UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DIRECTV, LLC,
Petitioner,

v.

ENTROPIC COMMUNICATIONS, LLC,
Patent Owner.

Case IPR2024-01064
Patent 8,631,450

EXHIBIT 2003

DECLARATION OF SAMUEL H. RUSS, PH.D.

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I. INTRODUCTION

1. My name is Samuel H. Russ. I have been retained as an expert witness to provide my independent opinion in regard to the matters at issue in *inter partes* review of U.S. Patent No. 8,631,450 ("the '450 patent") in IPR2024-01064. I have previously submitted a substantively identical declaration in regard to the matters at issue in *inter partes* review of the same '450 patent in IPR2024-00560. I have been retained by Entropic Communications, LLC ("Entropic"), the Patent Owner in this proceeding. Petitioner is DirecTV, LLC ("DirecTV" or "Petitioner").

2. I am being compensated $450 per hour for my time spent working in connection with this case. My compensation is in no way related to the outcome of this litigation. If called as a witness, I would testify as to the statements and opinions contained in this report.

3. I am not a legal expert and offer no opinions on the law. However, I have been informed by counsel of the various legal standards that apply, and I have applied those standards in arriving at my conclusions.

II. QUALIFICATIONS

4. I have more than 20 years of experience in the fields of broadband cable networks and communications engineering. My professional career has been

dedicated to issues relating to signal integrity, communication systems, and home networking more generally.

5. I received a Bachelor of Science in Electrical Engineering with Highest Honors from Georgia Institute of Technology in 1986 and a Ph.D. in Electrical Engineering from Georgia Institute of Technology in 1991. My Ph.D. dissertation was titled "An Information-Theoretic Approach to Analysis of Computer Architectures and Compression of Instruction Memory Usage."

6. I am currently an Associate Professor in the Department of Electrical and Computer Engineering at the University of South Alabama. I joined the Electrical and Computer Engineering faculty in 2007. I have taught a number of classes including classes in signal integrity, embedded systems, and the design of high-speed digital systems. During that time, I won awards for excellent teaching and have been actively publishing research in signal integrity, home networking, and digital video recording (DVR) technologies.

7. I also have significant industry experience. From 1994 to 1999, I served on the faculty of Mississippi State University as an Assistant Professor in the Department of Electrical & Computer Engineering. I taught circuit board design and two-way interactive video classes, among other topics.

8. From 2000 to 2007, I was the manager in the Advanced Technologies R&D group for Scientific-Atlanta (later Cisco, now Technicolor). As part of this

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work, I explored major new technologies including home networking and multi-room video distribution and managed a cable set-top box (STB) design group that designed four STB models for the cable television industry, including the Explorer 4200 (non-DVR) and 8300 (DVR) models. Both models were produced in high volumes and sold several million units. As the design-group manager, I was responsible for managing the design and prototyping activities of the group and for interfacing with other groups (especially integrated circuit design, procurement, software developers, the factory where prototypes were built, and product managers). I also maintained the hardware and mechanical development schedule.

9. While at Scientific-Atlanta, I became a staff expert in home networking, and conducted demonstrations of wireless video technology. I also managed a group that developed a new coaxial home networking system. This coaxial system won a Technology and Engineering Emmy Award in 2013. Further, I was a staff expert in digital video recorder (DVR) reliability, and led a team that improved the software, hardware, repair, and manufacturing processes.

10. I am the author of *Signal Integrity: Applied Electromagnetics and Professional Practice*, Springer, 1st ed. 2016, 2nd ed. 2022. I have also researched and written about video storage, multimedia broadcasting over networks, embedded systems, consumer electronics, set-top boxes, access of stored video from peer devices in a local network, electronic manufacturing systems, and other

topics in video and image processing. I have authored or co-authored 32 journal articles and conference papers in these areas of video storage, video networking and consumer electronics. One of my conference papers on digital video recording won second place in a "Best Paper" competition at the 2011 International Conference on Consumer Electronics in Las Vegas, Nevada.

11. I am a named inventor on 51 patent applications that were filed while I was at Scientific-Atlanta, many of which focus on cable technology. These applications have led to 29 issued U.S. patents and 9 as European patents, including U.S. Patent No. 7,908,625 ("Networked Multimedia System").

12. A detailed record of my professional qualifications is set forth in the attached Exhibit A, which is my *curriculum vitae*, including a list of publications, awards, research grants, and professional activities. My *curriculum vitae* also lists the matters in which I have served as an expert.

III. BASES OF OPINIONS

13. In the course of conducting my analysis and forming my opinions, I have reviewed materials including those listed below:

i. U.S. Patent No. 8,631,450 (Ex. 1001) ("the '450 patent");

ii. The prosecution history of the '450 patent (Ex. 1002)

iii. The Declaration signed by Tim A. Williams, Ph.D in IPR2024-00560, refiled here in IPR2024-01064 (Ex. 1003) (the "Williams Declaration");

iv. The Curriculum Vitae of Dr. Williams (Ex. 1004);

v. The Petition by DirecTV in IPR2024-01064;

vi. U.S. Patent No. 5,521,906 ("Grube") (Ex. 1005);

vii. U.S. Patent No. 6,473,438 ("Cioffi") (Ex. 1006);

viii. Canadian Patent Application No. 2350203 ("Matsumoto") (Ex. 1007);

ix. Microsoft Computer Dictionary, Fourth Ed., 1999 ("Microsoft") (Ex. 1009);

x. U.S. Patent No. 7,295,518 ("Monk") (Ex. 1010);

xi. U.S. Patent No. 6,252,900 ("Liu") (Ex. 1011);

xii. U.S. Patent No. 4,679,227 to Hughes-Hartogs ("Hughes-Hartogs") (Ex. 1012);

xiii. U.S. Patent No. 6,259,746 ("Levin") (Ex. 1013);

xiv. U.S. Patent No. 6,072,779 ("Tzannes") (Ex. 1014);

xv. U.S. Patent No. 4,866,395 ("Hostetter") (Ex. 1015);

xvi. U.S. Patent No. 6,298,092 ("Heath") (Ex. 1016);

xvii. The Supplemental Declaration signed by Tim A. Williams, Ph.D. in IPR2024-001064 (Ex. 1026);

xviii. The exhibits and other documents cited herein.

IV. APPLICABLE LEGAL STANDARDS

A. Level Of Ordinary Skill In The Art

14. My opinions in this declaration are based on the understandings of a person of ordinary skill in the art, which I understand is sometimes referred to as an "ordinary artisan" or by the acronyms "POSITA" or "PHOSITA," as of the time of the invention, which I understand is here assumed to be the effective filing date (December 2, 2004) provisional application from which the '450 patent issued. I understand that the person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the invention. By "relevant," I mean relevant to the challenged claims of the '450 patent.

15. I understand that factual indicators of the level of ordinary skill in the art include the various prior art approaches employed, the types of problems encountered in the art, the rapidity with which innovations are made, the sophistication of the technology involved, and the educational background of those actively working in the field. I understand that, in assessing the level of skill of a person of ordinary skill in the art, one should consider the type of problems encountered in the art, the prior solutions to those problems found in the prior art references, the rapidity with which innovations are made, the sophistication of the

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technology, the level of education of active workers in the field, and my own experience working with those of skill in the art at the time of the invention.

16. In this case, Dr. Williams has asserted in his declaration that a person of ordinary skill in the art as of the time of the ’450 patent would have had:

> 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*.

Ex. 1003 [Williams-Decl.] ¶ 19.

17. For the purposes of this declaration, I accept Dr. Williams’s proposed qualifications of a POSITA. I reserve the right to revisit the issue should the Petition be instituted.

18. As further discussed below, my opinions as stated in this declaration are valid even if the Board adopts a slightly different level of ordinary skill in the art. For example, as will be discussed throughout my report, even a person with the level of knowledge or experience described by Dr. Williams or adopted by the Board would not have a reasonable expectation of success in implementing certain aspects of the proposed combination as of the priority date of the ’450 patent.

B. My Understanding Of Legal Standards

19. When considering the ’450 patent and stating my opinions, I rely on the following legal standards as described to me by the attorneys for Entropic.

20. I understand that a patent claim is unpatentable if the claimed invention was anticipated by a prior art reference or would have been obvious to a person of ordinary skill in the art at the time of the purported invention.

21. I understand that anticipation requires that every limitation of the claim at issue be disclosed, either expressly or under principles of inherency, in a single prior art reference.

22. I understand that inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. Instead, it must be proven that the claim limitation not expressly found in the reference necessarily follows from what is found there.

23. I understand that an obviousness analysis involves comparing a claim to the prior art to determine whether the claimed invention would have been obvious to a person of ordinary skill in the art at the time of the invention in view of the prior art and in light of the general knowledge in the art as a whole. I also understand that obviousness is ultimately a legal conclusion based on underlying facts of four general types, all of which must be considered: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art; (3) the differences

between the claimed invention and the prior art; and (4) any objective indicia of non-obviousness, including any praise of the invention.

24. I also understand that obviousness may be established under certain circumstances by combining or modifying the teachings of the prior art. Specific teachings, suggestions, or motivations to combine any first prior art reference with a second prior art reference can be explicit or implicit, but must have existed before the date of purported invention. I understand that prior art references themselves may be one source of a specific teaching or suggestion to combine features of the prior art, but that such suggestions or motivations to combine art may come from the knowledge that a person of ordinary skill in the art would have had.

25. I understand that a reference may be relied upon for all that it teaches, including uses beyond its primary purpose, but also including teachings that lead away from the invention. I understand that a reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, although the mere disclosure of alternative designs does not teach away.

26. I further understand that whether there is a reasonable expectation of success in combining references in a particular way is also relevant to the analysis.

27. I understand that it is improper to use hindsight to combine references or elements of references to reconstruct the invention using the claims as a guide. My analysis of the prior art is made from the perspective of a person of ordinary skill in the art at the time of the invention.

28. I understand that in order to be eligible as prior art in obviousness and therefore form a reference in one of the instituted grounds, a reference must be analogous art to the ’450 patent. I also understand that it is Petitioner’s burden to prove that their asserted references are analogous art to the ’450 patent. I am informed that in order to determine whether a reference is analogous art to the ’450 patent, a two-part test is applied as follows:

> Two separate tests define the scope of analogous prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor’s endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.

In re Bigio, 381 F.3d 1320, 1325 (Fed. Cir. 2004); *see also In re Clay*, 966 F.2d 656, 658-659 (Fed. Cir. 1992). I have been informed and understand that to discern the field of endeavor, courts have looked to the specifications of the patent and the alleged prior art reference and particularly to the respective “background of Invention” and/or “field of the invention” sections. *See, e.g.*, *In re Wood*, 599 F.2d 1032, 1036 (CCPA 1979) (determining field of endeavor based on “Background of

Invention"); *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1237-38 (Fed. Cir. 2010) (finding reference concerning padlocks to be in the same field of endeavor where the "patent itself refers to 'the prior art padlock' in the background of the invention"); *Airbus S.A.S. v. Firepass Corp.*, 941 F.3d 1374, 1381 n. 8 (Fed. Cir. 2019) ("[T]he specification of each reference includes a 'Field of the Invention' section that distinctly describes each applicable field of endeavor.").

29. I am not offering any legal opinions in this declaration nor am I qualified to do so. I only consider such legal standards in framing my opinions and conclusions as well as placing assertions made by Petitioner in the Petition into the proper context. Additionally, from a subject matter perspective, I understand that the petitioner always has the burden of persuasion regarding a challenge of patentability of an invention under an inter partes review.

V. CLAIMS-AT-ISSUE (CLAIMS 29-38)

30. I understand that Petitioner has challenged the claims as follows:

- Independent claim 29, its dependent claims 30-31, independent claim 34, and its dependent claims 35-36 based on obviousness over Grube (Ground 1);
- Independent claim 29, its dependent claims 30-31, independent claim 34, and its dependent claims 35-36 based on obviousness over Grube and Cioffi (Ground 2); and

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- Independent claim 29, its dependent claims 30-33, independent claim 34, and its dependent claims 35-38 based on obviousness over Grube and Matsumoto (Ground 3A) or Grube, Cioffi, and Matsumoto (Ground 3B).

VI. OPINIONS

A. Overview Of The '450 Patent's And Grube's Fundamentally Different Systems.

31. Petitioner's grounds rely upon Grube alone or in combination. Grube, however, concerns a fundamentally different communications system from the '450 patent's.

32. The '450 patent is directed towards a local area broadband coaxial network ("BCN"), as reflected throughout the '450 patent's title, abstract, and claims. Ex. 1001 ['450] Title ("***BROADBAND LOCAL AREA NETWORK***"); Abstract ("A BCN network with BCN modems that enable network wired devices to communicate over a typical ***home coaxial network*** that may include passive splitters and different types of ***coaxial cable***."); cls. 29-38 ("a Broadband Coaxial Network"). The '450 patent is directed to facilitating node-to-node communications between various types of customer premises equipment (CPEs) within a BCN within building (*e.g.*, a home). Ex. 1001 ['450] 4:1-8 (the '450 patent addresses a need to "connect a variety of ***CPEs into a local data network***,

such as a local area network ('LAN'), within a building such as a home or office, while utilizing ***an existing coaxial cable network*** within the building.").

33. An important aspect of the '450 patent's BCNs is the fact that they are local area and are implemented using coaxial cable. *See* Ex. 1001 ['450] 4:1-8 (the '450 patent addresses a need to "connect a variety of CPEs into a ***local data network, such as a local area network ('LAN'), within a building such as a home or office,*** while utilizing ***an existing coaxial cable network within the building***."); *see* 1:33-40 ("Multiple TV receivers, audio video receivers, and/or video monitor devices may be located ***within the building*** and these multiple devices may be in signal communication with the POE via a broadband cable network that may include a plurality of cables and cable splitters."); 1:45-57 ("Within a ***typical building or home***, there may be a mixture of ***coaxial cables*** of varying types and quality, … Creating a less than optimal RF environment within the cable. … Another problem often encountered with a ***typical home or building coaxial cable configuration*** is the use of multiple splitters of varying quality and frequency ranges. Thus, creating a problem for known approaches to ***local area networking over coaxial cable***.").

34. Coaxial cable is shielded with precisely controlled geometries at manufacturing. *See* Ex. 2004 [Signal-Integrity] 82 ("The term 'coaxial' refers to the fact that it has a small center conductor surrounded by a cylinder of insulating

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material, which is in turn surrounded by a cylindrically shaped conductor. The two conductors are coaxial (get it?) and so they make a capacitor."). Because of this shielding, coaxial cable can have high-frequency bandwidths of, *e.g.*, "50 MHz bandwidth [] at approximately 900 MHz." Ex. 1001 ['450] 14:32-37; Ex. 2010 [Coaxial-Products] (coaxial cable "is designed to carry high-frequency signals, 900 MHz to 6GHz, and to protect those signals against electromagnetic interference (EMI) from external sources.").

35. As the '450 patent teaches, however, preexisting BCNs within buildings use splitters to distribute signals. Ex. 1001 ['450] 1:33-40 ("multiple devices may be in signal communication with the POE via a broadband cable network that may include a plurality of cables and cable splitters. Generally, these cable splitters are passive devices and distribute downstream signals from the POE to various terminals (also known as 'nodes') in the building."); 1:45-57 ("Another problem often encountered with a ***typical home or building coaxial cable configuration*** is the use of multiple splitters of varying quality and frequency ranges."). This preexisting network configuration using splitters is illustrated in the '450 patent's Figure 2, below:

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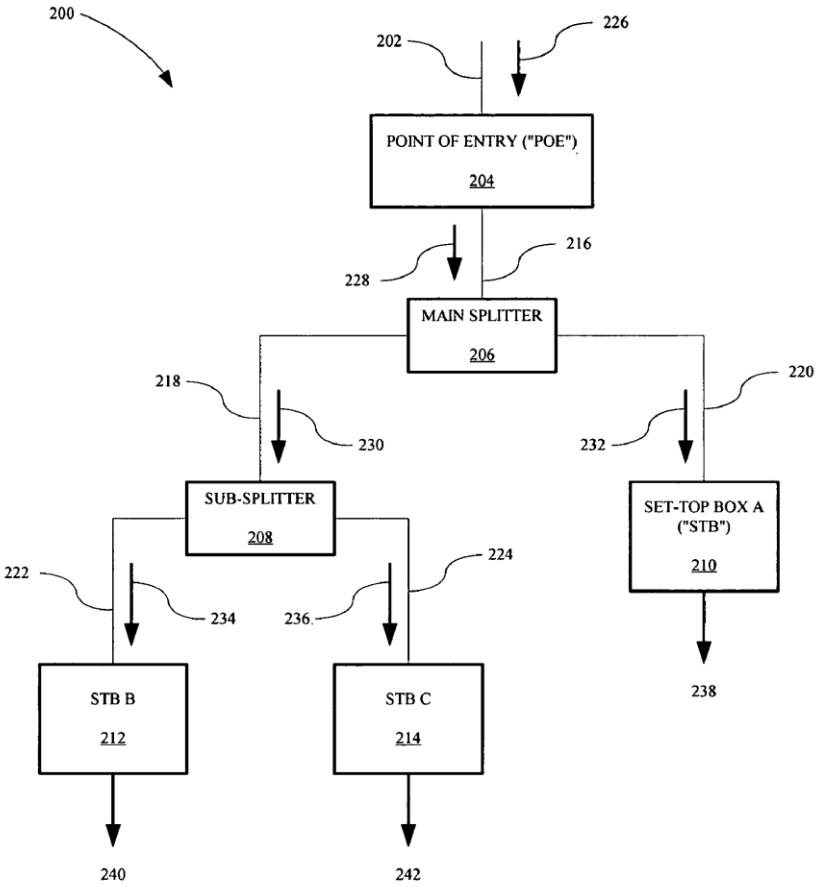

FIG. 2 (Prior Art)

Id., Fig. 2.

