

THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Arndt Mueller
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Title: METHOD AND APPARATUS FOR USING RANGING
MEASUREMENTS IN A MULTIMEDIA HOME
NETWORK

**DECLARATION OF SCOTT ACTON IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,363,681**

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DECLARATION OF SCOTT ACTON

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

I. QUALIFICATIONS AND BACKGROUND INFORMATION

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

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

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

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

promoted to Acting Deputy Division Director (Computing and Communication Foundations Division) of the Directorate. At the NSF, I contributed to programs in Communications and Information Foundations, Smart Health, Foundational Research in Robotics, the AI Institutes, and Predictive Intelligence for Pandemic Prevention.

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

6. For over 30 years, I have conducted research and taught classes in the field of image processing and image analysis. My research in the image processing area began with work in the Laboratory for Vision Systems (starting in 1990) and applied research with Motorola Semiconductor Products Sector (starting in 1991). At Motorola, I worked on inspection systems for communication devices (cell phones and satellite phones).

7. At the University of Virginia, I teach a variety of courses, including Digital Image Processing, Digital Signal Processing, Signals and Systems, the Science of Information, and “How the iPhone Works.” Both the Science of Information and How the iPhone Works teach the fundamentals of communication systems and networks. I have received several teaching awards such as the All University Teaching Award (2009) and the Educational Innovation Award (2017).

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

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

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

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

addition, I have analyzed the following publications and materials, in addition to other materials I cite in my declaration:

- U.S. Patent No. 8,363,681 (the “’681 Patent”) (DISH-1001), and its accompanying prosecution history (DISH-1002);
- “IEEE Standard for Information technology—Telecommunications and information exchange between systems— Local and metropolitan area networks—Specific requirements, Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications, Amendment: Media Access Control Parameters, Physical Layers, and Management Parameters for Subscriber Access Networks” (“IEEE802.3ah”) (DISH-1005);
- U.S. Patent Application Publication No. 2008/0101253 (“Shvodian”) (DISH-1006)
- U.S. Patent Application Publication No. 2007/0140127 (“Frei”) (DISH-1007);
- “MoCA: Ubiquitous Multimedia Networking in the Home” (“Ovadia”) (DISH-1008);
- U.S. Patent No. 7,821,958 (“Smith”) (DISH-1009);
- Poultney, S.K. (1971, December). Sub-Nanosecond Ranging Possibilities of Optical Radar at Various Signal Levels and Transmitted Pulse Widths. National Aeronautics and Space Administration (“Poultney”) (DISH-1011); and
- Huang, R.Y., & Hooten, P. (1971, February). Communication Satellite Processing Repeaters. Proceedings of the IEEE, 59(2), 238-252 (“Huang”) (DISH-1012).
- U.S. Provisional Application 61/144,676 to Mueller et al. (“’676 Provisional”) (DISH-1013)

II. LEGAL PRINCIPLES

A. Obviousness

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

13. For purposes of my analysis above and because I know of no indication from the patent owner or others to the contrary, I have applied a date of October 16, 2008, as the date of invention in my obviousness analyses, although in many cases the same analysis would hold true even at an earlier time than October 16, 2008.

14. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason to modify the single prior art reference, or combine two or more references, in order to achieve the claimed invention. This reason may come from a teaching, suggestion, or

motivation to combine, or may come from the reference or references themselves, the knowledge or “common sense” of one skilled in the art, or from the nature of the problem to be solved, and may be explicit or implicit from the prior art as a whole. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

III. OVERVIEW OF CONCLUSIONS FORMED

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

- Based upon my knowledge and experience and my review of the materials listed above, I believe that Claims 1-40 are rendered obvious by the references listed above.
- Specifically, it is my opinion that:
 - Claims 1-3 and 6-10 are rendered obvious by IEEE802.3ah in view of the knowledge of a POSITA;
 - Claims 11-13, 16-23, 26-33, and 36-40 are rendered obvious by IEEE802.3ah in view of Shvodian, and further in view of the knowledge of a POSITA;
 - Claims 1-3 and 6-10 are rendered obvious by IEEE802.3ah in view of Frei;
 - Claims 11-13, 16-23, 26-33, and 36-40 are rendered obvious by IEEE802.3ah in view of Shvodian, and further in view of Frei;
 - Claims 9-10 are rendered obvious by IEEE802.3ah in view of Frei, and further in view of Ovadia;

