hannel characteristics may be estimated by **periodic transmission**, by one of said transceivers, of a **base sync frame having a predetermined content** and comparing, in the other of said transceivers, **the received sync frame with a reference frame.**” *Id.*, 16:8-12; *see also id.*, 10:10-14. By having a transmitter (in one transceiver) transmit a base sync frame with predetermined content, which a receiver (in another transceiver) can compare with a reference frame, the receiver “can estimate the characteristics of the channel, over which the frame is transmitted, in terms of attenuation, phase shift and variance.” *Id.*, 79:5-14. A POSITA would have understood that to estimate the characteristics of the channel using the base sync frame, a receiver would compare a signal of the base sync frame to that of a reference frame to

determine the attenuation, phase shift, and variance experienced by the signal over the channel.

256. Isaksson describes that the transceivers periodically transmit the base sync frames at a base sync interval (BSI): “base sync frames may be transmitted at intervals, the BSI, and said BSI being locked into said transceivers thereby enabling said transceivers to identify a frame as a sync frame.” *Id.*, 16:15-20. In addition to the periodic base sync frames, “[a]dditional sync frames may be transmitted at intervals between said base sync frames.” *Id.* Therefore, Isaksson’s transceivers transmit and receive multiple base sync frames to one another through the cable wiring.

257. As I described previously, is my opinion that although Isaksson does not refer to the “base sync frame” as a “probe message,” a POSITA would have understood Isaksson’s base sync frame to be a “probe message” because Isaksson’s definition of “base sync frame” is effectively identical to the ’518 patent’s definition of “probe message.”

258. As I explained above, a POSITA would have found it obvious to modify Amit-Jacobsen’s HCN devices with Isaksson’s method of “maintaining synchronism between two transceivers during dynamic system reconfiguration of bit-loading factors.” DISH-1013, 4:21-25.

259. Here, each HCN device — as an uplink HCN device — would periodically transmit base sync frames, *i.e.*, probe messages, having predetermined content to other HCN devices — as downlink HCN devices — through coaxial cables (*i.e.*, “network devices transmit probe messages through the cable wiring”). *Id.*, 16:8-12. The downlink HCN devices would analyze the received base sync frames by comparing the frames with reference frames to determine channel characteristics. *Id.*, 79:9-14. In particular, the downlink HCN devices would analyze the signals of the base sync frames to characterize the channel in terms of attenuation, phase shift, and variance of the signals, *i.e.*, “analyze received probe message signals to determine channel characteristics.” *Id.*, 16:15-20.

260. As a result, it is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

7. Element 1d.ii

[1d.ii] bit loading is selected based on the determined channel characteristics

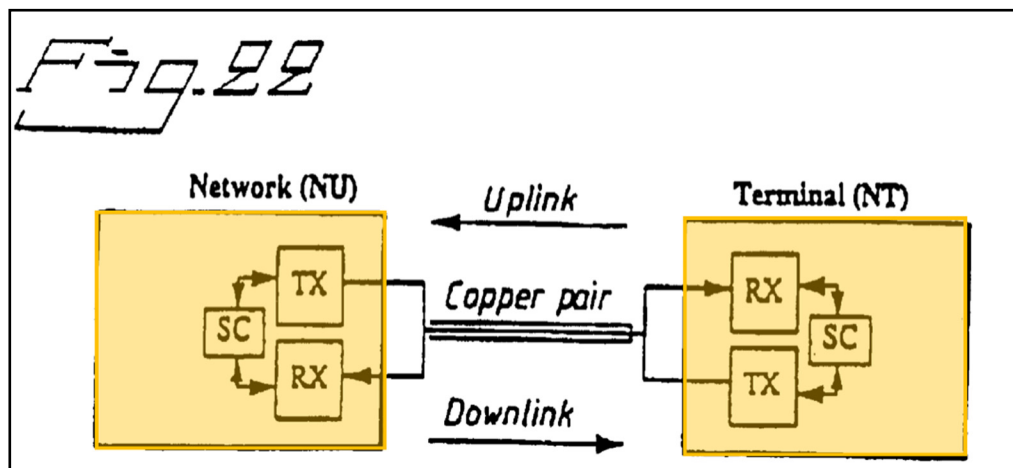
261. It is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

262. As I discussed in the previous limitation, the Amit-Jacobsen-Isaksson HCN devices transmit base sync frames through the cable wiring and analyze received base sync frame signals to determine channel characteristics.