36. Splitters are radio-frequency devices designed to route signals from one input to multiple destinations with low signal distortion. As the ’450 patent recognizes, one of the main problems with splitters is that two legs (outputs) of the splitter have a difficult time communicating because a splitter is purposely

designed to shield the outputs from one another. Ex. 1001 ['450] 3:56-64 ("splitters typically have a high level of isolation between the different connected terminals resulting in significant isolation between the various CPEs. … ***The isolation creates a difficult environment in which to network between the different CPEs*** because the isolation results in difficulty for transmitting two-way communication data between the different CPEs.").

37. Thus, the '450 patent recognizes a need to "connect a variety of CPEs into a local data network, such as a local area network ('LAN'), within a building such as a home or office, while ***utilizing an existing coaxial cable network*** within the building." Ex. 1001 ['450] 4:1-8. One difficulty with addressing this need is the fact that channel paths between different nodes "are physically and electrically different in the BCN network." *Id.*, 17:50-57. To this end, the '450 patent "utilizes" a "common bit-load[ing] modulation scheme" for communication between the CPEs. *Id.*, 20:12-20.

38. By contrast, Grube concerns an entirely different system which does not use coaxial cable. *See generally* Ex. 1005 [Grube]. Indeed, without coaxial cable, Grube has nothing to do with broadband or local area networks. Instead, Grube concerns a twisted-pair telephonic line system. *Id.*, 6:57-60 ("Generally, the present invention provides a method and apparatus for establishing a communication system infrastructure utilizing low pass transmission path, i.e.

twisted pair telephone line."); 7:1-3 ("The primary site communicates with the plurality of secondary sites via inbound and outbound low pass transmission paths."); 9:41-46 ("FIG. 9 illustrates a communication system 160 having a two-wire infrastructure. As shown, the primary site 102 is operably coupled to a plurality of secondary sites 104-108 via a twisted pair low pass transmission path 162. The low pass transmission path is a twisted pair copper wire, which may be a telephone line."); 12:31-33 ("In operation, the DMT receiver 122 receives information from an outbound twisted pair 150"); 13:38-40 ("In this mode, the DMT transmitter 124 places data on allocated carrier channels of the inbound twisted pair 148.").

39. Twisted-pair telephonic lines are unshielded to save costs of manufacturing. *See* Ex. 2004 [Signal-Integrity] 121 ("This is what Ethernet uses – unshielded twisted pair (UTP). This is important because, as one might guess, the unshielded cable is cheaper than shielded."). This lack of shielding, however, results in a loss of signal energy over distance and, consequently, lossy signal propagation. *Id.*, 107, 112-115. Electrically, therefore, the medium appears as a low-pass filter. In other words, the twisted-pair wiring causes higher frequencies to be filtered out, leaving only low frequencies successfully transmitted. *See*, *e.g.*, Ex. 1005 [Grube] Fig. 4 (showing 1.1 MHz bandlimit). This is also the technical reason why nearly all phone lines are point-to-point connections—they cannot

carry enough information to distribute information to multiple users. *See id.*, 2:41-44, 2:53-56, 4:20-23.

40. As Grube teaches, phone companies wanted to develop techniques to take advantage of the widely ubiquitous telephone lines and "[t]o enhance the transmit capabilities of a twisted pair copper telephone line." Ex. 1005 [Grube] 2:35-37. One such technique is "Asymmetrical Digital Subscriber Loop, or Link, (ADSL)" which "increases the bandwidth of the twisted pair telephone line up to 1.1 megahertz." *Id.*, 2:49-56. Notably, however, this increased bandwidth is still much smaller than coaxial cable's bandwidth, which can reach 900 MHz-6GHz. Ex. 2010 [Coaxial-Products] (coaxial cable "is designed to carry high-frequency signals, 900 MHz to 6GHz, and to protect those signals against electromagnetic interference (EMI) from external sources."). Despite the increased bandwidth, however, ADSL is still only "used for one-to-one communications," just like traditional twisted-pair telephone lines. Ex. 1005 [Grube] 2:51-56.

41. Moreover, Grube concerns a citywide telephonic one rather than a local area one (*e.g.*, within a building) as the '450 patent does. As can be seen in Grube's Figure 8 below, Grube's primary site communicates with numerous secondary sites, including secondary site 108 which interfaces with a subscriber interface which, in turn, services pagers or a fax machine, a phone, and a TV:

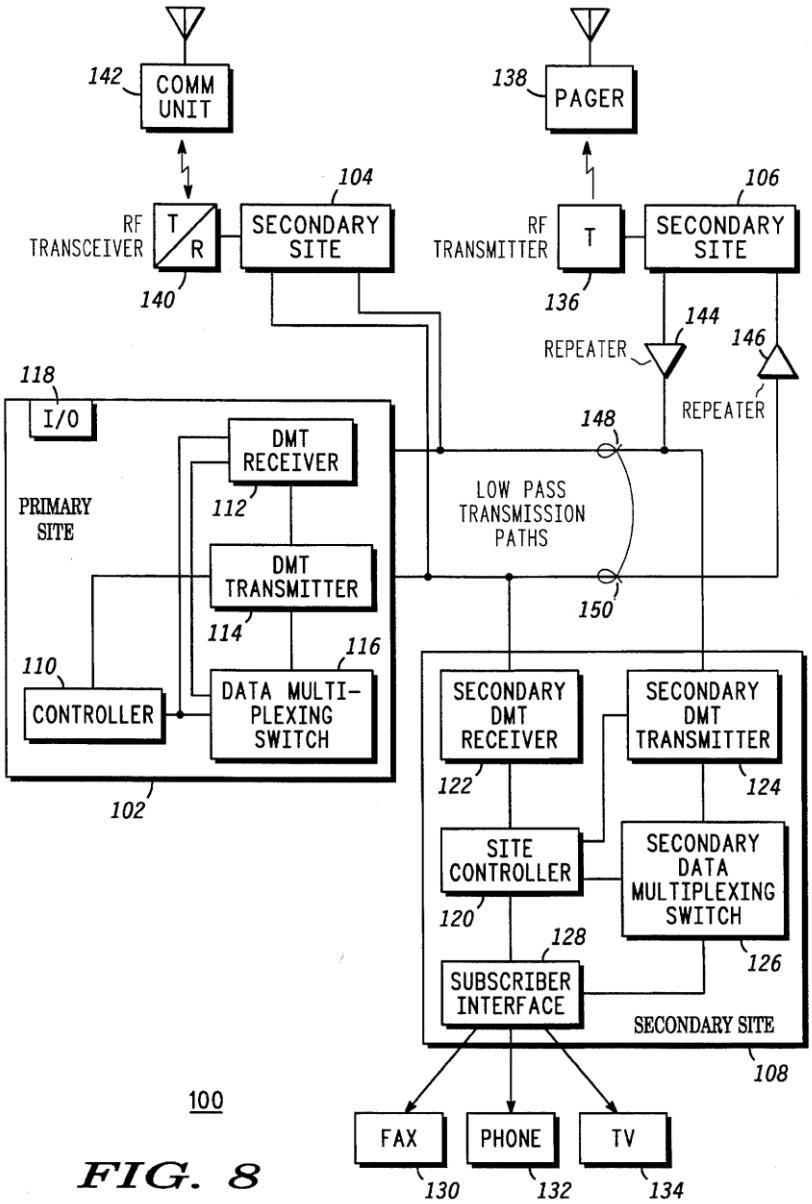

FIG. 8

Ex. 1005 [Grube] Fig. 8. Grube thus teaches that its primary site communicates with receivers meant to service entire buildings. *Id.*; *cf. id.*, Figs. 1-2 (existing telephonic systems also have citywide coverage). Reinforcing the fact that Grube concerns a citywide system, Grube also teaches that its primary site may be miles away from the secondary sites. *Id.*, 8:24-28 ("Note that, if ***the secondary sites are***

separated by more than a given geographic distance (12 Kft to 18Kft) from the primary site, … repeaters 144 146 may be required.”).

42. Grube thus seeks to take advantage of the increased bandwidth from ADSL and to utilize preexisting telephone lines. Ex. 1005 [Grube] 4:21-28 (“While the ADSL system increases the bandwidth of a telephone line, up to 1.1 megahertz, it is designed for one-to-one communications and not one-to-many or many-to-one communications. Therefore, a need exists for a one-to-many and/or many-to-one communication system infrastructure that utilizes existing telephone lines while providing the highly reliable service subscribers of wireless communication systems expect.”).

43. To accomplish its goal of adding one-to-many/many-to-one communications in a twisted-pair telephonic system with limited bandwidth, Grube utilizes a “primary site” at the headend that communicates with Grube’s “secondary sites.” Ex. 1005 [Grube] 7:1-3 (“The primary site communicates with the plurality of secondary sites via inbound and outbound low pass transmission paths.”). To be clear, “headend” is a term of art in cable systems. The primary site of Grube sits at the same place on its telephonic network, architecturally speaking, as a headend in a cable system. These secondary sites in turn communicate with “subscribers” such as telephones or television. *Id.*, 8:29-35 (each secondary site includes “at least one subscriber interface” that “may be coupled to a radio

frequency (RF) transceiver 140, an RF transmitter 136, a facsimile device 130, a telephone 132, or a television monitor 134."); 8:48-53 (similar).

44. This primary site transmits calls to the secondary sites, allocating channels to each call such that it occupies the minimum number of channels possible. Grube's process can be seen illustrated in Figure 29:

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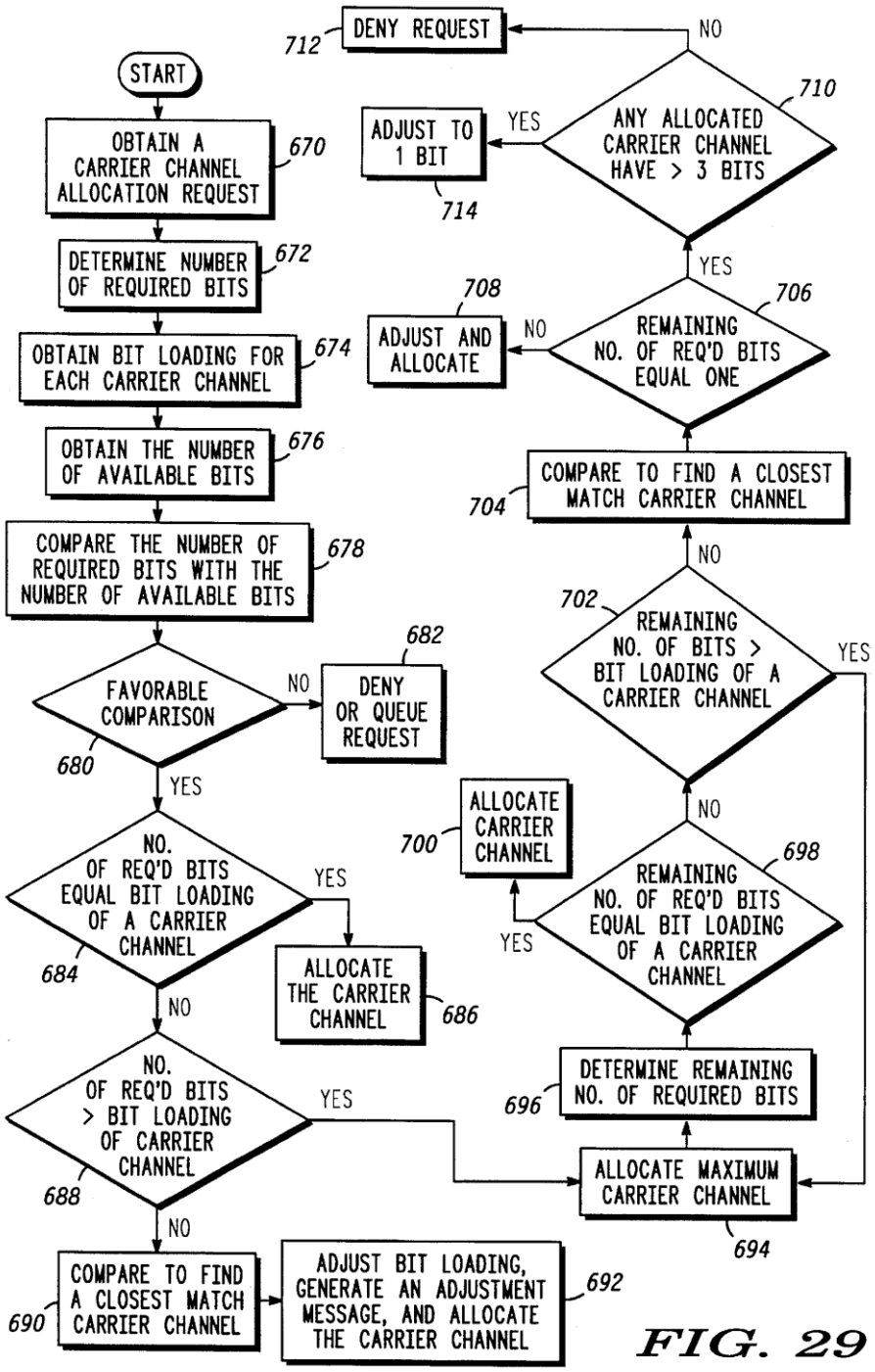

FIG. 29

Ex. 1005 [Grube] Fig. 29. As can be seen above, the primary site receives a "carrier channel allocation request" (also called a called a "call request" in Grube) (step 670) and "determines a number of required bits" based on the call type. *Id.*,

32:44-58. The primary site then "accesses an ordered bit loading table" (*id.*, 32:59-60) and then, using the table, either "queues or denies the request," "allocates the carrier channel having the bit loading which matches the number of required bits to the carrier channel request" if there is one, or "allocates the carrier channel[s] having the maximum bit loading, i.e., the maximum carrier channel, to the carrier channel request" until "the particular carrier channel allocation request has been allocated a sufficient number of carrier channels to fulfill the bandwidth requirements of the service being requested." *Id.*, 33:5-67. Thus, Grube seeks to minimize the number of channels allocated to a particular call with the ultimate goal of servicing more than one call at a time.

45. Grube and the '450 patent are thus, in my opinion, fundamentally different.

B. Grube Is Not Analogous Art (All Claims, All Grounds).

46. Each of the grounds presented by the Petition, again, relies on the Grube reference. Pet., 1. Based on the law regarding analogous art as explained to me by Entropic's attorneys and as summarized in Section IV.B above, it is my opinion that Petitioner and Dr. Williams have not shown Grube to be analogous art to the '450 patent.

47. I understand that Petitioner discusses analogous art as follows:

> Grube is analogous art to the ’450 Patent because both are from the same field of endeavor (one-to-many communication network infrastructures) and because Grube is pertinent to the problems that the ’450 Patent is concerned with (i.e., enabling one-to-many communications in a network using existing wired communications infrastructure). EX-1003, ¶¶54-56; EC-1001, 3:65-67, 4:1-8, 23:41-24:9; EX-1005, 1:6-8, 2:48-3:17, 4:21-28, 6:57-67.

Pet., 11-12 n.5. I note that Petitioner cites Dr. Williams’s declaration (*id.*) at paragraphs 54-56 which argues as follows:

> A POSITA would have understood that Grube is analogous art to the ’450 Patent.
>
> Both Grube and the ’450 Patent are from the same field of endeavor (communication network infrastructures involving one-to-many communications) and Grube is pertinent to the problems that the ’450 Patent is concerned with (i.e., enabling one-to-many communications in a network using existing wired communications infrastructure). DISH-1001, 3:65-67, 4:1-8, 23:41-24:9; DISH-1005, 1:6-8, 2:48-3:17, 4:21-28, 6:57-67.
>
> A POSITA would thus have been motivated to look to Grube to solve the issues facing the inventors of the ’450 Patent in the field of communications networking.

Ex. 1003 [Williams-Decl.] ¶ 54-56.

48. I disagree with Petitioner and Dr. Williams. In light of the fundamental difference between the two that I explained in Section VI.A, Grube

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does not share the ’450 patent’s field of endeavor and is not reasonably pertinent to the problem the inventors of the ’450 patent were trying to solve.

1. The ’450 Patent And Grube Do Not Share A Field Of Endeavor.

49. Neither Petitioner nor Dr. Williams provides any explanation for why a POSITA would consider “communication network infrastructures involving one-to-many communications” to be the field of endeavor for either the ’450 patent or Grube. Moreover, Petitioner and Dr. Williams are incorrect.

50. Rather, in my opinion, the traditional sources for identifying a field of endeavor confirm that the ’450’s field of endeavor is “broadband coaxial networks” (referred to as “BCNs”), and particularly local area BCNs. This is reflected in the ’450’s title “***BROADBAND LOCAL AREA NETWORK***” and Abstract (“A BCN network with BCN modems that enable network wired devices to communicate over a typical ***home coaxial network*** that may include passive splitters and different types of ***coaxial cable***.”). Ex. 1001 [’450] Title, Abstract. Notably, both Petitioner and Dr. Williams similarly seem to identify the ’450’s field as concerning broadband coaxial networks. *See* Pet., 3 (“The ’450 Patent ***relates to ‘[a] Broadband Coaxial Network (BCN) network*** formed by a plurality of common coaxial network elements.’”); Ex. 1003 [Williams-Decl.] ¶ 23 (same).

51. The ’450 patent’s “Field of Invention” similarly identifies “broadband communication networks,” particularly local area ones:

1. Field of Invention

> The invention relates to broadband communication networks, and in particular to local area broadband communication networks.

Ex. 1001 [’450] 1:21-24.

52. The Background of the Invention similarly focuses upon local broadband coaxial networks. Ex. 1001 [’450] 1:33-40 (describing prior art “broadband cable networks”); 1:45-57 (describing another prior art system with a “mixture of ***coaxial cables*** of varying types and quality”). The ’450 further addresses “a need for a system and method to connect a variety of CPEs into a local data network, such as a local area network (‘LAN’), within a building such as a home or office, while utilizing ***an existing coaxial cable network*** within the building.” *Id.*, 4:1-8; *see also* 1:45-57 (describing issues with “typical home or building coaxial cable configuration”).