- Claims 19-20, 29-30, and 39-40 are rendered obvious by IEEE802.3ah in view of Shvodian, further in view of Frei, and further in view of Ovadia;
- Claims 4-5 are rendered obvious by IEEE802.3ah in view of Frei, and further in view of Smith; and
- Claims 14-15, 24-25, and 34-35 are rendered obvious by IEEE802.3ah in view of Shvodian, further in view of Frei, and further in view of Smith.

IV. BACKGROUND KNOWLEDGE ONE OF ORDINARY SKILL IN THE ART WOULD HAVE HAD PRIOR TO THE PRIORITY DATE OF THE '681 PATENT

16. Based on the foregoing and upon my experience in this area, a POSITA relating to the subject matter of the '681 Patent as of October 16, 2008 would have had a Bachelor's degree in electrical engineering, computer engineering, computer science, or a related field, and 2-3 years of experience in design or development of communication systems/networks including cable communication systems, or the equivalent. Additional education could substitute for experience, or experience in the field could substitute for formal education. Additional education could substitute for experience, or experience in the field could substitute for formal education.

17. For at least the reasons I explained in the sections about my qualifications, I would consider myself to have qualified as a POSITA as of the earliest possible priority date for the '681 Patent of October 16, 2008.

V. INTERPRETATIONS OF THE '681 PATENT CLAIMS AT ISSUE

18. I understand that, for purposes of my analysis in this *Inter Partes* review proceeding, the terms appearing in the patent claims should be interpreted under the *Phillips* standard. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); *see* 37 C.F.R. § 42.100. In that regard, I understand that the best indicator of claim meaning is its usage in the context of the patent specification as understood by a POSITA. I further understand that the words of the claims should be given their plain meaning unless that meaning is inconsistent with the patent specification or the patent's history of examination before the Patent Office. I also understand that the words of the claims should be interpreted as they would have been interpreted by a POSITA at the time of the invention was made (not today).

19. Because I do not know at what date the invention as claimed was made, I have used the earliest possible priority date of the '681 Patent as the point in time for claim interpretation purposes. That date is October 16, 2008.

VI. OVERVIEW OF THE '681 PATENT

A. Brief Description

20. The technology in the '681 Patent relates to “systems, methods[,] and apparatuses . . . using ranging to improve network efficiency.” DISH-1001, Abstract. The patent explains that “network efficiency” can be improved by “provid[ing] ranging to improve local clock time synchronization,” where ranging “is a method by which nodes measure and/or estimate the propagation delays to and