263. Isaksson also discloses that bit-loading parameters are selected based on the determined channel characteristics.

264. In Isaksson's multi-carrier transmission system, "[d]ata is transmitted between the two transceivers using a plurality of carriers." DISH-1013, 25:26-26:20, 5:14-6:1. Isaksson teaches its transceivers can "dynamically chang[e] the number of coded/decoded bits per carrier wave." *Id.*, 4:1-20. To do so, each "receiver continuously measures and estimates the characteristics and changes of/in the channel. From this information, performance for each sub-channel (sub-wave) is identified. Then, on the basis of this information, reconfigurations of the transmitted number of bits per symbol for each single carrier wave are decided."

Id.



Isaksson, Fig. 22.

265. More specifically, Isaksson's receivers send information about the measured channels to the Isaksson's transmitter in the uplink transceiver. *See id.*, 77:27-79:14. The transmitter in the uplink transceiver "obtains [the] information about measured channels from the uplink and downlink receivers." *Id.* Then, the transmitter selects "the bit-loading for each carrier wave" and "transmits the bit-loading constellation (i.e., diagram) to the downlink transceiver." *Id.* Once the transmitter receives confirmation from the downlink transceiver, the transmitter changes the bit-loading diagram in the uplink transceiver. *See id.*

266. Isaksson discloses that the information based of which Isaksson's system selects bit-loading is SNR: "In systems that use bit-loading techniques, the number of transmitted bits per symbol is adapted, or regulated, to the [SNR] of the current carrier wave." *Id.*, 3:24-27. To do so, the "individual carrier's SNR is calculated on the receiver side." *Id.*, 26:12-14. Then "the number of transmitted bits per symbol is adapted, or regulated, to the [SNR] of the current carrier wave." *Id.*, 3:24-27. A POSITA would have understood that the signal characteristics of "attenuation, phase shift and variance," which are measured by the receivers, can be used by the receivers to calculate SNR. In particular, a POSITA would have understood that measured attenuation and noise or interference variance can be used to measure the noise in the channel, which in turn can be used to calculate the signal-to-noise ration. Indeed, Isaksson describes that in some scenarios "the SNR

is given by: $SNR_i = W_i$ (4) where W_i is the estimated interference variance.” *Id.*, 56:3-8.

267. As I explained above, a POSITA would have found it obvious to modify the Amit-Jacobsen HomeCN with Isaksson’s method of “maintaining synchronism between two transceivers during dynamic system reconfiguration of bit-loading factors.” *Id.*, 4:21-25. As I also discussed in the previous limitation, each HCN device — as an uplink HCN device — would periodically transmit base sync frames to other HCN devices — as downlink HCN devices. *Id.*, 16:8-12. Amit’s downlink HCN devices would analyze the received base sync frames to determine channel characteristics. Then, Amit’s downlink HCN devices would send information about the measured channels, e.g., SNR, to the uplink HCN device. *See id.*, 77:27-79:14. The uplink HCN device would obtain the information and select the bit-loading parameters for the channels based on the channel characteristics, *i.e.*, the claimed “bit loading is selected based on the determined channel characteristics.” *Id.*, 4:1-20.

268. As a result, it is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

269. In sum, the combination of Amit-Jacobsen-Isaksson renders obvious claim 1.

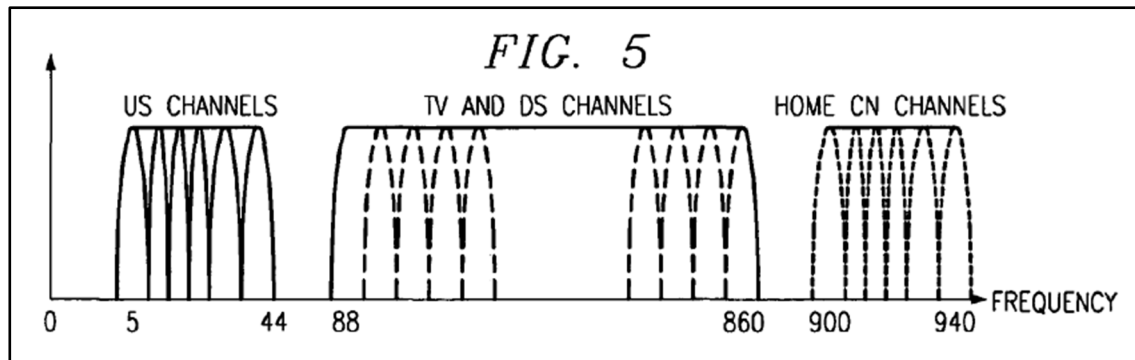
E. Claim 3

1. Element 3a

[3a] The data communication network of claim 1 wherein the network shares the cable wiring with a cable television service