53. Similarly, each of the claims is directed towards a “Broadband Coaxial Network.” *Id.*, cls. 1-38. Each of the ’450’s embodiments, like the claims, is directed towards a broadband coaxial/cable network as reflected in Figure 3 below:

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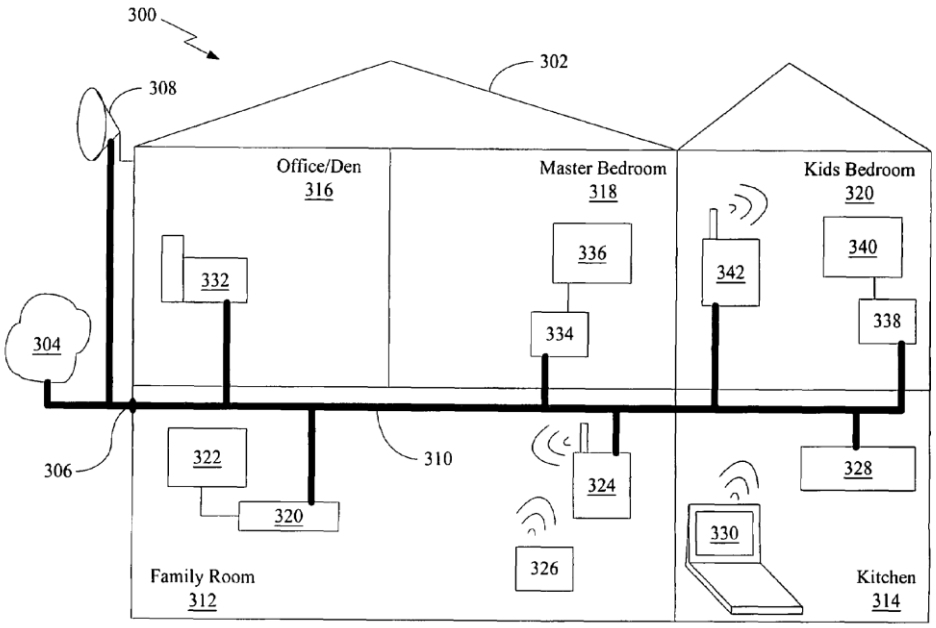

FIG. 3

Ex. 1001 [’450] Fig. 3, 4:53-54 (“FIG. 3 shows an example of a BCN network within a home or building and its utilization.”); *see* 4:12 (defining “BCN” as “Broadband Coaxial Network”). Similarly, the other figures either refer to prior art “broadcast cable system[s]” or refer back (directly or indirectly) to Figure 3’s “BCN”:

FIG. **1** shows a block diagram of an example implementation of a known broadband cable system within a building.

FIG. **2** shows a block diagram of another example implementation of a known broadband cable system within the building shown in FIG. **1**.

FIG. **3** shows an example of a BCN network within a home or building and its utilization.

FIG. **4** illustrates two examples of two different architectures for a satellite television system utilizing networking between devices, in this case, utilizing the Satellite cable to form a network between the devices.

FIG. **5** illustrates another satellite television bridging approach that employs the BCN network of FIG. **3**.

FIG. **6** is a block diagram of a multiple dwelling implementation that employs another configuration and utilization of a BCN network.

FIG. **7** is a block diagram of the BCN network of FIG. **3**.

FIG. **8** is an illustration of a functional diagram showing the communication between various nodes of a network similar to the one shown in FIG. **3**.

FIG. **9** is another functional diagram showing the interfaces and functional relationships between the Nodes of a network similar to the one shown in FIG. **3**.

FIG. **10** shows a block diagram of another example implementation and signal flows of a BCN network.

FIG. **11** illustrates another block diagram of another example implementation and signal flows of a BCN network.

FIG. **12** shows a plot of an example bit-loading constellation versus frequency.

FIG. **13**A shows a plot of the bit-loading constellation versus carrier number for the channel path between node A and node B of FIG. **7**.

FIG. **13**B shows a plot of the bit-loading constellation versus carrier number for the channel path between node A and node C shown in FIG. **7**.

FIG. **13**C shows a plot of the bit-loading constellation versus carrier number for the resulting broadcast channel path between node A and node B and node A and node C based on the constellations shown in FIGS. **13**A and **13**B.

FIG. **14** shows an example block diagram of an Ethernet to Coax bridge node in a BCN network.

FIG. **15** is a block diagram of one implementation of a multi-port Ethernet to coax bridge/router.

FIG. **16** is a block diagram of an Ethernet bridge/router with additional WAN and LAN ports including DSL/Cable Modem and wireless.

FIG. **17**, an illustration of various frequency plans for use of the BCN network in different home environments that may include satellite, cable, telco or other services.

FIG. **18** is diagram of a plurality of BCN modem enabled and corresponding devices.

FIG. **19** shows a flowchart illustrating the method performed by the BCN network shown in FIG. **7**.

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Id., 4:48-5:33. Not surprisingly, "broadband" and "broadband coaxial networks" (abbreviated as BCNs) are discussed pervasively throughout the disclosure and appear over 400 times in the '450 patent. Similarly, references to "coaxial" or "coaxial cable" appear over 75 times.

54. Thus, each of the traditional sources used to discern the field of endeavor—the title, the abstract, the "field of the invention," the function and structure of the claims, the embodiments, and more—all confirm that the '450 patent's field of endeavor is local area broadband coaxial networks. In accord, Petitioner's expert, Dr. Williams, agrees that "[t]he '450 Patent ***relates to '[a] Broadband Coaxial Network (BCN) network*** …" Ex. 1003 [Williams-Decl.] ¶ 23.

55. In my opinion, Grube's field is not local area "broadband coaxial networks." Significantly, Grube does not mention "broadband" at all. *See generally* Ex. 1005 [Grube]. Nor is "cable" mentioned aside from a solitary reference to a "cable box" which can "interface with" Grube's secondary site (an alleged "receiving node"). *See id.*, 12:67-13:2.

56. There is no reason to believe that Grube's field has anything to do with "broadband coaxial networks." Rather, Grube is directed to networks that use twisted pair telephone wires, not coaxial cable. Ex. 1005 [Grube] 6:57-60 ("Generally, the present invention provides a method and apparatus for

establishing a communication system infrastructure utilizing ***low pass transmission path, i.e. twisted pair telephone line***."); 7:1-3 ("The primary site communicates with the plurality of secondary sites via inbound and outbound ***low pass transmission paths***."); 9:41-46 ("FIG. 9 illustrates a communication system 160 having a two-wire infrastructure. As shown, the primary site 102 is operably coupled to a plurality of secondary sites 104-108 via a ***twisted pair low pass transmission path 162***. The low pass transmission path is a ***twisted pair copper wire, which may be a telephone line***."); 12:32-34 ("In operation, the DMT receiver 122 receives information from an outbound ***twisted pair 150***"); 13:37-40 ("In this mode, the DMT transmitter 124 places data on allocated carrier channels of the inbound ***twisted pair 148***."); *see also* 1:21-24 (Grube's "wireline links 34-38 are typically ***T1 links***"); Ex. 2005 [One-Ring-Networks] 1 (a "T1 line" is "a communications transmission service that uses 2 ***twisted pair copper wires*** to transmit and receive data or voice traffic."). Petitioner and Dr. Williams similarly acknowledge Grube's focus upon "telephone lines." *See, e.g.*, Pet., 6 ("Grube focuses on improving reliability and bandwidth over existing wiring in a home environment, e.g., ***telephone lines***,"); 12 ("Grube developed a one-to-many communication system utilizing 'twisted pair telephone line.'"); Ex. 1003 [Williams-Decl.] ¶¶ 43, 58.

57. Twisted pair wires are substantially different from coaxial cable. *See* Ex. 2009 [Coaxial-vs-Twisted-Pair] (describing major differences between and advantages of coaxial cable over twisted pair). While both phone lines and coaxial cables are transmission lines (Ex. 2004 [Signal-Integrity] 82), the frequencies, and therefore wavelengths, involved are dramatically different due to coaxial cable's superior shielding and precisely controlled geometries at manufacturing. *Id.* ("The term 'coaxial' refers to the fact that it has a small center conductor surrounded by a cylinder of insulating material, which is in turn surrounded by a cylindrically shaped conductor. The two conductors are coaxial (get it?) and so they make a capacitor."). A 1 MHz signal has a wavelength of roughly 300m or about 1000 feet ($\lambda = c/f$). Lower frequencies on a phone line have even longer wavelengths. Conversely, a cable signal at, *e.g.*, 900 MHz (the range of the '450 patent's home network) has a wavelength of 0.33m, or about one foot. This difference has physical significance—transmission-line effects, such as reflections, cause the frequency response of coaxial cable to be much more chaotic than telephone lines. Ex. 2004 [Signal-Integrity] 94-96, 99-101. Worse, these effects appear over much shorter cable lengths, such as those found inside homes, than telephone lines. Indeed, inside a home, it is clear that propagation over telephone lines is lumped, not distributed, and transmission-line effects such as reflections disappear. Phone line is fundamentally different from coaxial cable.

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58. Moreover, Grube's network using twisted pair wires (rather than coaxial cable) would not be considered broadband, at least at the time of the '450 patent's invention. Grube's disclosure confirms that Grube is not directed towards "broadband" as used by the '450 patent and employs twisted pair telephone lines with a bandwidth of "up to 1.1 MHz." Ex. 1005 [Grube] 15:44-51 ("For example, one sinusoidal signal will have a frequency of 25 kilohertz, a second signal will have a frequency of approximately 29 kilohertz, a third signal will have a frequency of approximately 33 kilohertz, wherein each of the remaining sinusoidal signals will be increased by approximately four kilohertz up to approximately 1.1 megahertz."); 16:29-32 ("The second training signal is similar to the first training signal in that it contains a plurality of sinusoidal signals separated in frequency by approximately 4 kilohertz starting at 25 kilohertz ***up to a frequency of 1.1 megahertz***."); 52:6-9 ("As previously mentioned, the ADSL system incorporates 256 carrier channels, ***beginning at 25 kilohertz up to 1.1 MHz*** at increments of 4 kilohertz."). A bandwidth of 1.1 MHz would not be considered to be "broadband," at least in the sense of the '450 patent's usage. The '450 patent refers to a bandwidth of, *e.g.*, 50 MHz, *i.e.*, over 45 times broader than Grube. Ex. 1001 ['450] 14:32-39; *see also, e.g.*, Ex. 2006 [CTC] 7.

59. Further, the '450 patent's BCN is fundamentally different from Grube's phone line network. For example, the '450's BCN contains splitters,

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radio-frequency devices designed to route signals from one input to multiple destinations with low signal distortion. Ex. 1001 ['450] 3:20-28 ("most broadband cable networks … presently utilized within most existing buildings are not configured to allow for networking between CPEs. Most broadband cable networks utilize broadband cable splitters that are designed to split an incoming signal from the POE into numerous split signals that are passed downstream to the different nodes in different rooms"); Fig. 2. One of the main problems with splitters is that two legs (outputs) of the splitter have a difficult time communicating because a splitter is purposely designed to shield the outputs from one another. *See* Ex. 1001 ['450] 3:56-60. Phone networks have no such issue due to the low frequencies involved, and devices are simply wired together. *See* Ex. 1005 [Grube] Figs. 8, 9 (splitters are noticeably absent).

60. Moreover, Grube has nothing to do with ***local*** area networks, such as in a home. Rather, Grube concerns a twisted pair telephonic system on a ***citywide*** scale.

61. As can be seen in Grube's Figure 8 below, Grube's primary site communicates with numerous secondary sites, including secondary site 108 which services a fax machine, a phone, and a TV:

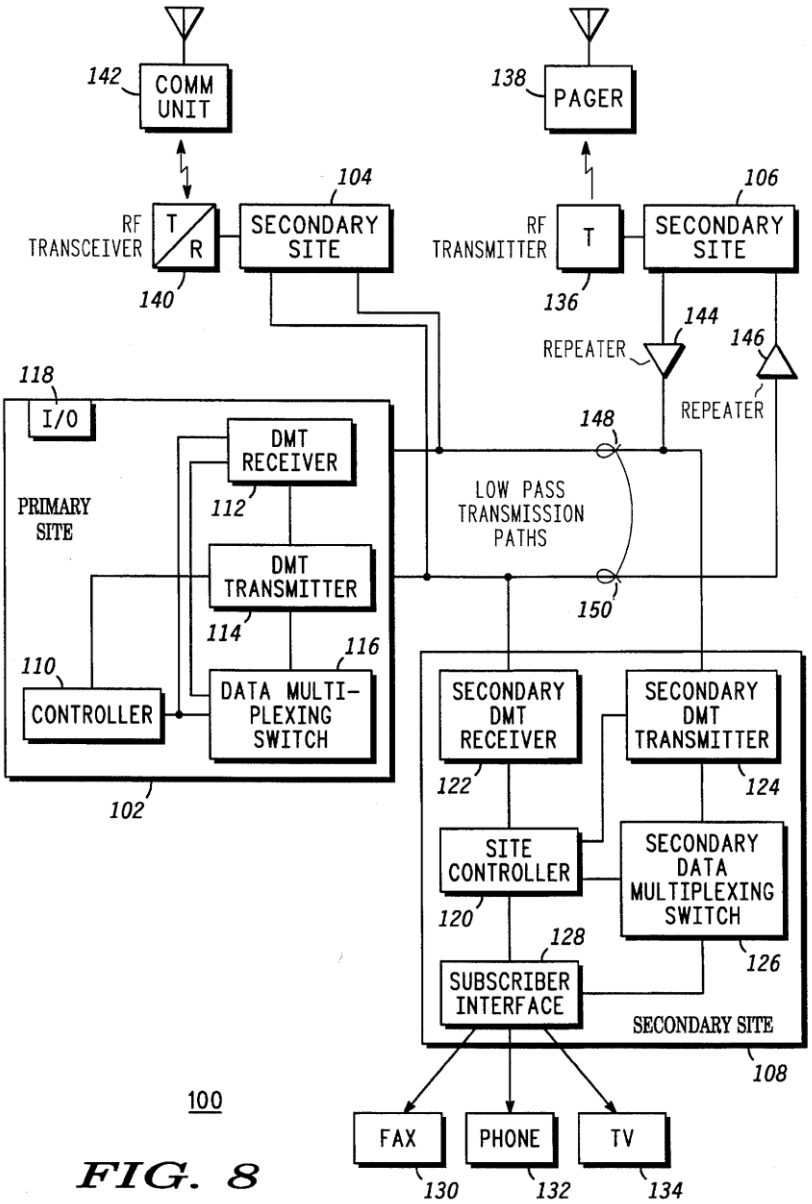

FIG. 8

Ex. 1005 [Grube] Fig. 8. Grube thus teaches that its primary site communicates with receivers meant to service entire buildings. Indeed, Grube teaches that its primary site is responsible for receiving call requests, determining which secondary site should receive a particular call, and then allocating available channel resources to the call. *See* Ex. 1005 [Grube] 8:41-9:40 (describing how

Grube's primary site handles call requests). In accord, Grube teaches that its primary site "would ***include a public switched telephone network (PSTN) interconnection*** to support telephone interconnect operations and to transceive facsimiles." *Id.*, 10:26-29; *see also id.*, 8:62-67. Grube also teaches that its primary site may be miles away from the secondary sites. *Id.*, 8:24-28 ("Note that, if ***the secondary sites are separated by more than a given geographic distance (12 Kft to 18Kft) from the primary site***, … repeaters 144 146 may be required.").

62. Thus, in my opinion, Petitioner and Dr. Williams's asserted field of "one-to-many communication network infrastructures" is misleading, especially given the significant differences between the '450 patent and Grube's respective technologies. This alleged field is overly generic and not supported by any of the citations. The sections of the '450 patent that Petitioner cites as allegedly supporting a field of "one-to-many communication network infrastructures" do not in fact mention "one-to-many communication," let alone in the way that Grube describes it (between a headend and buildings). Ex. 1001 ['450] 3:65-67 ("a growing number of users desire to ***network multiple CPEs to share storage and capabilities across the network***."), 4:1-8 ("Therefore, there is a need for a system and method to ***connect a variety of CPEs into a local data network***"), 23:41-24:15 (describing method of determining common bit-loading modulation schemes so the BCN may "freely transmit information ***between the various nodes***."). While

Grube describes that adding one-to-many communications between a headend and buildings to telephone lines as its invention (*see* Ex. 1005 [Grube] 4:24-28), such one-to-many communications between cable operators and premises were addressed long ago in cable. Ex. 2007 [Cable-Television-Laboratories] 150. Thus, Petitioner and Dr. Williams's assertion that the '450 patent's field concerns "one-to-many communication network infrastructure" misses the mark.

63. Consequently, Grube is not directed toward local area "broadband coaxial networks" and thus, is not in the same field of endeavor as the '450. Likewise, while Grube's focus is upon twisted pair telephone wires, the '450 never even mentions "twisted pairs."

2. Grube Is Not Reasonably Pertinent To The'450 Patent's Problem

64. I do not believe that Grube is reasonably pertinent to the problem with which the inventors of the '450 patent were concerned.

65. The '450 patent addresses a problem with broadband coaxial networks ("BCNs") within a building. As the '450 patent explains, current BCNs within a building typically receive broadcast signals "at **a point-of-entry ('POE')**." Ex. 1001 ['450] 1:28-33. That signal is then distributed from the POE to **"nodes"** connected to **"various types of customer premise equipment ('CPE')** such as cable converter boxes, televisions, video monitors, cable modems, cable phones,

audio video receivers, set-top boxes (STBs) and video game consoles" via broadband cable splitters. *Id.*, 1:37-43.