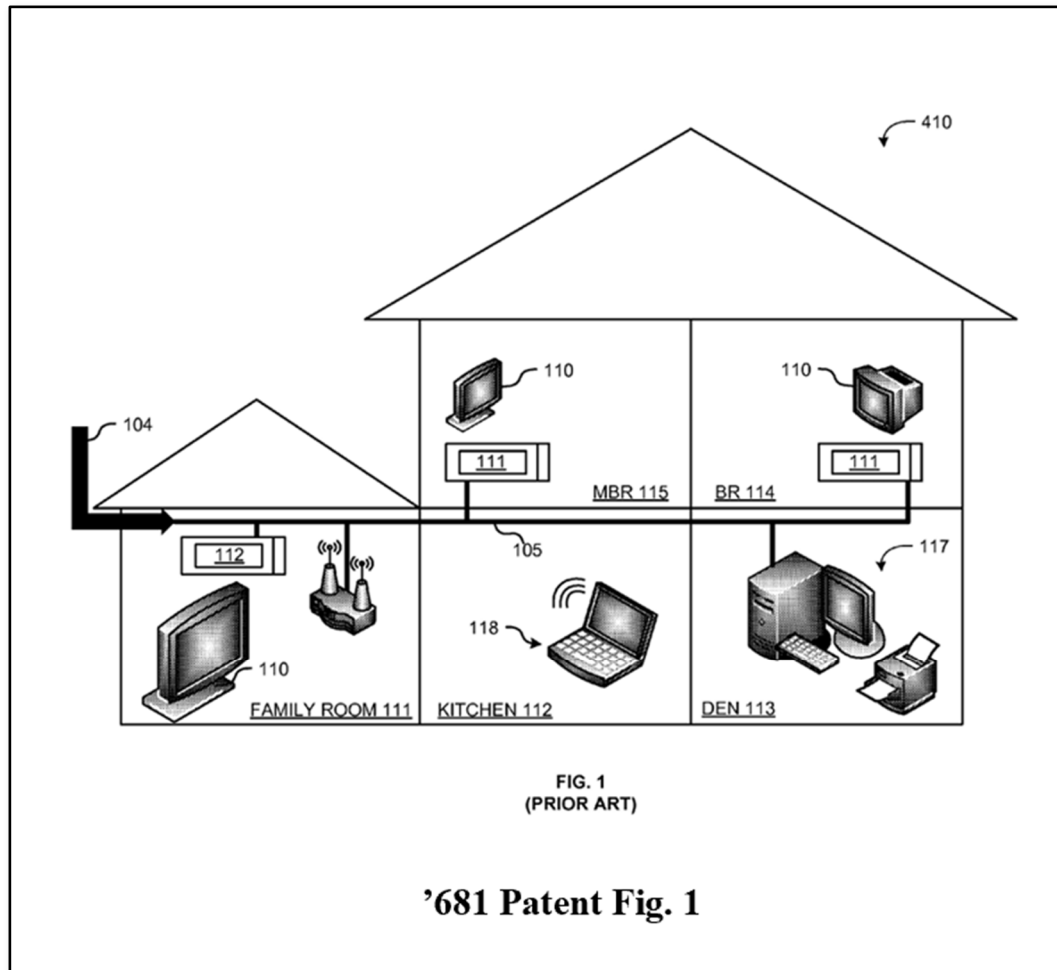
from other nodes in the network.” *Id.*, 3:58-60. “[R]anging can result in reduced inter-frame gap (IFG) by more accurately controlling the expected start and end times for arriving network packets.” *Id.*, 3:61-65.

21. It is my opinion that before the priority date of the ’681 Patent, there were many patents and publications that implemented or described the functionality claimed in the ’681 Patent. As a result, the system and methods of the ’681 Patent were well-known in the art. Moreover, to the extent there was any problem to be solved in the ’681 Patent, it had already been solved in the prior art before the priority date of the ’681 Patent.

22. The title of the ’681 Patent is “Method and apparatus for using ranging measurements in a multimedia home network.” DISH-1001, Cover. The ’681 Patent describes using a ranging procedure to improve local clock time synchronization. *Id.*, 3:56-58. By sending messages back-and-forth and estimating delay, the nodes synchronize their internal clocks, which improves network efficiency. *See generally id.*

23. The ’681 Patent explains that by the time of filing of the ’681 Patent, there was already a “growing demand for the ability to connect content devices (e.g., televisions, DVD players and recorders, digital cameras, speakers, video cameras, etc.), computing devices, I/O devices, home appliances[,] and modems.” *Id.*, 1:34-40. “To address the growing demand for a digital home networking market, a

consortium of industry leading companies formed the Multimedia over Coax Alliance (MoCA™).” *Id.*, 1:59-61. MoCA had “provided a technical standard (referred to as “MoCA 1.0”) which defines a protocol for distributing digital entertainment over the available bandwidth on coaxial cable previously installed in households for cable or satellite TV services.” *Id.*, 1:62-66. The MoCA 1.0 standard further “defined” a “Mesh topology in which any node can communicate directly with any other node in the network,” and which “might be more typically found in a home environment where, although there may be a common source of broadband data (e.g., the main cable feed into the home), the homeowners may wish to share content originating from a device in one room with other devices in other rooms in their home.” *Id.*, 1:46-58. FIG. 1 of the ’681 Patent provides one such example of a “digital home networking market” to which MoCA 1.0 may apply:



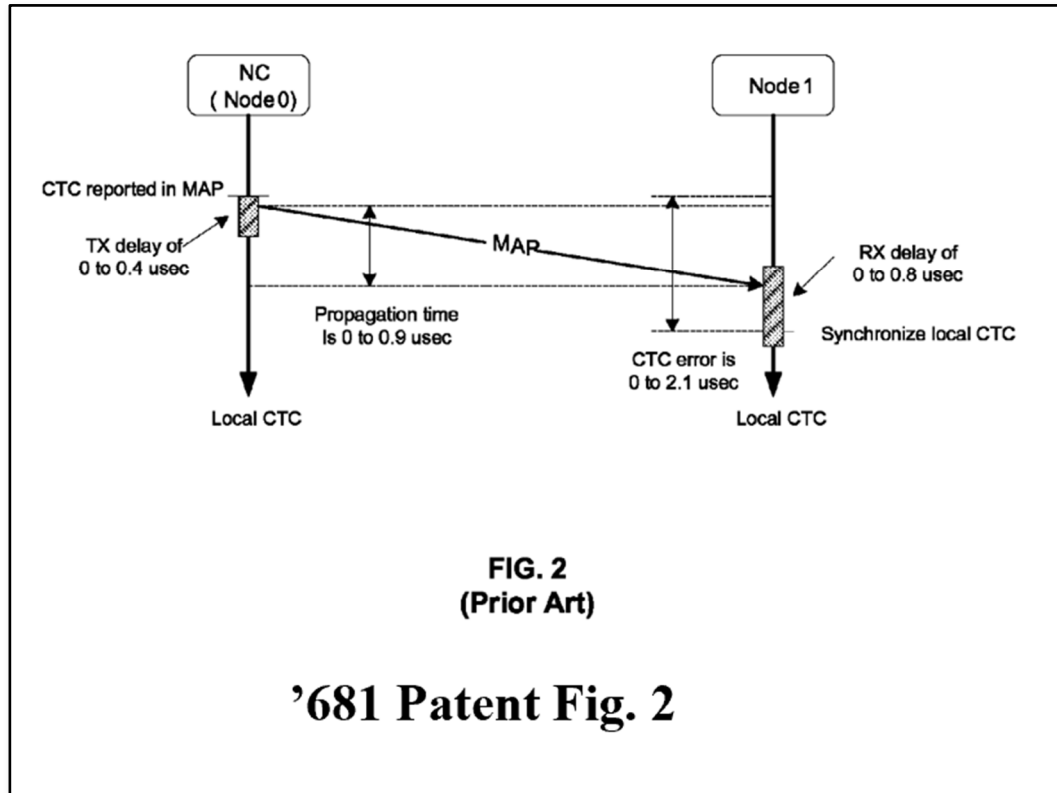
24. The '681 Patent acknowledged that network architects had “long struggled with the challenge of managing multiple communications from various devices across a limited channel.” *Id.*, 2:4-13. In response, network architects have developed “various solutions to arbitrate disputes or otherwise allocate bandwidth among the various communicating devices, or clients, on the network,” including “token rings, Ethernet, and other configurations . . . to allow sharing of the available bandwidth.” *Id.*

25. One solution developed to address this challenge was to designate one of the nodes as the “network coordinator” (“NC”), which would be “relied upon to schedule all traffic on the network, thereby allocating the network bandwidth and avoiding packet collisions.” *Id.*, 2:37-39. The NC “communicates the schedule to each client node in “Media Access Packets” (MAPs).” *Id.*, 2:39-41.

26. For such a solution to be effective, each node must have a local clock that is sufficiently synchronized with others to prevent nodes from inadvertently sending messages at the same time. *Id.*, 2:44-59. Alternatively, the NC could provide for additional time in between messages to prevent collisions, although such a mechanism would slow down communication. *Id.*, 3:15-49, 3:48-49.