270. It is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

271. Amit discloses that “[t]he home networking equipment coexists with the other services on the cable network ... [such that] [i]t does not cause harmful interference to any other services that are assigned to the cable network in spectrum outside of that allocated to the home networking.” DISH-1014, 18:46-56. In particular, the HomeCN is “spectrally aligned with any combination of television and other signals in the cables,” and therefore, “should not interfere with the TV/video channels.” *Id.* Amit further discloses 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).” *Id.*, 3:24-27. For example, Figure 5 of Amit “presents a typical channel allocation” between “TV channels,” “HomeCN channels,” and other services using the same coaxial cable network. *Id.*, 7:60-63.



Amit, FIG. 5.

272. As a result, it is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

2. Element 3b

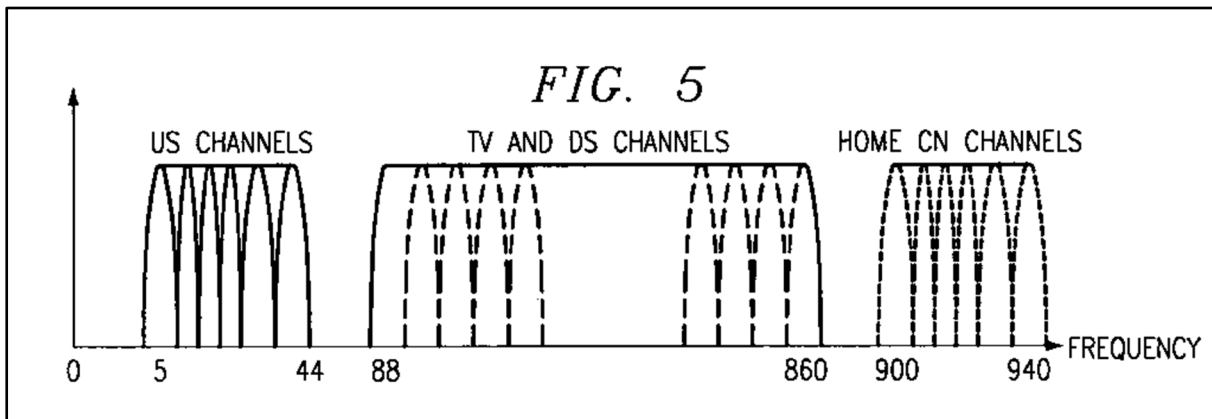
[3b] and the network device up converter translates the modulated data to an RF carrier frequency above the frequency used by the cable television service

273. It is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

274. As I discussed at [1a.ii], Amit discloses an up-converter that translates the modulated data to an RF carrier frequency. See element 1a.ii.

275. Amit also discloses that the carrier frequency used by the HomeCN is above the frequency used by the cable television service. DISH-1014, 3:24-27 (“When 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).”). Amit’s Figure 5 depicts a “typical channel allocation” in a

system that supplies “TV channels, DOCSIS CM (US and DS), and HomeCN channels.” *Id.*, FIG. 5, 7:61-63. As shown below in Figure 5, the frequency band used by the cable television service is below 860 MHz. *Id.* As also shown, the frequency band used by the HomeCN channels, *i.e.*, the RF carrier frequency, is 900-940 MHz. *Id.*, 7:61-8:3, 8:22-28.



Amit, FIG. 5.

276. As a result, it is my opinion that the Amit-Jacobsen-Isaksson combination renders this limitation obvious.

277. In sum, the combination of Amit-Jacobsen-Isaksson renders obvious claim 3.

IX. RESERVATIONS

278. If I am called to testify at the hearing, I may rely on demonstrative exhibits that illustrate and help explain the bases of my opinions (including those presented above).

279. Other than as provided or referenced in this declaration, I have not yet prepared any exhibits to support my opinions.

280. If new information becomes available, or new arguments are presented, I may revise or supplement my analysis.

X. CONCLUSION

281. For the reasons discussed above, in my opinion a person of ordinary skill in the art would have found claims 1 and 3 of the '518 patent obvious over the references presented in Ground 1.

282. Likewise, for the reasons discussed above, in my opinion a person of ordinary skill in the art would have found claims 1 and 3 of the '518 patent obvious over the references presented in Ground 2.

283. I declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true. I also 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 18 U.S.C. §1001. I declare under the penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Date: 15Jan2024


Tim A. Williams, Ph.D.