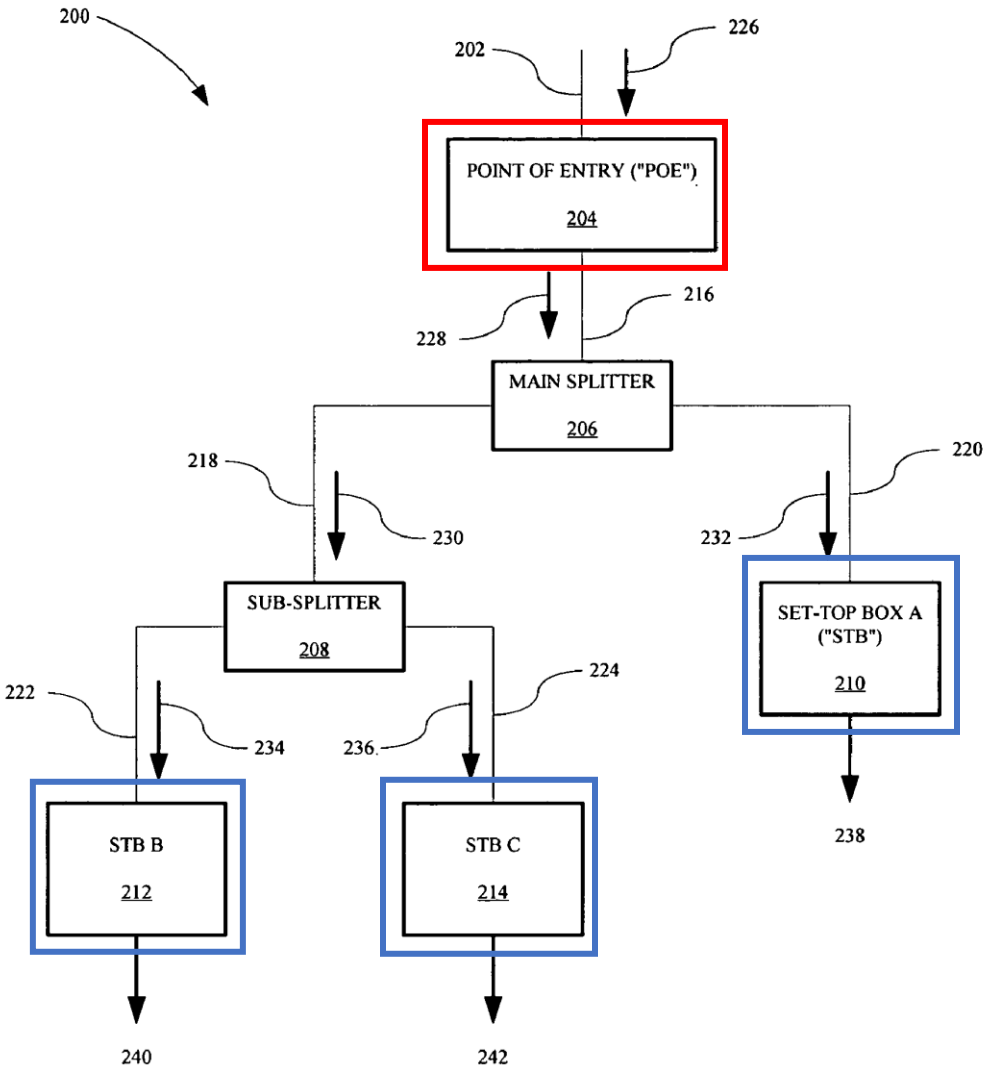

FIG. 2 (Prior Art)

Id., Fig. 2 (annotated).

66. One major source of the difficulty in peer-to-peer communications is the necessary use of splitters to route cable network access to each device, as seen in Figure 2 above. As a result of this configuration, "most broadband cable networks … presently utilized within most existing buildings are not configured to allow for networking ***between CPEs [because m]ost broadband cable networks utilize broadband cable splitters*** …" Ex. 1001 ['450] 3:20-25. As the '450 patent further explains:

> Usually, most of the energy from the upstream signals is passed from the CPEs to the POE because the splitters typically have a high level of isolation between the different connected terminals resulting in significant isolation between the various CPEs.
>
> ***The isolation creates a difficult environment in which to network between the different CPEs*** because the isolation results in difficulty for transmitting two-way communication data between the different CPEs.

Id., 3:56-64; *see also* 17:50-57 ("Physically the channels often vary in length between nodes and electrically vary because of the paths through and the reflections from the various cables, switches, terminals, connections, and other electrical components in the BCN network."). Thus, the '450 patent addresses a need to "connect a variety of CPEs into a local data network, such as a local area network ('LAN'), within a building such as a home or office, while utilizing an existing coaxial cable network within the building." *Id.*, 4:1-8; *see also id.*, 3:1-10

("There are large numbers and types of CPEs that can be utilized and shared in such a fashion including televisions, video monitors, cable modems, cable phones, video game consoles, and audio components, as well as various storage devices. There is a growing need ***for different CPEs to communicate between themselves in a network type of environment within the building***.").

67. The isolation and transmission line effects in BCNs within a building also make it more difficult for a node to simultaneously transmit a message to multiple other nodes. The channel paths between different nodes "are physically and electrically different in the BCN network. Physically the channels often vary in length between nodes and electrically vary because of the paths through and the reflections from the various cables, switches, terminals, connections, and other electrical components in the BCN network." Ex. 1001 ['450] 17:50-57. In other words, the physical medium of coaxial cable carrying high-frequency signals causes unique signal-propagation issues. These issues are not found in phone wiring. Consequently, in order to transmit a message from node A to nodes B and C simultaneously, a "common bit-loading modulation scheme" is necessary. *Id.*, 20:12-20.

68. I do not agree with Petitioner's contention that the '450 patent's inventors were concerned with was the abstract problem of "enabling one-to-many communications in a network using existing wired communication infrastructure"

(Pet., 11 n.5). That level of abstraction obscures the specificity of the problem the '450's inventors were trying to solve. Indeed, the problem of "one-to-many communications"—especially as Grube describes one-to-many communications between a headend and buildings—had already been solved in cable before the time of the '450 patent's invention. Indeed, the industry standard for one-to-many/many-to-one communications between cable operators and premises had already been established in 1997, well before the time of the invention.[1] Ex. 2007 [Cable-Television-Laboratories] 150 (discussing such broadcasting).

69. Grube is directed towards a different problem in an entirely different portion of a signal path than what is relevant in the '450 patent. Grube addresses a need "for a one-to-many and/or many-to-one communication system infrastructure that utilizes existing telephone lines while providing the highly reliable service subscribers of wireless communication systems expect." Ex. 1005 [Grube] 4:24-28.

70. To address this need, Grube teaches the use of a "primary site" which routes calls to various secondary sites (receivers) which are in turn affiliated with

[1] To be sure, however, Grube (and DOCSIS for that matter), are one further step removed from—and share no relevant characteristics with—a local area BCN much less any communications between devices within that BCN.

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various subscribers (e.g., pagers, phones, faxes). Ex. 1005 [Grube] Abstract, Fig. 8, 7:1-8:15, 8:16-37. Importantly, the secondary sites receive all communication from the primary site and not from each other. *Id.*, Fig. 8, 8:17-21.

71. The problems the ’450 patent and Grube address are simply entirely different from each other, dealing with different parts of a signal transmission and the different issues that arise due to the different wires the ’450 patent uses (coaxial cable) and Grube uses (twisted pair). Again, the ’450 patent addresses issues with devices within a building communicating with each other, in a peer-to-peer manner, at high frequences (*e.g.*, 800 MHz). Grube addresses issues with a single citywide-scale headend transmitting signals to multiple receivers or receiving signals from those receivers at much lower frequencies (*e.g.*, 1.1 MHz). *See* Ex. 1005 [Grube] 8:24-28 (“if the secondary sites are separated by more than a given geographic distance (***12 Kft to 18Kft***) from the primary site, … repeaters 144 146 may be required.”). Grube’s receivers or secondary sites are more akin to the points of entry to buildings described in the ’450 patent rather than the devices within those buildings the ’450 patent allows to communicate with each other.

72. Petitioner and Dr. Williams overlook that the physical media involved (coaxial cable versus twisted-pair phone lines) are substantially different, and so a POSITA would know that a solution for one (*e.g.*, twisted-pair phone lines) would not be relevant to the other (*e.g.*, coaxial cable). To illustrate this point, consider

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the language of Grube. It consistently (over 27 times) refers to the phone line as a "low pass transmission path." *E.g.*, Ex. 1005 [Grube] 6:62-64 ("The primary site is coupled to a plurality of secondary sites via ***low pass transmission paths***."). This is correct—a twisted pair phone line acts like a low pass filter over distance. The twisted-pair structure is unshielded (for cost reasons), which leads to a loss of signal energy over distance. Electrically, therefore, the medium appears as a low-pass filter. In other words, the twisted-pair wiring causes higher frequencies to be filtered out, leaving only low frequencies successfully transmitted. This is why the diagrams in Grube (*e.g.*, Fig. 4) show a 1.1 MHz bandlimit. This is also the technical reason why nearly all phone lines are point-to-point connections—they cannot carry enough information to distribute information to multiple users. Grube attempts to address the lack of point-to-multipoint connections but cannot address the more fundamental issue that twisted-pair is unsuitable for it.

73. Conversely, coaxial cable, because of its shielding and tightly controlled impedance, can carry signals at a much higher frequency. *Contrast*, *e.g.*, Ex. 1001 ['450] Fig. 6 (showing signal-carrying capacity above 770 MHz) *with* Ex. 1005 [Grube] Fig. 4 (showing a 1.1 MHz bandlimit). The differences between the physical properties of coaxial and telephone cabling are particularly noticeable at high frequency. Transmitting signals at a higher frequency over telephone lines actually results in higher losses and drops in signal strength. *See*

Ex. 1005 [Grube] Fig. 2 (drops in bit-loading as frequency goes up). Meanwhile, at high frequencies, the behavior of coaxial cable is well-known to be chaotic, with sharp increases in attenuation at very specific frequencies. When we were developing our own in-home coaxial video distribution system, we referred to the sudden drop in signal propagation at very specific frequencies as "deep nulls". This is seen, *e.g.*, in Fig. 9 of the '450 patent.

74. Beyond the very significant difference between the media (*i.e.*, coaxial cable versus twisted pair), in deployments utilizing coaxial cable, Grube is likewise irrelevant. There is no indication that cable systems lacked mechanisms to transport content between anything resembling the primary sites in Grube. Certainly, to the extent that one considers the cable operator's connection to cable modem connection, the DOCSIS standard was long since established and addressed certain issues addressed by Grube in the twisted-pair context in the context of communications between cable providers and customers (*e.g.*, one-to-many and many-to-one communications). Significantly, the problems that Grube seeks to address in the context of citywide telephonic infrastructure had already long been solved at a macro level in cable infrastructure, *i.e.*, at the operator-to-premises level. Indeed, the industry standard for one-to-many/many-to-one communications in cable between a headend and buildings had already been established in 1997, well before the time of the invention. Ex. 2007 [Cable-

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Television-Laboratories] 150 (discussing such broadcasting). To be sure, however, Grube (and DOCSIS for that matter), are one further step removed from—and share no relevant characteristics with—a local BCN much less any communications between devices within that BCN. Cable networks were quite capable of connecting devices such as cable set-top boxes and television sets to broadcast video while, at the same time, permitting hundreds of users to use cable modems for two-way interactive communications.

75. Thus, the ’450 patent’s and Grube’s problems are entirely distinct, and Petitioner and Dr. Williams do not explain why Grube is reasonably pertinent to the ’450 patent in view of these manifest differences. In my opinion, Petitioner and Dr. Williams fail to demonstrate that Grube is analogous art to the ’450 patent.

C. “A Broadband Coaxial Network” (All Claims, All Grounds).

76. Each of the independent claims require “a Broadband Coaxial Network (‘BCN’)”:

> Limitation 29[pre] “A broadcasting method within a Broadband Coaxial Network (‘BCN’), comprising:”
>
> Limitation 34[pre] “A Broadband Coaxial Network (‘BCN’), comprising:”
>
> Limitation 34[a] “a first BCN modem comprising a first controller; and”

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Limitation 34[b] "a plurality of BCN modems comprising a plurality of controllers;"

77. As for claim 29, I note that the claimed "BCN" appears later in a dependent claim:

Claim 32 "The broadcasting method within the BCN of claim 29, wherein each node of the BCN determines a respective common bit-loading modulation scheme for broadcasting to the other nodes of the BCN."

Consequently, claim 29's preamble provides antecedent basis for the BCN also recited in claim 32.

78. I understand that Petitioner contends that the BCN limitation is satisfied by Grube alone (Ground 1) or Grube in combination with Cioffi (Grounds 2 and 3). Pet., 11, 38, 62, 64, 80, 83. In my opinion, both arguments fail for the reasons explained below.

1. Grube Does Not Render Obvious A "Broadcast Coaxial Network" ("BCN").

79. Notably, a "Broadcast Coaxial Network ('BCN')" lies at the heart of the claims.

80. As I have previously explained, the '450 patent's field is "local area broadband coaxial networks" and the '450 patent is directed towards enabling peer-to-peer communication among nodes within a local area BCN. Due to the configuration of prior art BCNs and the inherent properties of coaxial cable "most

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broadband cable networks … presently utilized within most existing buildings are not configured to allow for networking ***between CPEs*** [because m]ost broadband cable networks utilize broadband cable splitters that are designed to split an incoming signal from the POE into numerous split signals that are passed downstream to the different nodes in different rooms…" Ex. 1001 ['450] 3:21-30. The '450 patent further explains that local area BCNs face certain technological challenges by virtue of the small distance and coaxial cable properties:

> Within a typical building or home, there may be a mixture of coaxial cables of varying types and quality, such as RG-59, RG-6, RG-6 quad shield. Creating a less than optimal RF environment within the cable. Further, typical homes do little or no termination of cable outlets enabling the introduction of RF interference into the coaxial cables. Another problem often encountered with a typical home or building coaxial cable configuration is the use of multiple splitters of varying quality and frequency ranges. ***Thus, creating a problem for known approaches to local area networking over coaxial cable***. Such networking often requires a more controlled RF environment or higher quality cabling to support higher frequency ranges.

Id., 1:45-57.

81. In accord, the '450 patent addresses a need to "***connect a variety of CPEs into a local data network, such as a local area network ('LAN'), within a building such as a home or office,*** while utilizing an existing ***coaxial cable network within the building***." *Id.*, 4:1-8; *see also id.*, 2:59-3:10 ("The main

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drawback to the ability of users to view multimedia information stored on multiple storage devices at the home and view it (or listen to it) on any capable home appliance at the time and manner of his choosing is the lack of a viable home networking solution. … There is a growing need ***for different CPEs to communicate between themselves in a network type of environment within the building***.”). Thus, a “broadband coaxial network” goes to the heart of the ’450 patent’s invention.

82. Petitioner, however, fails to demonstrate that this important limitation is met.

83. I understand that Petitioner alleges that Grube “renders obvious” the limitations-in-question, rather than that Grube discloses them:

> Grube ***renders obvious*** that the claimed “broadcasting method” is implemented “within a Broadband Coaxial Network.” Grube couples its secondary sites to “a communication unit 142, … a telephone 132, … or any other type of device that can receive digital information.” EX-1005, 8:46-53; *see also id.*, FIG. 8. While it was well-known that such devices were commonly used in broadband coaxial networks (EX-1003, ¶62-64), ***Grube does not explicitly describe its system as such a network.*** *See generally* EX-1006. As Dr. Williams explains, however, ***a POSITA would have been motivated and would have found it obvious to implement Grube’s system and method in broadband coaxial networks.*** EX-1003, ¶¶62-71.

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Pet., 14-15.

84. As an initial matter, it is unsurprising that Petitioner must concede that "Grube does not explicitly describe its system as" a BCN. Indeed, this greatly understates what Grube actually teaches. Grube has nothing to do with a broadband coaxial network either explicitly or implicitly. Grube does not even mention "broadband" or "coaxial" cable. *See generally* Ex. 1005 [Grube].

85. Rather, as I have explained, Grube is directed toward a citywide twisted-pair telephone line system. Ex. 1005 [Grube] 6:57-60, 7:1-3, 8:24-28, 9:41-46, 12:32-33; *see* Section VI.A. Twisted-pair telephone lines are significantly different from and not even in the same field as the required BCN. *See* Section VI.B.1.

86. One critical difference stems from the fact that coaxial cable is shielded while twisted-pair telephone lines are not. *See* Ex. 2004 [Signal-Integrity] 82 ("The term 'coaxial' refers to the fact that it has a small center conductor surrounded by a cylinder of insulating material, which is in turn surrounded by a cylindrically shaped conductor. The two conductors are coaxial (get it?) and so they make a capacitor."); 121 ("This is what Ethernet uses – unshielded twisted pair (UTP). This is important because, as one might guess, the unshielded cable is cheaper than shielded."). As I explained, twisted-pair's lack of shielding results in much lower bandwidths than coaxial cable—even with the expanded bandwidth

from ADSL. *Compare* Ex. 1005 [Grube] 1:21-24, 15:44-51, 16:29-32, 52:6-9 (ADSL's expanded bandwidth is approximately 1.1 MHz) *with* Ex. 1001 ['450] 14:32-39 (the '450 patent utilizing a bandwidth of 50 MHz). Grube would not be considered "broadband" at the time of the invention.

87. Grube simply has nothing to do with "broadband" or "coaxial" cable, and thus, also has nothing to do with the claimed "Broadband Coaxial Network."

88. Despite this fact, I understand that Petitioner argues that that "a POSITA would have been motivated and would have found it obvious to implement Grube's system and method in broadband coaxial networks." Pet., 15. Specifically, Petitioner argues that this implementation would have allowed Grube's invention "to reap the well-known benefits of the high bandwidth available in coaxial networks." *Id.* Petitioner further argues that "a POSITA would have been motivated ***to implement Grube's system and method without modification*** in a broadband coaxial network" because "[c]oaxial cable networks and twisted-pair telephone line networks are structurally similar." *Id.*, 16; *see also* 15 ("Grube was applicable to pre-existing home/building networks, and coaxial cable networks were already commonly used to connect various devices throughout a home/building."); 16-17 ("coaxial cable networks … also involves multiple carrier channels possibly possessing different transmission characteristics from the point-of-entry to a network device."). I disagree.