27. The MoCA 1.x standard had already addressed the problem of synchronizing clock times by having “the NC and each node in the network maintain a local channel clock time (CTC) counter,” where “all nodes are responsible for synchronizing their CTC counts to that of the NC.” *Id.*, 2:44-3:14. More specifically, the “CTC is encoded in either [the] MAC header or [the] payload of MoCA network packets, depending on the type of data or link control packet,” and the “encoded CTC count of the MoCA network packet represents the time instant that the first sample of the PHY preamble is transmitted on to the network medium. *Id.* When a node receives a packet from the NC, “each node records the instant in time when it received the first sample of the PHY preamble of the MAP packet using

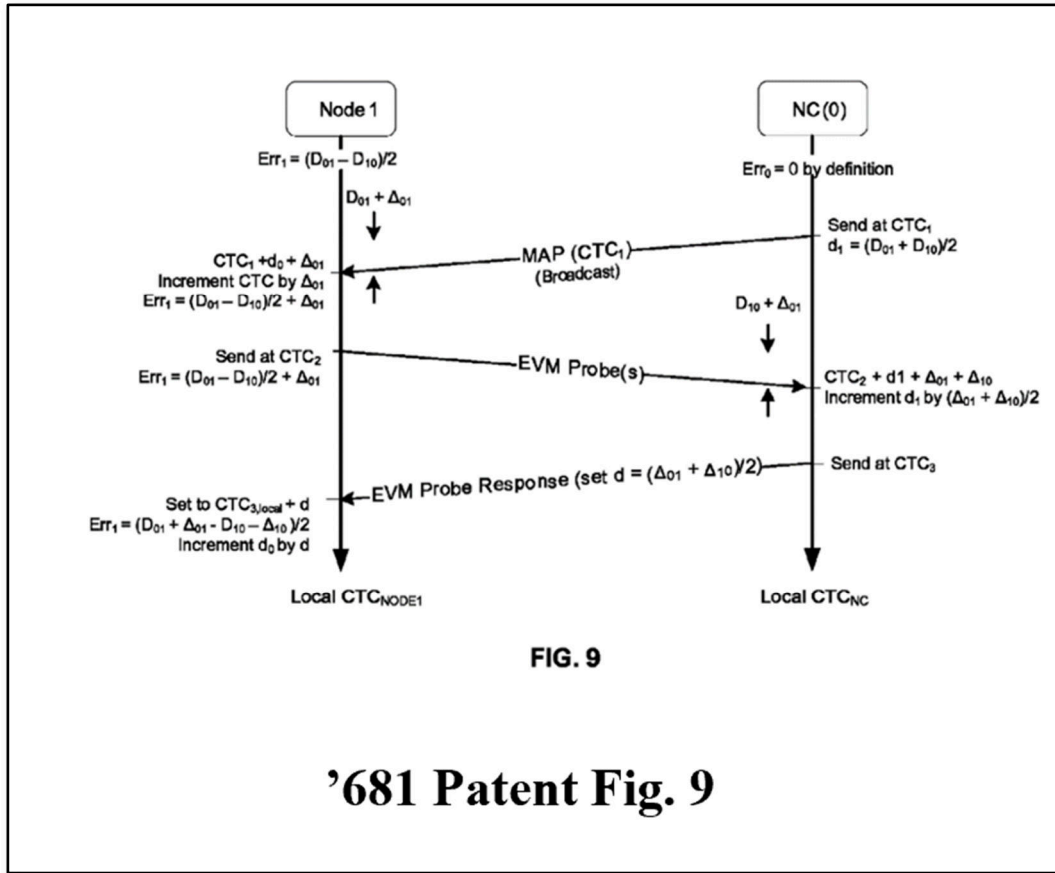
its local CTC count. The receiver then adjusts its own CTC count to synchronize it to the NC's counter." *Id.* Such a mechanism is depicted in FIG. 2:



28. The '681 Patent describes a node synchronization technique claims to “more accurately control[] the expected start and end times for arriving network packets,” and that pivots away from the one-directional synchronization process of the MoCA 1.x standard and instead involves sending messages back and forth between two nodes. *Id.*, 3:54-65, cl. 1.