89. In my opinion, Petitioner is merely generically arguing that coaxial cable would have increased Grube's bandwidth and without modification. This overlooks the plain facts that, first, the benefits Grube purports to bring to telephonic networks (the ability to route multiple calls over citywide phone wiring) had already been brought to cable networks (the ability to route both broadcast television and two-way Internet over citywide coaxial wiring) and, second, the '450 is drawn to in-home wiring, not city-wide wiring. But this is just as nonsensical as it would be to argue that a POSITA would be motivated to replace an automobile engine in a reference specifically directed towards improving that automobile's engine with a jet engine—somehow without modifying the automobile's system—because it would make the automobile "faster."

90. Additionally, changing Grube's twisted-pair telephonic system to be implemented in coaxial cable and take advantage of coaxial cable's increased bandwidth would require entirely replacing twisted-pair telephone lines with coaxial cable. Indeed, because twisted-pair telephone lines act as a "low-pass filter," all of Grube's twisted-pair lines would have to be replaced in order for signal to propagate through the entire system. *See* Ex. 1005 [Grube] 6:57-60 ("Generally, the present invention provides a method and apparatus for establishing a communication system infrastructure utilizing ***low pass transmission path, i.e. twisted pair telephone line***."). This change would

undermine Grube's stated purpose of "utiliz[ing] existing telephone lines" to take advantage of these "inexpensive twisted pair copper wire telephone lines" which are of "added benefit in newly emerging industrialized nations that have a limited communication infrastructure of twisted pair copper wire telephone lines and little, if any, of the more expensive transmission links." *Id.*, 4:24-28, 27:63-28:3; *see also* Ex. 2004 [Signal-Integrity] 121 ("This is what Ethernet uses – unshielded twisted pair (UTP). This is important because, as one might guess, the ***unshielded cable is cheaper than shielded***."). The petitioner's proposed modification to use coaxial cable to implement Grube therefore also overlooks the obvious high costs associated with the change.

91. Moreover, "coaxial cable networks and twisted pair-telephone line networks" are not "structurally similar," contrary to Petitioner's contention. Pet., 16. To reiterate, coaxial cable and twisted-pair phone lines are physically different. Because the twisted-pair structure is unshielded for cost reasons (Ex. 2004 [Signal-Integrity] 121), there is a loss of signal energy over distance and the medium appears as a low-pass filter. Only low frequencies are successfully transmitted as high frequencies are attenuated, resulting in a low bandlimit. Ex. 1005 [Grube] 2:49-53 (bandlimit up to 1.1 MHz). Conversely, coaxial cable, because of its shielding and tightly controlled impedance, can carry signals at a much higher frequency and thus has a much higher bandwidth. *See* Ex. 1001

[’450] 14:32-37 (“50 MHz bandwidth [] at approximately 900 MHz.”). Indeed, the difference in bandwidth between the ’450 patent’s system and Grube’s is 45x. In fact, my recollection is that the cable systems that drove the set-top boxes my group designed worked from 5 MHz to 860 MHz. In other words, the entire bandwidth of a phone cable is so small that it is in the band that cable networks do not even use or need. As a consequence, the problems Grube’s twisted-pair telephonic system grapples with in managing and allocating its limited bandwidth are nonexistent, or at most trivial, in a coaxial cable system.

92. Furthermore, as I have explained, Grube’s entire purpose is to “utilize[] existing telephone lines” to take advantage of these “inexpensive twisted pair copper wire telephone lines” which are of “added benefit in newly emerging industrialized nations that have a limited communication infrastructure of twisted pair copper wire telephone lines and little, if any, of the more expensive transmission links.” Ex. 1005 [Grube] 4:24-28, 27:63-28:3. As such, Grube’s system is a citywide twisted-pair system and is directed towards addressing a need “for a one-to-many and/or many-to-one communication system infrastructure that utilizes existing telephone lines” between a headend and buildings. *Id.*, 4:24-28. In other words, Grube’s system is intended to overcome shortcomings specific to the very limited yet widely available and inexpensive twisted-pair telephone wires. Grube’s system particularly addresses the lack of frequency bandwidth available

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for one-to-many communications in a citywide area while taking advantage of widely available preexisting telephone networks.

93. These problems that Grube attempts to address are irrelevant to coaxial cable systems, which have far higher bandwidths and which addressed one-to-many communications between a cable operator and premises in 1997 via the DOCSIS standard. Ex. 2007 [Cable-Television-Laboratories] 150. Thus, removing Grube's teachings from its limited bandwidth context to coaxial cable's comparatively unlimited bandwidth context would simply make no sense.

94. I also note that Petitioner appears to imply that Grube is directed to home/building networks. Pet., 15 ("Grube was applicable to pre-existing home/building networks"). I disagree.

95. Grube is, again, directed toward a citywide telephone network, as illustrated in Grube's Figure 8:

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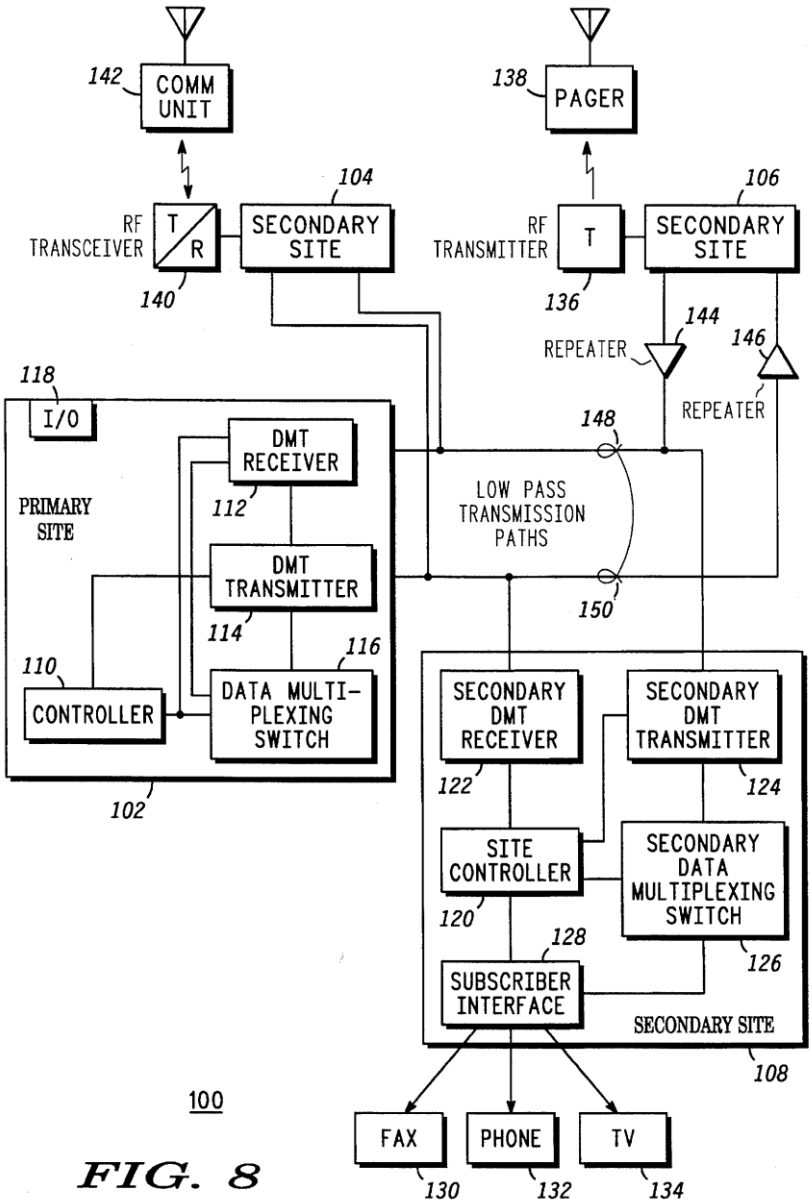

FIG. 8

Ex. 1005 [Grube] Fig. 8; *see also id.*, 8:24-28 ("Note that, if ***the secondary sites are separated by more than a given geographic distance (12 Kft to 18Kft) from the primary site***, … repeaters 144 146 may be required."). Grube is entirely unconcerned with the communication between the fax 130, phone 132, and TV 134 that would be connected to a LAN, if there were one.

96. Thus, in my opinion, Petitioner and Dr. Williams fail to demonstrate that Grube alone renders obvious a "Broadband Coaxial Network ('BCN')."

2. A POSITA Would Not Be Motivated To Combine Grube With Cioffi.

97. I understand that Petitioner also argues that its Grube-Cioffi and Grube(-Cioffi)-Matsumoto grounds "incorporate[] ***Cioffi's teachings about broadband coaxial networks*** into Grube's system and method for determining a common bit-loading modulation scheme." Pet., 56. I do not believe a POSITA would be motivated to do so.

98. For much the same reasons as a POSITA would not be motivated to add coaxial cable in general to Grube's twisted-pair telephonic system, a POSITA would also not be motivated to add Cioffi's coaxial cable network to Grube's twisted-pair telephonic system. To reiterate for clarity, Grube's entire purpose and principle of operation is to achieve one-to-many and many-to-one communications "utiliz[ing] existing telephone lines," *i.e.*, the existing twisted-pair telephonic system which is physically limited in bandwidth. Replacing those twisted-pair lines with Cioffi's coaxial cable (which has much higher bandwidth and thus does not face the same problems as Grube's system) would be utterly nonsensical and sheer hindsight.

99. Moreover, I understand that Petitioner argues that because Grube uses DMT transmitters and receivers, a POSITA would be motivated to add coaxial cable to Grube's system:

> …Grube teaches determining a common bit-loading modulation scheme in the context of a "primary site" having "a DMT transmitter" and a "DMT receiver," and a plurality of secondary sites, each having "a secondary DMT receiver" and "a secondary DMT transmitter," Grube's exemplary infrastructure for such a network is a "twisted pair telephone line." EX-1005, 6:57-67.
>
> …
>
> Cioffi recognizes that "DMT transmission scheme[s] ha[ve] the potential for use in applications well beyond data transmissions over telephone lines," and "it can be used in a variety of other digital subscriber access systems as well," including "cable based subscriber systems (which typically use coaxial cable)." EX-1006, 2:5-11; *see also id.*, 3:9-16 (recognizing applicability of DMT transmission schemes to both twisted pair telephone lines and coaxial cables). Cioffi further teaches the use of broadband signals in its coaxial cable network. *See, e.g., id.*, 3:63-65.
>
> A POSITA would have thus been motivated to incorporate Cioffi's coaxial cable network infrastructure that supports the transmission of broadband signals into Grube's determination of a common bit-loading modulation scheme in the context of DMT transmission schemes. EX-1003, ¶¶207-209.

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Pet., 57-58.

100. But the fact that "DMT transmission schemes" may generally be used in coaxial cable has no bearing on whether a POSITA would be motivated to add coaxial cable to Grube's specific system. And indeed, as I have explained, a POSITA would not be so motivated. Grube's teachings of enabling one-to-many communications between a headend and buildings on a telephone line are simply irrelevant in a cable system, which long ago addressed one-to-many communications between a cable operator and premises. Adding Cioffi's coaxial cable to Grube's system obviates the need for Grube's teachings, and thus obviates Grube's entire purpose.

101. Thus, in my opinion, Petitioner's proposed combination is based upon hindsight, and a POSITA would not be motivated to add Cioffi's coaxial cable to Grube's twisted-pair telephonic system.

***

102. Consequently, in my opinion, Petitioner and Dr. Williams have failed to demonstrate that Grube alone or in combination with Cioffi teach a "Broadband Coaxial Network."

D. "Relaying The Common Bit-Loading Modulation Scheme To The Plurality Of" "Receiving Nodes" Or "Controllers" (All Claims, All Grounds).

103. Each of the '450's independent claims require "relaying the common bit-loading modulation scheme to the plurality of" receiving nodes or controllers:

> Limitation 29[h] "the transmitting node transmitting a broadcast signal relaying the common bit-loading modulation scheme to the plurality of receiving nodes."
>
> Limitation 34[j] "transmit a broadcast signal relaying the common bit-loading modulation scheme to the plurality of controllers."

104. Petitioner argues that Grube alone renders these limitations obvious (Grounds 1 & 2) or that the Grube(-Cioffi)-Matsumoto combination teaches these limitations (Ground 3). In my opinion, both of Petitioner's arguments fail.

1. Grube Does Not Render Obvious "Relaying The Common Bit-Loading Modulation Scheme To The Plurality Of" "Receiving Nodes" Or "Controllers."

105. I understand that Petitioner argues that "Grube renders obvious" these limitations. Pet., 37, 48-49. Specifically, Petitioner argues:

> Based on Grube's disclosures, a POSITA would have been motivated to transmit information from the primary site to the secondary sites to enable effective data transmissions. EX-1003, ¶¶132-135. For example, ***a POSITA would have understood that transmitting the information in Grube's "control channel bit loading table 1110" to all secondary sites*** (claimed "transmitting … common bit-loading modulation scheme") ***prior to the occurrence of a call over the***

> ***network would be beneficial so Grube's secondary sites can prepare to receive data transmissions from the primary site.*** DISH-1003, ¶133; *see, e.g.*, EX-1007, 6:24-7:4, 5:9-14 (The "commonly-used carrier among the communication devices and the commonly-used number of bits that can be assigned to each carrier" is known as "mapping information," which may be provided to "all the communication devices" to allow them to operate "based upon the mapping information").

Id.¸ 38. I disagree.

106. As an initial matter, I note that Petitioner does not argue that Grube discloses "relaying the common bit-loading modulation scheme to the plurality of" "receiving nodes" or "controllers." Pet., 37-38. And for good reason. As Petitioner acknowledges (*id.*), Grube teaches that when its system allocates an outbound channel for a particular call request, "the primary site transmits a signal to all the secondary sites ***indicating the carrier channel allocations*** as the control channel." Ex. 1005 [Grube] 18:7-16. Thus, Grube discloses relaying the ***channels*** allocated for a particular call to the secondary sites rather than the "control bit loading table" (the alleged common bit-loading modulation scheme).

107. "Relaying the common bit-loading modulation scheme to the plurality of" "receiving nodes" or "controllers" is a key aspect of the '450 patent's invention. As I previously explained, the '450 patent addresses a need to "***connect a variety of CPEs*** into a local data network, such as a local area network ('LAN'),

within a building such as a home or office, while utilizing an existing coaxial cable network within the building." Ex. 1001 ['450] 4:1-8; *see also id.*, 3:1-10 ("There are large numbers and types of CPEs that can be utilized and shared in such a fashion including televisions, video monitors, cable modems, cable phones, video game consoles, and audio components, as well as various storage devices. There is a growing need ***for different CPEs to communicate between themselves in a network type of environment within the building***."). Because the nodes themselves are communicating with each other, the '450 patent teaches a system wherein each node receives the "common bit-load[ing] modulation scheme" in order for, *e.g.*, node A to transmit a message to nodes B and C simultaneously. *Id.*, 20:12-20. Consequently, "relaying the common bit-loading modulation scheme to the plurality of" "receiving nodes" or "controllers" is critical to the '450 patent's method of addressing the problem the '450 patent is concerned with.

108. In my opinion, Petitioner does not demonstrate that a POSITA would be motivated to modify Grube to perform this important limitation. Rather, Grube would not see the benefit that Petitioner argues would be added—allowing secondary sites to prepare to receive data transmissions from the primary site (Pet., 38).

109. Grube teaches a "primary site" which "communicates with [a] plurality of secondary sites." Ex. 1005 [Grube] 7:1-3. The primary site receives

"call request[s]," and then "***allocates carrier channels*** of the inbound and outbound low pass transmission paths 148, 150 ***depending on the type of call requested and the bandwidth requirements for the call***." *Id.*, 8:53-59. "To allocate the carrier channels, the primary site generates" and uses the carrier channel bit loading table. *Id.*, 8:66-9:5. Thus, the primary site coordinates which carrier channels are allocated to a particular call using the information about the type of call requested, the bandwidth requirements for the call, and the carrier channel bit loading table. In this way, the primary site can minimize the bandwidth allocated to each ongoing call, thereby preserving bandwidth for potential future calls and allowing for the possibility of servicing multiple calls at a time.

110. By contrast to the primary site, Grube teaches that after sending its bit-loading information, the individual secondary sites merely receive calls coordinated by the primary site. *See* Ex. 1005 [Grube] 8:1-15. Because the secondary sites do not have a coordinating role, they simply would have no need for the carrier channel bit loading table. This reflects Grube's hub-and-spoke topology, where there is one central coordinating station and all others communicate directly with it, not with each other. Moreover, the secondary sites would not be able to "prepare to receive data transmissions from the primary site," based just upon the carrier channel bit loading table, as Petitioner asserts they

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would. Pet., 38. The secondary sites never receive the call requests, let alone information about the call requests, or determine the bandwidth requirements for the call as the primary site does. *See* Ex. 1005 [Grube] 12:24-13:45 (discussing functions of secondary site). Consequently, without this additional information, the secondary sites would not be able to "prepare to receive data transmissions from the primary site" using the carrier channel bit loading table alone. The "carrier channel allocations" that Grube already teaches sending is all that the secondary sites need to "prepare to receive data transmissions from the primary site."

111. I note that Petitioner cites Matsumoto's teachings of providing mapping information to communication devices as evidence that a POSITA would be motivated to do such a thing in Grube. Pet., 38 (citing Ex. 1007 [Matsumoto] 6:24-7:4, 5:9-14). But that ***Matsumoto's power line system*** benefits from giving "mapping information to all the communication devices" is irrelevant to whether ***Grube's twisted pair telephonic system*** would benefit from doing such a thing. Indeed, providing "mapping information to all the communication devices" serves a specific purpose in Matsumoto— overcoming the problem of "synchronization" in "N to N communications" (also called many-to-many communications). *See* Ex. 1007 [Matsumoto] 3:14-24. Grube, however, does not have this synchronization problem as Matsumoto teaches that "[i]n … one-to-N (integer of not less than 2)

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communications, for example, communications between a base station and a plurality of (or single) mobile stations, can be achieved on ***the base station side which controls the respective mobile stations so as to be synchronized***." *Id.* Thus, Grube's one-to-many communications system would not see the benefit seen in Matsumoto's many-to-many communications system.

112. Thus, in my opinion, Petitioner's proposed modification to Grube would serve no purpose, and a POSITA would not be motivated to add sending Grube's alleged common bit-loading modulation scheme to the secondary sites.

2. A POSITA Would Not Be Motivated To Combine Grube And Matsumoto As Proposed To Add "Relaying The Common Bit-Loading Modulation Scheme To The Plurality Of "Receiving Nodes" Or "Controllers."

113. I understand that in Ground 3, Petitioner again relies upon Matsumoto's teaching, arguing that a POSITA would be motivated to add Matsumoto's many-to-many communications to Grube (and Cioffi)'s system:

> A POSITA would thus have recognized the benefit of having increased connectivity between nodes. *Id.*, ¶268; EX-1005, 4:22-24 (applicable to "one-to-many" communications); *see generally* EX-1007 (applicable to N-to-N communications). This is particularly so, because technological advancements have resulted in an increasing number of devices within a home/building environment. EX-1003, ¶¶268-269. ***To further increase connectivity between nodes, a POSITA would have been motivated to expand Grube(-Cioffi)'s method and system to include many-to-many communications.*** *Id*.

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Pet., 74-75. I disagree for multiple reasons.

114. First, Matsumoto "concerns a communication method which realizes data communication through the existing ***power lines***." Ex. 1007 [Matsumoto] 1:8-14. By contrast and as I have explained, Grube concerns "twisted-pair" telephone lines. Ex. 1005 [Grube] 6:57-60, 7:1-3; 9:41-46; 12:32-33; 13:38-40. These are two fundamentally different communications technologies.

115. Data lines typically carry complex, noise-susceptible signals. Consequently, data lines are either twisted or shielded to reduce the magnetic field influence, and thus noise, on the cable. Ex. 2011 [Powerline-Communications] 45. Power lines, by contrast, only carry power and thus do not care about induced noise. Therefore, twisting or shielding power lines would add no benefit while only increasing manufacturing costs. This means that data transmitted over power lines is more vulnerable to noise sources sharing the power line, of which there also are many more than in data lines. *See* Ex. 1007 [Matsumoto] 3:1-7 ("Moreover, in the case when the existing power lines whose main purpose is not directed to data communication such as the power line modem are used for data communication, various equipment connected for supplying power form noise sources, and ***countermeasures have to be taken to deal with these noise sources***."); Ex. 2012 [X10-Debugging-Tips] 4-5 (listing devices such as "electric

razors, hair dryers, vacuum cleaners, food processors, electric carving knives, blenders, mixers" as potential sources of noise).

116. Should the communication over power line system be able to overcome the noise issues, however, such a system would have very high bandwidth inside of a building. Ex. 2013 [Broadband-Powerline] 10 (power line's "high-frequency and very-high frequency spectrum rang[es] from 1.8 MHz to 250 MHz"). By contrast, twisted-pair telephone line's bandwidth is 1.1 MHz (Ex. 1005 [Grube] Fig. 4, 1:21-24, 15:44-51, 16:29-32, 52:6-9), approximately 227x smaller than the power line's bandwidth. Thus, communication over power line faces a very different problem (high amounts of noise) from communication over twisted-pair telephone line (low bandwidth). There is no reason a POSITA would turn to such a fundamentally different reference to improve Grube's twisted-pair telephonic system.

117. Moreover, Grube's problem of limited bandwidth means that a POSITA would not be motivated to add many-to-many communications to its system. Traditional systems over twisted-pair telephone lines have used one-to-one communications as a result of the limited bandwidth. *See* Ex. 1005 [Grube] 2:41-43 (prior art system designed for "one-to-one communications"), 2:53-55 (similar), 4:20-23 (similar). Bandwidth is even more precious in Grube's system because Grube's network services secondary sites in a citywide area. *See* Ex. 1005

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[Grube] Fig. 8 (illustrating secondary sites as analogous to buildings), 8:24-28 (secondary sites may be miles away from primary site). Grube's system has only a limited number of channels that must be shared between perhaps hundreds of secondary sites. In accord, Grube's system has one-to-many/many-to-one communications, managed by a primary site which allocates channels to calls in a way that minimizes the bandwidth dedicated to a particular call. Ex. 1005 [Grube] 4:24-28 (Grube's goal is one-to-many communications), 8:53-9:5 (describing allocation of channels).

118. Consequently, many-to-many communications are not appropriate for a system with limited bandwidth like Grube's. There are simply too few channels available for the many secondary sites to directly communicate with each other easily. Without a centralized coordinator to oversee calls and allocate channels, channel allocation (if any could occur) would be suboptimal at best. A POSITA would thus recognize that, on balance, many-to-many communications are not desirable in a twisted-pair telephone line system having limited bandwidth. Unsurprisingly, therefore, I see no mention within Grube of the possibility of adding many-to-many communications, let alone the desire to. *See generally* Ex. 1005 [Grube].

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119. Finally, even if, for the sake of argument, Matsumoto's many-to-many communications could be added to Grube/Cioffi, it would change their principles of operation.

120. Again, Grube uses a primary site to communicate with multiple secondary sites, as illustrated in Figure 8:

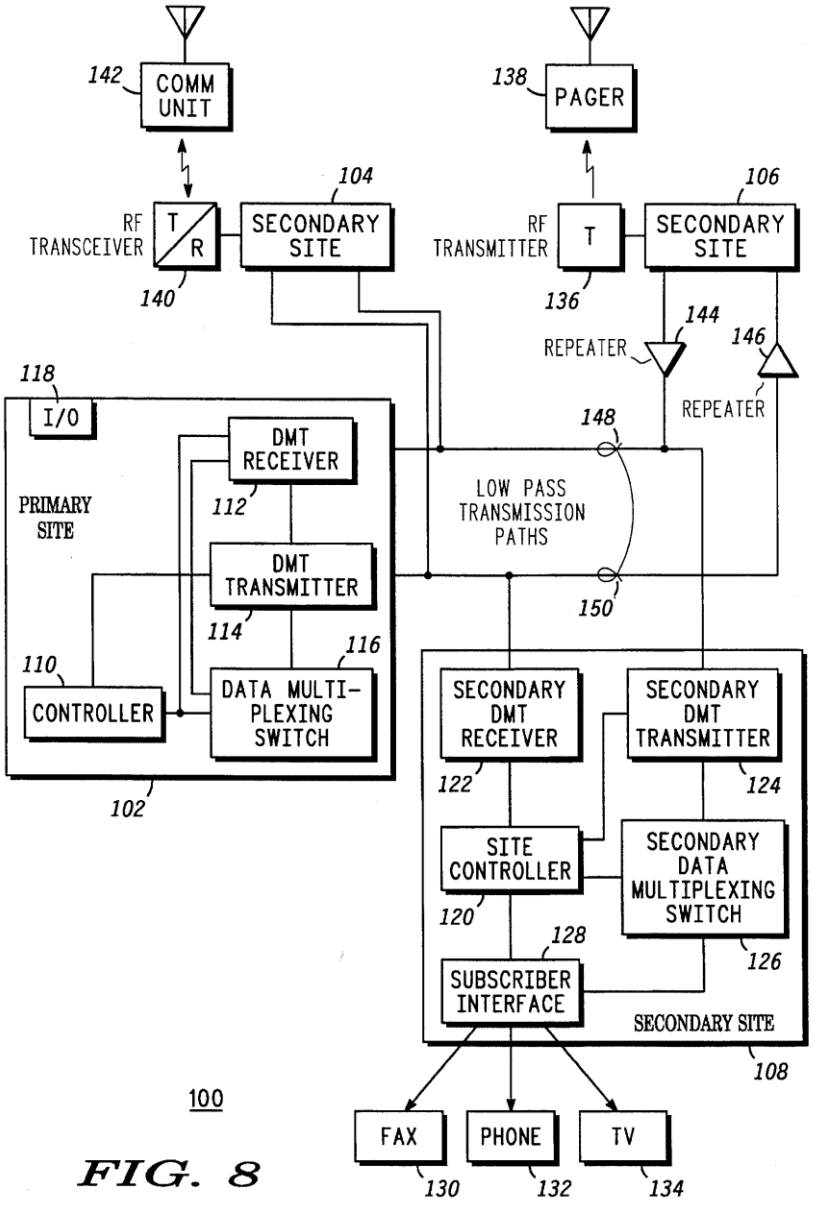
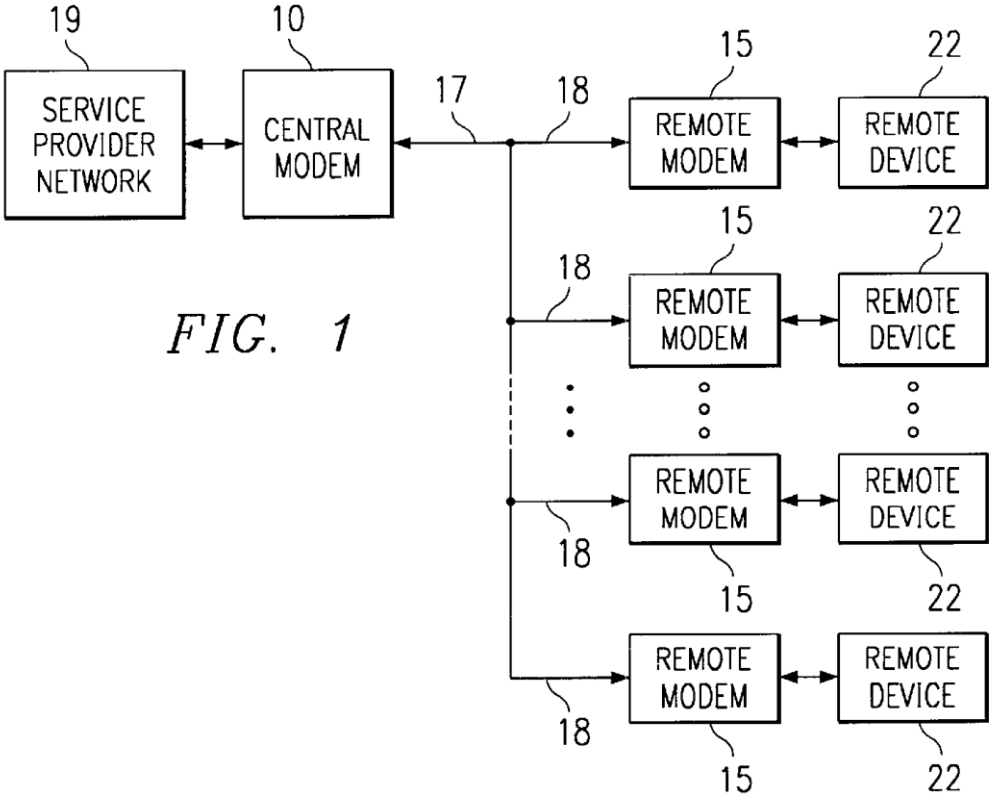


FIG. 8

Ex. 1005 [Grube] Fig. 8. As can be seen above, the secondary sites receive all communication from the primary site and not from each other. *See also id.*, 8:17-21. Essentially, Grube's system uses a hub-and-spoke topology, with the primary site as the hub that is responsible for transmitting, receiving, and coordinating all communications with the secondary-site spokes. *See id.*, 6:57-8:15 (describing function of primary site).

121. Cioffi can also be thought of as a hub-and-spoke system. As can be seen in Cioffi's Figure 1 below, Cioffi uses a "central unit" or modem which "communicates with a plurality of remote units over a common transmission line":



Ex. 1006 [Cioffi] Fig. 1; 7:23-26. As the hub, so to speak, the central unit "allocat[es] … bandwidth to the remote units" (*id.*, 4:22-23) and transmits data between a "service provider" and the remote units (*id.*, 7:29-33).

122. Thus, both Grube and Cioffi use hub-and-spoke type systems and their principles of operation are one-to-many/many-to-one communications using a primary site/central unit to allocate the channels used to transmit data.

123. In my opinion, adding many-to-many communications to Grube and Cioffi would render their respective primary site and central unit inoperable. If the secondary sites/remote units were to communicate directly with each other, the primary site/central unit would no longer be aware of which channels were allocated to ongoing calls or transmissions. Nor would the primary site/central unit be aware of whether there were ongoing calls or transmissions at all. Without this information, the primary site/central unit would no longer be able to coordinate transmissions to or from the secondary sites/remote units. It is unclear how the primary site/central unit would be involved in communications at all should many-to-many communications be added. Petitioner's proposed combination is based on sheer speculation with no evidence that the combination is workable. Thus, in Petitioner's proposed combination, Grube and Cioffi's primary site/central unit would no longer function and there would no longer be any one-to-many/many-to-one communications.

***

124. Thus, in my opinion, Petitioner and Dr. Williams have failed to demonstrate that its grounds teach "relaying the common bit-loading modulation scheme to the plurality of" "receiving nodes" or "controllers."

VII. CONCLUSION

125. At this stage of the proceedings, my opinions are preliminary and limited to the issues on which I have been asked to form an opinion. I may further develop these opinions or offer additional opinions after a decision to institute, should the Board decide to do so.

126. Although my complete opinions are set forth above, for convenience I summarize several points of my opinions in conclusion. For the foregoing reasons, based on my expertise and experience and the record of this case that I have reviewed, it is my opinion that:

- Claims 29-31 and 34-36 are not obvious over Grube;
- Claims 29-31 and 34-36 are not obvious over Grube and Cioffi;
- Claims 29-33 and 34-38 are not obvious over Grube and Matsumoto or Grube, Cioffi, and Matsumoto.

127. I understand that my opinions discussed above support a legal conclusion that claims 29-38 are nonobvious.

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

I hereby declare that all statements made herein of my own knowledge are true and all statements made herein on information and belief were and are believed by me to be true, and that all statements herein were and are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that any such willful false statements may jeopardize the validity of the application or any patents issued thereon.

Respectfully submitted,

Dated: October 28, 2024

Samuel H. Russ

Samuel H. Russ, Ph.D.

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EXHIBIT A

Curriculum Vitae of Dr. Samuel H. Russ

Personal

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Education

Ph.D. in Electrical Engineering, Georgia Institute of Technology, 1991.

Thesis Title: *An Information-Theoretic Approach to Analysis of Computer Architectures and Compression of Instruction Memory Usage*

Thesis Advisor: Dr. Cecil O. Alford

Bachelor's of Electrical Engineering (with Highest Honor), Georgia Institute of Technology, 1986.

Employment

University of South Alabama 2007 – Present

Interim Chair, Department of Electrical and Computer Engineering (2015-2016)

Associate Professor, Department of Electrical and Computer Engineering (2011-present)

Assistant Professor, Department of Electrical and Computer Engineering

Developing new class in signal integrity, developing cross-disciplinary collaborative research efforts, updating labs and class materials, teaching both undergraduate and graduate classes.

Scientific-Atlanta (Later Cisco, Now Technicolor) 2000 - 2007

Manager, Advanced Technologies R&D, Explored major new technologies including home networking and multi-room video distribution; oversaw construction of prototypes and demonstrations; demonstrated technologies at trade shows and to stock analysts; managed group of approximately 10 designing set-top boxes for the cable television industry including all phases of high-volume electronic design including layout, high-speed digital design, emissions considerations, gate array conversion, and designing with custom ASICs; supervised cross-functional team to increase hard drive reliability; wrote numerous patent applications. Products deployed widely, including Time Warner Cable and Cablevision.

IVI Checkmate (Now Ingenico) 1999 – 2000

Matrix Manager, Electrical Engineering, Supervised staff of approximately 6 electrical engineers, oversaw assignments, allocated time across multiple projects, worked to coordinate project schedules with priorities, assisted in sales and other customer communications.

Staff Electrical Engineer, Oversaw major design overhaul of touch-pad payment system including embedded-systems design, power-system design, and system layout and schematic capture. System deployed widely at Wal-Mart, Home Depot, and others.

Mississippi State University 1994 - 1999

Thrust Leader, Computing Systems Research Thrust and Systems Integration Group, NSF Engineering Research Center -- Coordinate research plans and NSF reporting for 6 faculty and 3 full-time staff, assist in development of strategic plans and pursuit of funding opportunities, oversight of development of the ERC-wide integrated testbed. Managed multi-year research project in distributed computing that included 11 students and 5 faculty.

Assistant Professor, Department of Electrical & Computer Engineering -- Developed all-new graduate class in circuit board design, authored textbook chapter, developing new undergraduate lab, pioneered teaching classes over 2-way interactive video.

Dickerson Vision Technologies (Now Cognex) 1992 - 1994

Director of Manufacturing--Oversaw the development and implementation of a manufacturing plan for the company.

Senior Applications Engineer--Developed firmware and user-interface software for the company's proprietary hardware, Assisted in development of machine vision system hardware, Assisted in sales duties.

Georgia Institute of Technology 1987 - 1991

Graduate Research Assistant--Helped design five VLSI chips while developing two custom CPU's, Silicon-compiler-based computer chip design, including initial design, full functional simulation, size and timing optimization, and manufacturing test development.