29. The '681 Patent's procedure estimates the “propagation delay” between two nodes and then adjusts the local clock time based on the estimated propagation delay. *Id.*, 4:20-34. This ranging procedure is depicted in Figures 5 and 9. *Id.*,

FIGS. 5-9. Notably, the claims do not explicitly recite implementation in a coaxial network. **First**, a “first packet” is transmitted “from the first node to the second node, wherein the first packet includes a first packet clock time set to the local clock time of the first node at transmission time, and includes a scheduled arrival clock time.” *Id.* **Second**, the “local clock time of the second node” is set “to the first packet clock time.” *Id.* **Third**, “a second packet” is transmitted “from the second node to the first node, wherein the second packet is transmitted from the second node at the scheduled arrival clock time, and wherein the second packet is received by the first node at an actual arrival clock time.” *Id.* **Fourth**, the “estimated propagation delay” is calculated and stored “at the first node, wherein calculating the estimated propagation delay is based on the scheduled arrival clock time and the actual arrival time.” *Id.* **Fifth**, “a third packet” is transmitted “from the first node to the second node, wherein the third packet comprises the estimated propagation delay,” and the “local clock time of either the first or second node” is adjusted “based on the estimated propagation delay, thereby resulting in a synchronized local clock time between the first and second node.” *Id.* This technique is depicted in Figure 9:



B. Prosecution History

30. The '681 Patent issued on January 29, 2013, from U.S. Patent Application No. 12/580,127 (the "127 Application"), which was filed on October 15, 2009, which claimed priority to U.S. Provisional Patent Application Nos. 61/205,942 (filed on October 16, 2008), 61/144,061 (filed on January 12, 2009), and 61/144,676 (filed January 14, 2009). DISH-1001, Cover.

31. I have reviewed the entire file history, but I only address the most important aspects below.

32. During prosecution, the '127 Application was rejected as directed to patent ineligible subject matter (as to Claims 21-30), as anticipated by U.S. Patent Publication No. 2008/0056308 to Zumsteg (as to Claims 1-2 and 6-9), and as obvious in light of Zumsteg, U.S. Patent Publication No. 2008/0271076 to Schlack (Claim 10), and as obvious in light of Zumsteg, in view of the Examiner's Official Notice (as to Claims 12-12, 16-19, 21-22, 26-29, 31-32, and 36-39), and also as obvious in light of Zumsteg, in view of the Examiner's Official Notice and further in view of Schlack (as to Claims 20, 30, and 40), although dependent claims 3-5, 13-15, 23-25, and 33-35 were deemed to include allowable subject matter. DISH-1002, 2012-02-01 Non-Final Rejection.

33. In response, the Applicant amended the rejected independent claims to purportedly "incorporate limitations from allowable dependent claims 3, 13, 23, and 33." *Id.*, 2012-04-05 Applicant Response. As an illustrative example, the Applicant amended independent claim 1 to clarify that the "exchanging [of] a local clock time between a first node and a second node over the communication network" comprises "transmitting a first packet from the first node to the second node, wherein the first packet include a first packet clock time set to the local clock time of the first node at transmission time, and includes a scheduled arrival clock time, and setting the local clock time of the second node to the first packet clock time," and also to clarify that the "ranging method between the first and second nodes based on the local clock

time exchanged” comprises “transmitting a second packet from the second node to the first node, wherein the second packet is transmitted from the second node at the scheduled arrival clock time, and wherein the second packet is received by the first node at an actual arrival clock time, calculating and storing the estimated propagation delay at the first node, wherein calculating the estimated propagation delay is based on the scheduled arrival clock time and the actual arrival time, and transmitting a third packet from the first node to the second node, wherein the third packet comprises the estimated propagation delay.” *Id.* The other independent claims were similarly amended. *Id.*

34. The Examiner’s next action was to issue a Notice of Allowance on September 19, 2012. *Id.*, 2012-09-19 Notice of Allowance.