Publications

Books

1. Samuel H. Russ, *Signal Integrity: Applied Electromagnetics and Professional Practice*, Springer, 2016. (Textbook)
2. Samuel H. Russ, *Signal Integrity: Applied Electromagnetics and Professional Practice*, Second Edition, Springer, 2022. (Textbook)

Book Chapters

1. Samuel H. Russ, "High-Speed Digital Effects", Chapter 10 of John Kraus and Daniel Fleisch, *Electromagnetics with Applications, Fifth Edition*, McGraw-Hill, 1998. (Textbook)
2. Samuel Russ, Bret Webb, Jonathan Holifield and Justin Walker (2011). "PILS: Low-Cost Water-Level Monitoring, Environmental Monitoring", Dr. E.O. Ekundayo, Ph.D., (Ed.), pp. 137-156, ISBN: 978-953-307-724-6, InTech, (Peer-reviewed)

Journal and Magazine Articles

1. Samuel Russ, "The Threat of Malicious Circuit-Board Alteration: Attack Taxonomy and Examples," *Electronic Device Failure Analysis*, Vol. 23, Issue 3, August 2021, pp. 13-22.
2. Mink DM, McDonald J, Bagui S, Glisson WB, Shropshire J, Benton R, Russ S. Near-Real-Time IDS for the U.S. FAA's NextGen ADS-B. Big Data and Cognitive Computing. 2021; 5(2):27. https://doi.org/10.3390/bdcc5020027
3. S. H. Russ and J. Gatlin, "Ways to hack a printed circuit board: PCB production is an underappreciated vulnerability in the global supply chain," *IEEE Spectrum*, vol. 57, no. 9, pp. 38-43, Sept. 2020.
4. Samuel H. Russ, Cade C. Cashen, Thomas Thomas, and Roma Hanks, "Smart Grid Architecture for Unobtrusive Home Health Monitoring," *National Social Science Journal*, Vol. 44, No. 1, 2015, pp. 62-68.
5. Samuel H. Russ, Tho D. Ha, and Jonathan H. Shapiro, "Simulation-based Optimization of Wear Leveling for Solid-State Disk Digital Video Recording," *IEEE Transactions on Consumer Electronics*, Vol. 60, No. 3, Nov. 2014, pp. 363-367.
6. Samuel H. Russ and Salim Alsharif, "Packet Loss Behavior of HomePlug AV Traffic at Video Bit Rates", *IEEE Transactions on Consumer Electronics*, Vol. 57, No. 2, May 2011, pp. 823-826.
7. Samuel H. Russ and Ramesh Nallur, "Digital Video Recording onto Solid-State Disks: Feasibility and Lifetime Estimation", *IEEE Transactions on Consumer Electronics*, Vol. 57, No. 2, May 2011, pp. 558-563.
8. Samuel H. Russ and Sasan Haghani, "802.11g Packet-Loss Behavior at High Sustained Bit Rates

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in the Home", *IEEE Transactions on Consumer Electronics*, Vol. 55, No. 2, May 2009, pp. 788-791.

9. Samuel H. Russ, and Ramesh Nallur, "A Framework for Calculating Fundamental DVR Performance Limits", *IEEE Transactions on Consumer Electronics*, Vol. 55, No. 1, Feb. 2009, pp. 132-138.
10. Ioana Banicescu, Sheikh Ghafoor, Vijay Velusamy, Samuel H. Russ, Mark Bilderback, "Experiences from integrating algorithmic and systemic load balancing strategies", *Concurrency and Computation: Practice and Experience*, Volume 13, Number 2, pp. 121-139 (2001).
11. Roger L. King, Samuel H. Russ, Aric B. Lambert, Donna S. Reese, "An artificial immune system model for intelligent agents", *Future Generation Computer Systems*, Volume 17 , Issue 4, pp. 335 - 343 (January 2001).
12. Dr. Samuel H. Russ, Jonathan Robinson, Matt Gleeson, Brad Meyers, and Chun-Heong Tan, "Using Hector to Run MPI Programs over Networked Workstations", *Concurrency - Practice and Experience,* Vol. 11, No. 4, pp. 189-204 (1999).
13. Russ, S.H. Reece, K. Robinson, J. Meyers, B. Rajan, D. Rajagopalan, L. Chun-Heong Tan, "Hector: an agent based architecture for dynamic resource management", *IEEE Concurrency*, Vol. 7, No. 2, pp. 47-55, Apr-Jun 1999.
14. Dr. Samuel H. Russ, Jonathan Robinson, Dr. Brian K. Flachs, and Bjorn Heckel, "The Hector Distributed Run-Time Environment", *IEEE Transactions on Parallel and Distributed Systems*, Vol. 9, No. 11, pp. 1102-1114 (1998).
15. S.H. Russ and C.O. Alford, "Coupled Noise and Its Effects on Modern Packaging Technology", *IEEE Transactions on Components, Hybrids, and Manufacturing Technology*, Volume 13, Number 4, December 1990, pp. 1074-1082.

U.S. Patents

1. U.S. Patent Number 6,748,080, "Apparatus for entitling remote client devices", Samuel Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, June 8, 2004.
2. U.S. Patent Number 7,181,010, "Apparatus for entitling remote client devices", Samuel Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, February 20, 2007.
3. U.S. Patent Number 7,360,233, "Broadcast carousel system access for remote home communication terminal", Samuel Russ, Michael Gaul, and Anthony Wasilewski, April 15, 2008.
4. U.S. Patent Number 7,360,235, "Systems and methods for operating a peripheral record/playback device in a networked multimedia system", David Davies, Samuel Russ, and Irvan Krantzler, April 15, 2008.
5. U.S. Patent Number 7,499,822, "Analog set-top calibration patterns in manufacturing", Leo Montreuil, Wayne B. Williams, Samuel H. Russ, and Robert Kriete, March 3, 2009
6. U.S. Patent Number 7,505,592, "Apparatus for entitling and transmitting service instances to remote client devices", Samuel H. Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, March 17, 2009
7. U.S. Patent Number 7,516,470, "Locally-updated interactive program guide", Samuel H. Russ and Michael Gaul, April 7, 2009
8. U.S. Patent Number 7,826,711, "Digital Video Disc (DVD) Player or Digital Video Recorder (DVR) Playback with Memory", Samuel H. Russ, Nov. 2, 2010.
9. U.S. Patent Number 7,849,486, "Networked subscriber television distribution", Samuel H. Russ, David Lett, Jonathan Robinson, and Michael Gaul, Dec. 7, 2010.
10. U.S. Patent Number 7,860,250, "Apparatus for entitling and transmitting service instances to remote client devices", Samuel H. Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, Dec. 28, 2010.
11. U.S. Patent Number 7,861,272, "Networked subscriber television distribution", Samuel H. Russ, David Lett, Jonathan Robinson, and Michael Gaul, Dec. 28, 2010.

12. U.S. Patent Number 7,870,584, "Interactive program guide with selectable updating", Samuel H. Russ and Michael Gaul, Jan. 11, 2011.
13. U.S. Patent Number 7,876,998, "DVD playback over multi-room by copying to HDD", William Wall and Samuel H. Russ, Jan. 25, 2011.
14. U.S. Patent Number 7,908,625, "Networked multimedia system", Neil C. Robertson, David B. Lett, Samuel H. Russ, Bohdan S. Prus, Michael A. Gaul, and Ajith N. Nair, March 15, 2011.
15. U.S. Patent Number 7,937,737, "Field qualification of disk drives in consumer electronics devices", Samuel H. Russ and Mark R. Murray, May 3, 2011.
16. U.S. Patent Number 7,961,780, "Generated set top calibration patterns in manufacturing", Leo Montreuil, Wayne B. Williams, Samuel H. Russ, and Robert Kriete, Jun. 14, 2011.
17. U.S. Patent Number 7,978,720, "Digital media device having media content transfer capability", Samuel H. Russ, Christopher L. Stallings, July 12, 2011.
18. U.S. Patent Number 8,046,806, "Multiroom point of deployment module", William E. Wall, Samuel H. Russ, Oct. 25, 2011.
19. U.S. Patent Number 8,127,236, "Proximity detection using wireless connectivity in a communications system", Paul J. Claussen, Ajith N. Nair, and Samuel H. Russ, Feb. 28, 2012.
20. U.S. Patent Number 8,181,205, "PVR Channel and PVR IPG Information", Samuel H. Russ, Michael A. Gaul, and Dariusz S. Kaminski, May 15, 2012.
21. U.S. Patent Number 8,208,796, "Systems and methods for prioritizing the storage location of media data", Bohdan Prus and Samuel H. Russ, June 26, 2012.
22. U.S. Patent Number 8,280,229, "DVD playback over multi-room by copying to HDD", William E. Wall and Samuel H. Russ, October 2, 2012.
23. U.S. Patent Number 8,295,338, "Generated set top calibration patterns in manufacturing", Leo Montreuil, Wayne B. Williams, Samuel H. Russ, and Robert A. Kriete, October 23, 2012
24. U.S. Patent Number 8,364,015, "Stretch and zoom bar for displaying information", Samuel H. Russ and Gary Hibbard, January 29, 2013.
25. U.S. Patent Number 8,549,567, "Media content sharing over a home network", Samuel H. Russ, David B. Lett, Jonathan Robinson, Michael A. Gaul, October 1, 2013.
26. U.S. Patent Number 8,627,385, "Systems and methods for operating a peripheral record playback device in a networked multimedia system", David B. Davies, Samuel H. Russ, Irvan J. Krantzler, January 7, 2014.
27. U.S. Patent Number 8,966,550, "Home communication systems," David B. Davies, Samuel H. Russ, Irvan J. Krantzler, February 24, 2015.
28. U.S. Patent Number 9,762,970, "Access of stored video from peer devices in a local network," David B. Davies, Samuel H. Russ, and Irvan J. Krantzler, September 12, 2017.
29. U.S. Patent Number 10,412,439, "PVR Channel and PVR IPG Information", Samuel H. Russ, Michael A. Gaul, and Dariusz S. Kaminski, Sep. 10, 2019.

European Patents

1. European Patent Number EP1543680B1, "Locally-updated interactive program guide", Samuel Russ and Michael Gaul, Feb. 17, 2010.
2. European Patent Number EP1673937B1, "Proximity detection using wireless connectivity in a communications system", Paul Claussen, Ajith Nair, and Samuel Russ, April 21, 2010.
3. European Patent Number EP1604523B1, "Method for determining the encryption of a service content depending on the fidelity of the reformatting of said content", Samuel Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, Nov. 21, 2012.
4. European Patent Number EP1552699B1, "Networked multimedia system", Neil Robertson, David Lett, Samuel Russ, Bohdan Prus, Michael Gaul, and Ajith Nair, Dec. 18, 2013.
5. European Patent Number EP1334617B1, "Networked Subscriber Television Distribution", Samuel Russ, David Lett, Jonathan Robinson, and Michael Gaul, April 1, 2015.

6. European Patent Number EP1920601B1, "Multiroom Point of Deployment Module," William Wall and Samuel Russ, May 4, 2016.
7. European Patent Number EP1510033B1, "Apparatus for Entitling Remote Client Devices," Samuel H. Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, Aprl 26, 2017.
8. European Patent Number EP1540946B1, "Broadcast Carousel System Access for Remote Home Communications Terminal via a Gateway Device," Samuel Russ, Michael Gaul, and Anthony Wasilewski, April 18, 2018.
9. European Patent Number EP2008280B1, "Method and Device for Prioritizing the Storage Location of Media Data," Bohdan Prus and Samuel Russ, September 26, 2018.

Conference Papers

1. S.H. Russ, M. Khan, S. Latif, "Surreptitiously Adding a WLAN Antenna to a Printed Circuit Board" 2022 IEEE Physical Assurance and Inspection of Electronics (PAINE), Huntsville, AL, USA, 2022.
2. J. Todd McDonald, Rebecca C. Clark, Lee M. Hively, and Samuel H. Russ. 2022. "Phase space power analysis for PC-based rootkit detection." In *Proceedings of the 2022 ACM Southeast Conference (ACM SE '22)*. Association for Computing Machinery, New York, NY, USA, 82–90. https://doi.org/10.1145/3476883.3520212
3. S. H. Russ, " Surreptitiously Adding a Microcontroller to a Printed Circuit Board," 2021 IEEE Physical Assurance and Inspection of Electronics (PAINE), Washington, DC, USA, 2021.
4. S.H. Russ, "Circuit Board Security Vulnerabilities and Counteractions", IPC APEX EXPO 2021.
5. S. H. Russ, "Techniques to Thwart Surreptitiously Altered PCBs," 2020 IEEE Physical Assurance and Inspection of Electronics (PAINE), Washington, DC, USA, 2020, pp. 1-4.
6. S. H. Russ, E. Spencer, T. Scroggins, and S. Latif, "Power-Efficient Software Architecture for a CubeSat System", *2020 SoutheastCon*, Raleigh, NC, USA, 2020, pp. 1-6.
7. A. Russ, S. H. Russ, E. Spencer and M. Frank, "Motor Controller and Reaction Wheel for CubeSat," *2019 SoutheastCon*, Huntsville, AL, USA, 2019, pp. 1-3.
8. F. Lorenzo, J. T. McDonald, T. R. Andel, W. B. Glisson and S. Russ, "Evaluating Side Channel Resilience in iPhone 5c Unlock Scenarios," *2019 SoutheastCon*, Huntsville, AL, USA, 2019, pp. 1-7
9. E. Spencer, D. Clark, S. Russ, *et al*., "First results from a time domain impedance probe for measuring plasma properties in the ionosphere," 2017 IEEE 60th International Midwest Symposium on Circuits and Systems (MWSCAS), Boston, MA, 2017, pp. 1284-1287.
10. E. Spencer, D. Clark, R. Gollapalli, S. Russ and B. Kerrigan, "A System On Chip design for fast time domain impedance spectroscopy," 2017 IEEE 60th International Midwest Symposium on Circuits and Systems (MWSCAS), Boston, MA, 2017, pp. 124-127.
11. Ramya Manikyam, J. Todd McDonald, William R. Mahoney, Todd R. Andel, and Samuel H. Russ, "Comparing the effectiveness of commercial obfuscators against MATE attacks," *Proceedings of the 6th Workshop on Software Security, Protection, and Reverse Engineering (SSPREW '16)*, 2016, Article 8. DOI: https://doi.org/10.1145/3015135.3015143
12. Samuel Russ, Tho Ha, and Jonathan Shapiro, "Simulation of Digital Video Recording to Maximize Solid-State Disk Lifetime," *Proceedings of the 2014 International Conference on Consumer Electronics*, Jan. 10-13, 2014, pp. 562-563.
13. Thomas Thomas, Cade Cashen, and Samuel Russ, "Leveraging Smart Grid Technology for Home Health Care", *Proceedings of the 2013 International Conference on Consumer Electronics*, Jan. 11-14, 2013, pp. 276-277.
14. Cade Cashen, Samuel Russ, and Thomas Thomas, "Using a Wireless LAN to Perform Motion Detection", *Proceedings of the 2013 International Conference on Consumer Electronics*, Jan. 11-14, 2013, pp. 63-64.
15. Nicklaus Thomas, David Evans, and Samuel Russ, "A Markovian Algorithm for Creating

Immersive Public-Speaking Audiences", *Proceedings of the 2013 International Conference on Consumer Electronics*, Jan. 11-14, 2013, pp. 384-385.

16. Samuel H. Russ, "Podcasting to Improve Software Usage", *Proceedings of the 2012 ASEE Southeastern Section Conference,* April 1-3 2012, Starkville, MS, Paper ID 605.
17. Samuel H. Russ, "Using Student ID Numbers to Create Customized Homework Problems", *Proceedings of the 2012 ASEE Southeastern Section Conference,* April 1-3 2012, Starkville, MS, Paper ID 606.
18. Samuel H. Russ and Ramesh Nallur, "Digital Video Recording Onto Solid-State Disks", *2011 Digest of Technical Papers, 2011 International Conference on Consumer Electronics*, pp. 495-496. (2nd place in best paper contest, 2011.)
19. Mohammad Mushtaq, Samuel H. Russ, and Mohammad S. Alam, "Variable FEC to Reduce ECC Overhead in Digital Video Transmission", *2011 Digest of Technical Papers, 2011 International Conference on Consumer Electronics*, pp. 215-216.
20. Samuel H. Russ and Salim Alsharif, "Behavior of HomePlug AV Traffic At High Sustained Bit Rates in the Home", *2011 Digest of Technical Papers, 2011 International Conference on Consumer Electronics*, pp. 682-683.
21. Samuel H. Russ, Viswakalyan Perepa, Silas Leavesly, and Bret Webb, "Novel Low-Cost Salinity Sensor for Embedded Environmental Monitoring", *Proceedings of IEEE Southeastcon 2010*, March 18-21, 2010, pp. 53-56.
22. Samuel H. Russ and Kung-Hsien Chen, "Thermally Conductive Circuit Boards", *Proceedings of the 59th Electronic Components and Technology Conference (ECTC 2009),* May 2009, pp. 465-468.
23. Samuel H. Russ and Sasan Haghani, "Behavior of 802.11g Traffic at High Sustained Bit Rates in the Home", *2009 Digest of Technical Papers, 2009 International Conference on Consumer Electronics, Jan. 2009*, pp. 423-424.
24. Samuel H. Russ, and Ramesh Nallur, "A Framework for Calculating Fundamental DVR Performance Limits", *2009 Digest of Technical Papers, 2009 International Conference on Consumer Electronics, Jan. 2009*, pp. 51-52.
25. Samuel H. Russ, "Home Networking: Extending Cable's Reach", *The Complete Technical Paper Proceedings from NCTA*, 2001, pp. 160-165.
26. Samuel H. Russ, Rashid Jean-Baptiste, Tangirala Shailendra Krishna Kumar, and Marion G. Harmon, "Transparent Real-Time Monitoring in MPI", *IPPS/SPDP Workshops 1999,* in *Parallel and Distributed Processing*, Lecture Notes in Computer Science, vol. 1586, Springer-Verlag, 1999, pp. 1327-1334.
27. Roger L. King, Aric B. Lambert, Samuel H. Russ, and Donna S. Reese, "The Biological Basis of the Immune System as a Model for Intelligent Agents", *IPPS/SPDP Workshops 1999,* in *Parallel and Distributed Processing*, Lecture Notes in Computer Science, vol. 1586, Springer-Verlag, 1999, pp. 156-164.
28. Aric Lambert, Roger King, Sam Russ, and Donna Reese, "Intelligent Control Agents for Resource Management of Heterogeneous Parallel Computing", Computational Intelligence for Modeling, Control, and Automation (CIMCA 98) in Concurrent Systems Series, vol. 55, IOS Press, 1999, pp. 116-121.
29. Samuel H. Russ and Adam Gaither, "Developing An Integrated Environment for Computational Field Simulation", *Object-Oriented Methods for Inter-Operable Scientific and Engineering Computing: Proceedings of the 1998 SIAM Workshop*, pp. 50-57.
30. Samuel H. Russ, Ioana Banicescu, Sheikh Ghafoor, Bharathi Janapareddi, Jonathan Robinson, and Rong Lu, "Hectiling: An Integration of Fine and Coarse-Grained Load-Balancing Strategies", *Proceedings of the Seventh International Symposium on High Performance Distributed Computing*, August 1998, IEEE Computer Society, pp. 106-113.

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31. Samuel H. Russ, "An Architecture for Rapid Distributed Fault Tolerance", 3rd International Workshop on Embedded High-Performance Computing, in J. Rolim, Editor, *Parallel and Distributed Processing*, Lecture Notes in Computer Science, vol. 1388, Springer-Verlag, 1998, pp. 925-930.
32. Dr. Samuel H. Russ, Brad Meyers, Jonathan Robinson, Matt Gleeson, Laxman Rajagopalan, Chun-Heong Tan, and Bjørn Heckel, "User-Transparent Run-Time Performance Optimization", *Proceedings of the 2nd International Workshop on Embedded HPC Systems and Applications*, Geneva, April 1997.
33. J. Robinson, S.H. Russ, B. Flachs, and B. Heckel, "A Task Migration Implementation of the Message-Passing Interface", *Proceedings of the 5th High Performance Distributed Computing Conference* (HPDC-5), August 1996, IEEE Computer Society, pp. 61-68.
34. S.H. Russ, B. Flachs, J. Robinson, and B. Heckel, "Hector: Automated Task Allocation for MPI", *Proceedings of the 10th International Parallel Processing Symposium*, April, 1996, IEEE Computer Society, pp. 344-348.
35. W.S. Tan, C.O. Alford, and S.H. Russ, "GT-EP: A Novel High-Performance Real-Time Architecture", *Proceedings of the 18th International Symposium on Computer Architecture*, May 1991, pp. 12-21.

Reports

1. Aric B. Lambert, Roger L. King, Samuel H. Russ, Donna S. Reese, "Adaptive Analysis for the Design of Hardware Agents Using the Artificial Immune System Model for Resource Management of Heterogeneous Systems", Miss. State Technical Report No. MSSU-COE-ERC-98-10, Aug. 1998.
2. Daniel H. Linder, Robert B. Reese, Jon Robinson, and Samuel H. Russ, "JavaCADD: A Java-based Server and GUI for Providing Distributed ECAD Services", Mississippi State University Technical Report No. MSSU-COE-ERC-98-07, May 1998.
3. Samuel H. Russ, "Using Hector in an Architecture for Rapid Distributed Fault Tolerance", Mississippi State Technical Report No. MSSU-EIRS-ERC-97-17, December 1997.
4. Samuel H. Russ, Jonathan Robinson, Matt Gleeson, and Jose Figueroa, "Dynamic Communication Mechanism Switching in Hector", Mississippi State Technical Report No. MSSU-EIRS-ERC-97-8, September 1997.
5. Samuel H. Russ, Brian Flachs, Jonathan Robinson, and Bjorn Heckel, "Hector: Automated Task Allocation for MPI", Mississippi State Technical Report No. MSSU-EIRS-ERC-95-6, September, 1995.

Funded Grants and Contracts

University of South Alabama

1. National Space Grant Foundation, Aug. 2018-May 2019, "Automation Infrastructure for Gateway Biological Laboratory," PI, $28,062.
2. Nfina (Local Mobile Company), March 2018 – March 2019, "Redhawk", PI, $119,881.
3. NASA, May 2016 – Present, "Spatially Resolved Measurements Of Plasma Density Irregularities In The Ionosphere F Region For Scintillation Studies", Co-I, $100,000.
4. Marine Environmental Science Consortium (GRI), Jan. 2011-Dec. 2011, "Conductivity Based In-Situ Hydrocarbon Sensor", PI, $9,338.
5. University of South Alabama Research Council (USARC), Feb. 2008 – Feb. 2009, "Instrumentation of Hurricane Forecast Models for Performance Optimization", $5,000 for one year.

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Mississippi State University

1. National Science Foundation, April 1998-March 1999, "An ERC-CREST Partnership in Distributed and Computational Systems", PI, $100,000/year, renewable for 5 years.

2. Office of Naval Research, Nov. 1996-Nov. 1998, `"Distributed Visualization and Virtual Environments for Oceanography and Meteorology", Co-PI, $200,000.

3. U.S. Army Waterways Experiment Station, July 1996-July 1999, `"Efficient Parallel Wave Modeling", PI, $200,000, Funded under CHSSI (Common HPC Scalable Software Initiative) of the DoD. ($50,000 actually funded.)

4. NSF Engineering Research Center for Computational Field Simulation, April 1995- May 1999, "Heterogeneous Computing Testbed (CA 8)", PI, By year: $34,983/$70,111/$55,916. Funded through NSF Engineering Research Center.

Dickerson Vision Technology

1. Small Business Innovations Research Program of the NSF, Division of Industrial Interface, September 1993 - February 1994, Award No. III-9260914. ($50,000 Phase I contract conducted at Dickerson Vision Technologies.)

Technology Transfer and Licensing

Hector Distributed Run-Time Environment licensed by MPI Software Technology, Inc., Starkville, MS in June 1998 (while at Mississippi State University)

Students Advised (Major Professor)

Level	At USA	At MSU
Ph.D.	--	0
Masters	3	9

Courses Created and Enhanced

University of South Alabama

EE 264 Microprocessor Systems and Interfacing – Replaced 68HC11 with Freescale 9S12 architecture and redesigned the entire course, Introduced use of 68HC11 simulator and accompanying podcast to enhance student's ability to visualize microprocessor operation

EE 268 Digital Logic Design Lab – Updated one lab experiment

EE 368 Microprocessor Systems Lab – Developed all-new sequence to tie EE 368 to senior projects with hands-on experiments like motors, photocells, and servomotors.

EE 401 Introduction to ECE Design – Completely overhauled the first-semester senior project course. Added lectures on professionalism, career development, and legal aspects of engineering. Structured the course so that reports would lead up to their senior-project reports.

EE 404 ECE Design – Completely overhauled the second-semester senior project course by requiring better projects and adding material on giving effective presentations. Obtained very enthusiastic response from the department's Industrial Advisory Board.

EE 446 – Obtained donation of boards from Freescale and redesigned all of the experiments to develop more interesting demonstrations and to switch from assembly language to C.

EE 457/557 – Developing series of podcasts to augment in-class lectures with materials related to embedded systems and professional development.

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EE 469/569 Advanced Digital System Design – Developed all-new course in high-speed circuit board design from an electromagnetics perspective, and authored a textbook for the course. Added a lab experience in 2009.

EE 560 Advanced Computer Architecture – Selected new textbook for the class and developed lecture materials to match

EG 101 – Developed systematic curriculum shared by all sections including "checklists" for instructors, handouts, and lecture materials. Introduced motors project, which has become the most popular EG 101 project.

Mississippi State University

EE 8993 High Speed Digital Design -- Offered on video nationwide, it features pioneering treatment of high-speed circuit board design from an electromagnetics perspective. Material from the class has been included in one of the best-known electromagnetics textbooks, and it continues to be one of the most popular graduate classes in the department.

EE 4743 Computer Aided Digital Design -- Added breakthrough educational technology to permit remote access to logic synthesis capabilities. Offered on live two-way video starting Fall 1998.

Courses Taught

University of South Alabama

EE 220, Circuit Analysis I, 1 course.
EE 263, Digital Logic Design, 2 courses.
EE 264, Microprocessor Sys-Interfacing, 4 courses.
EE 268, Digital Logic Design Lab, 1 course.
EE 368, Microprocessor Sys Interf Lab, 14 courses.
EE 401, Intro Elec and CpE Design - W, 7 courses.
EE 404, Elec and Comp Eng Designs-W, 7 courses.
EE 440, HDL Logic Synthesis, 1 course.
EE 446, Embedded System Design Lab, 2 courses.
EE 457, Embedded System Design, 10 courses.
EE 469, Signal Integrity, 5 courses.
EE 534, VLSI Design Systems, 1 course.
EE 540, HDL Logic Synthesis, 1 course.
EE 548, Computer-Network Security, 5 courses.
EE 557, Adv. Embedded System Design, 8 courses.
EE 560, Adv Computer Architecture, 3 courses.
EE 569, Signal Integrity, 5 courses.
EG 101, Intro to Engineering & Design, 5 courses.
EG 231, Intro to Ethics and Economics, 2 courses.

Mississippi State University

Number	Description	Class Description
EE 2111	Electrical Lab I	Accompanies introductory digital class
EE 2713	Digital Devices	Introductory digital class
EE 4723	Microcomputers II	Microcontroller interfacing
EE 4743	Computer Aided Digital Design	VHDL, logic design, and synthesis
EE 8993	High-Speed Digital Design	Signal integrity and high-speed design

Honors and Awards

University of South Alabama College of Engineering "Teacher of the Year" 2015

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Mobile Area Council on Engineering "Engineering Educator of the Year" 2015

Technology and Engineering Emmy® Award, 2012, for "Pioneering Development of Multi-Room DVR." Awarded to Cisco. I managed the groups that built the first prototypes, gave public demonstrations, wrote numerous patent applications, and developed the first mass-production set-top containing Multi-Room DVR.

2nd Place in "Best Paper – Storage Category" at ICCE 2011. The paper is "Digital Video Recording Onto Solid-State Disks" as noted in Conference publications above.

Attendee, "Top Prof" Banquet – University of South Alabama chapter of Mortar Board, 2009,2010

Tau Beta Pi Engineering Professor of the Year – University of South Alabama chapter of Tau Beta Pi, 2008. One of two highest awards in the College of Engineering for teaching, and the only award voted on by honor students in the College.

Finalist, 53rd International Science and Engineering Fair, 1983, Albuquerque, NM.

Professional Activities

Expert Witness Engagements

Case	Jurisdiction and Case Number	Year(s)	Witness for	Expert Reports	Dep.	Trial	IPR* Rep.
WNE Holdings v. Rockwell Automat.	Southern District of Alabama	2011	Plaintiff	1	0	0	0
Personalized Media Corp. (PMC) v. Echostar	Eastern District of Texas	2010-2015	Plaintiff	2	3	0	0
Pegasus v. DirecTV et al.	Delaware	2011-13	Plaintiff	1	0	0	0
Apple v. Samsung	Int'l Trade Commission 337-TA-796	2012	Respondent	4	1	1	0
EON v. MobiTV et al.	Delaware	2013	Defendant	1	1	0	0
PMC v. Zynga	Eastern District of Texas	2013	Plaintiff	1	5	0	4
OpenTV v. Netflix	Delaware	2014	Defendant	0	0	0	0
Kaplan v. OnForce	N.D. California	2014	Defendant	0	0	0	1
Intellectual Ventures v. J.P. Morgan Chase	Southern District of New York	2013-2019	Defendant	2	2	0	0
PMC v. Amazon	Delaware	2014-2015	Plaintiff	1	9	0	5
Better Mouse Corp. v. Steelseries et al.	Eastern District of Texas	2015-2016	Plaintiff	2	0	1	0
SyncPoint v. Nintendo et al.	Eastern District of Texas	2015	Plaintiff	2	1	0	0
TQ Beta v. Dish	USPTO (IPR)	2016	Defendant	1	1	0	0
Script v. ADT et al.	Eastern District of Texas	2016	Plaintiff	2	2	0	0
Sony v. Pace	USPTO (IPR)	2016	Defendant	0	1	0	4
PMC v. Apple	EDTX and USPTO (IPR)	2016-Now	Patent Owner	2	1	1	2

Case	Jurisdiction and Case Number	Year(s)	Witness for	Expert Reports	Dep.	Trial	IPR* Rep.
PMC v. Samsung	Eastern District of Texas	2016	Patent Owner	2	0	0	0
Music Choice v. Stingray	Eastern District of Texas	2016-now	Plaintiff	2	2	0	4
Broadcom v. AMD	USPTO (IPR)	2016	Petitioner	0	0	0	1
Tech Pharmacy v. Alixa et al.	Eastern District of Texas	2017	Plaintiff	2	2	1	0
Rovi v. PMC	Eastern District of Texas, Arbitration	2017	Defendant	0	1	0	0
Implicit v. Trend Micro	Eastern District of Texas	2017	Defendant	2	1	0	0
Implicit v. Palo Alto	Eastern District of Texas	2018	Defendant	1	1	0	0
Invensas v. Samsung	Eastern District of Texas	2018	Plaintiff	2	1	0	0
Selective Signals v. Palo Alto	USPTO (IPR)	2018-Now	Petitioner	0	1	0	1
Rovi Tivo v. Various	Canada	2018-Now	Plaintiff	0	0	0	0
Implicit v. Netscout	Eastern District of Texas	2018-Now	Defendant	0	0	0	0
Rovi Tivo v. Comcast	USPTO (IPR)	2019-2020	Plainitff	0	4	0	5
Rovi Tivo v. Comcast	ITC	2019-2020	Petitioner	2	1	1	0
American Patents v. Various	Eastern District of Texas	2019-Now	Plaintiff	0	0	0	0
BBiTV v. OpenTV	California	2019	Defendant	0	0	0	0
Roku v UEI	USPTO (IPR)	2019-Now	Petitioner	0	6	0	8
MV3 v Roku	Western District of Texas	2019-2020	Defendant	2	2	1	0
BBiTV v Dish	USPTO (IPR)	2019-2020	Petitioner	0	3	0	6
PMC v Google	Eastern District of Texas	2020	Plaintiff	1	1	0	0
PMC v Netflix	Southern District of New York	2020-Now	Plaintiff	2	0	0	0
UEI v Roku *et al.*	ITC	2020-2021	Respondent	1	1	1	0
BBiTV v Dish	Western District of Texas	2020-2021	Defendant	1	5	0	6
Flexiworld v Amazon *et al.*	Western District of Texas	2020-Now	Defendant	0	0	0	0
Flexiworld v Roku	Western District of Texas	2021-2022	Defendant	2	0	0	0
Roku v UEI *et al.*	ITC	2021-	Complain.	1	0	1	0

Case	Jurisdiction and Case Number	Year(s)	Witness for	Expert Reports	Dep.	Trial	IPR* Rep.
		2022					
Roku v DivX	USPTO (IPR)	2021-Now	Petitioner	0	0	0	1
Apple v Identity	USPTO (IPR), Ex Parte Re-Exam, Western District of Texas	2022-Now	Patent Owner	2	1	0	6
Audi v Aprese	USPTO (IPR)	2022-Now	Petitioner	0	0	0	2
paSafeShare	Ex Parte Re-Exam, Western District of Texas	2021-Now	Patent Owner, Plaintiff	0	0	0	3
PerfectVision v PPC Broadband	USPTO (IPR)	2022-Now	Petitioner	0	0	0	1
Google v Nobots	USPTO (IPR)	2022-Now	Patent Owner	0	2	0	4
Fall Line v Various	Eastern District of Texas	2022-Now	Plaintiff	2	1	0	0
Assa Abloy v CPC	USPTO (IPR)	2023-Now	Patent Owner	0	2	0	4
IOENGINE v Roku	Western District of Texas	2023-Now	Defendant	5	2	0	0
Gratuity v Toast	USPTO (IPR)	2023-Now	Petitioner	0	0	0	1

* Includes reports submitted for IPRs, CBMRs, and Re-Exams

Invited Lectures

"Real-time Monitoring in MPI", Florida A&M University, Tallahassee, FL, August 1998

Consulting

Consulted with various investment firms concerning telecommunications market, 2007 – ongoing
Cox Communications – DVR Reliability – 2015

Society Memberships

Institute of Electrical and Electronic Engineers (Senior Member), IEEE Consumer Electronics Society, IEEE Computer Society, Eta Kappa Nu, Tau Beta Pi, Phi Kappa Phi, Gamma Beta Phi
Secretary, Northeast Mississippi Subsection of the IEEE, 1994-95

Article Reviewer

Computers and Electrical Engineering, Supercomputing '94, IEE *Transactions*, *Concurrency: Practice and Experience,* International Parallel Processing Symposium, *IEEE Transactions on Education, IEEE Transactions on Parallel and Distributed Systems, ICT 2012, ICAEE 2012*

Proposal Reviewer

Army Research Office, National Science Foundation, U.S. Department of Energy

University Service

Chair, Search Committee, ECE Department – Search for Assistant Professor positions, 2008-now (chair since 2011)

Member, ECE Department Undergraduate Affairs Committee, 2015-now
Member, College of Engineering Academic Standards Committee, 2016-now
Member, Search Committee, College of Engineering – Search for 2 Associate Dean positions, 2015
Member, Search Committee, College of Engineering – Search for Associate Dean positions, 2008-09
Member, University of South Alabama Council on International Education, 2008-15
Chairman, ECE Department "Open House" Committee, 2008-09
Conducted open house and other demonstrations for the department, 2008-now
Chairman, ECE Department Recruiting and Retention Committee, 2007-08
Updated and conducted experiment for ACE program, 2007
Member, Hearin Undergraduate Committee, 1998
Department Coordinator, United Way Campaign, 1995
Award Referee, 1995 Instructional Paper Award, MSU College of Engineering

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