VII. THE CHALLENGED CLAIMS ARE UNPATENTABLE

35. It is my opinion that each of the claims recites subject matter rendered obvious by the grounds described in this declaration and the petition.

36. IEEE802.3ah provided blueprints for coordinating network node clocks. Like other networking protocols of the time, IEEE802.3ah included multiple features to ensure that network nodes communicated efficiently. This is similar to the concession made in the ’681 Patent, which admits that network architects had already “come up with various solutions” to increase network efficiency. DISH-1001, 2:4-13

37. One such solution was the technique of back-and-forth “ranging.” DISH-1005, 4. Dating back to the 1970s, ranging is a process whereby network nodes send messages back-and-forth to measure the time it takes for a message to travel between nodes. One example is the optical communication system of Poultney (DISH-1011): “...ranging is the measurement of the time interval between the laser output time and the return pulse time as derived above.” DISH-1011 at 6. Huang (DISH-1012) discusses ranging in a satellite communication system: “However, for the ground terminal transmission to be in time synchronism with the satellite clock when it arrives at the satellite requires further that the range from the ground transmitting terminal to the satellite be accurately known. Conventional space-ground ranging systems provide accuracies on the order of 50 ft; thus the ground transmission may be received at the satellite in time error by the equivalent of 100 ft, or 0.1 μ s.” DISH-1012 at 246. In this case, the travel between nodes can be measured in physical distance or time. Nodes use such a ranging technique to synchronize their local clocks—if a recipient node knows the time a message was sent and how long it took to arrive, the recipient can use that information to set its clock to be the same as the sending node’s clock. DISH-1005, 4. And thus, ranging allows the avoidance of a collision between transmitted and received signals, for example.

38. Likewise, Frei's network protocol also implemented a back-and-forth ranging procedure. *See generally* DISH-1007. Frei explicitly calculates propagation delay and then sends that value to other nodes so that they can synchronize their local clocks.

39. It is my opinion that IEEE802.3ah, individually and in combination with other references, such as Frei, renders obvious the subject matter recited in the claims of the '681 Patent.

A. GROUND 1A – IEEE802.3ah (Claims 1-3, 6-10)

1. Overview of IEEE802.3ah

40. IEEE802.3ah is a standard by the IEEE Standard for Information Technology. DISH-1005, Abstract. It describes protocols for operation, administration, and maintenance of “optical fiber” and “copper cable” networks, including a network using ranging to synchronize its node clocks. *Id.*, Abstract, 4. This Petition refers to the 2004 amendment to the standard, which was published on September 7, 2004. DISH-1005, Cover. It is attached as DISH-1005 and lists its title on the cover page:

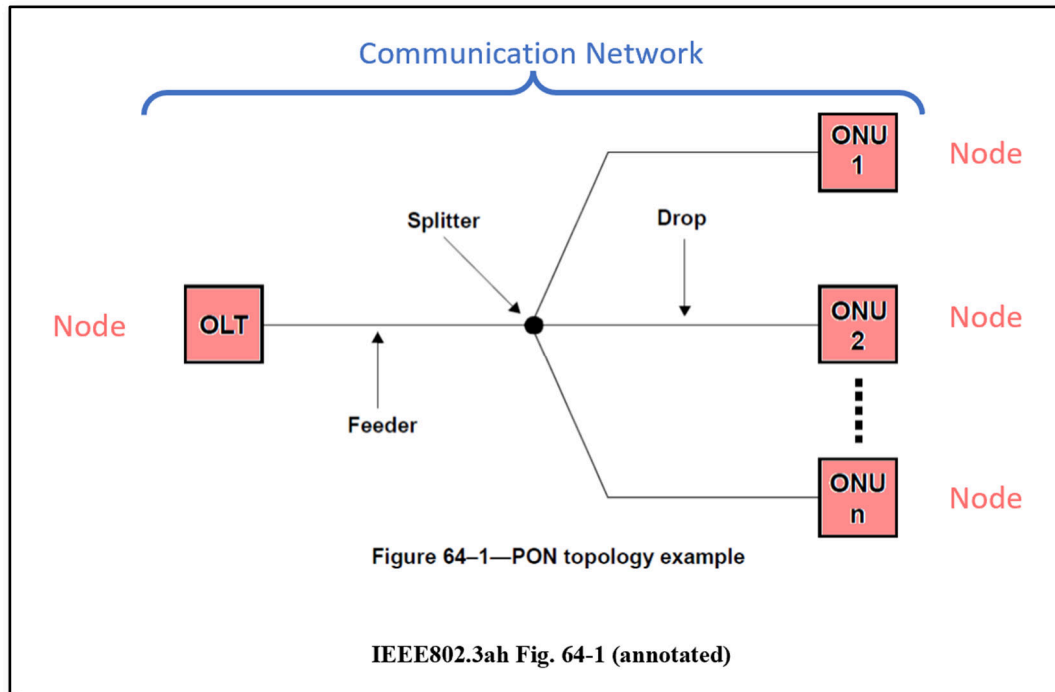
IEEE Standard for Information technology—
Telecommunications and information exchange between
systems—
Local and metropolitan area networks—
Specific requirements

Part 3: Carrier Sense Multiple Access with Collision
Detection (CSMA/CD) Access Method and Physical
Layer Specifications

Amendment: Media Access Control Parameters, Physical
Layers, and Management Parameters for Subscriber
Access Networks

DISH-1005, Cover.

41. IEEE802.3ah “introduce[d] the concept of Ethernet Passive Optical Networks (EPONs), in which a point to multipoint (P2MP) network topology is implemented with passive optical splitters.” *Id.*, 179. The P2MP network topology is “an asymmetrical medium based on a tree (or tree-and-branch) topology,” where the “DTE [Data Terminal Equipment] connected to the trunk of the tree is called optical line terminal (OLT) and the DTEs connected at the branches of the tree are called optical network units (ONUs).” *Id.*, 421. An exemplary tree-and-branch structure depicted in IEEE802.3ah below shows data terminal equipment (i.e., nodes) with the trunk of the tree connected to an optical line terminal (OLT) and branches connected to optical network units (ONUs).



42. IEEE802.3ah is designed to avoid packet collisions, that is, when ONU_1 and ONU_2 , for example, send packets that arrive at the splitter at the same time, thus colliding. “The network operates by allowing only a single ONU to transmit in the upstream direction at a time,” with the OLT “responsible for timing the different transmissions.” *Id.*, 422.

43. When signals are transmitted downstream from the OLT to an ONU, the signals “pass through a 1:N passive splitter (or cascade of splitters) and reach each ONU.” *Id.* This allows the OLT to communicate with many nodes (i.e., “point to multipoint functionality”) despite having a “tree-and-branch” structure. *Id.*

44. In contrast, “only a single ONU [can] transmit in the upstream direction at a time,” and the OLT “is responsible for timing the different transmission.” *Id.*,

422. When signals are transmitted upstream from an ONU to the OLT, each ONU's transmissions are "arbitrated" so as to "avoid data collisions and [to] increase the efficiency of the subscriber access network." *Id.*, 421. This "arbitration" involves the "allocat[ion] of a transmission window (grant) to each ONU," where each "ONU defers transmission until its grant arrives," at which time "the ONU transmits frames at wire speed during its assigned time slot." *Id.* This "arbitration" prevents the possibility that multiple ONUs transmit packets at times such that they arrive at the splitter at the same time, which would cause a data collision. *Id.*

45. To prevent any inadvertent overlap in the "assigned time slot[s]" for each ONU, which would leave room for data collisions to occur, the OLT and the ONUs must all have synchronized internal clocks. IEEE 802.3ah recognized that the synchronization of internal clocks could be performed by a ranging procedure between the OLT and the ONUs. *Id.*, 427-28.

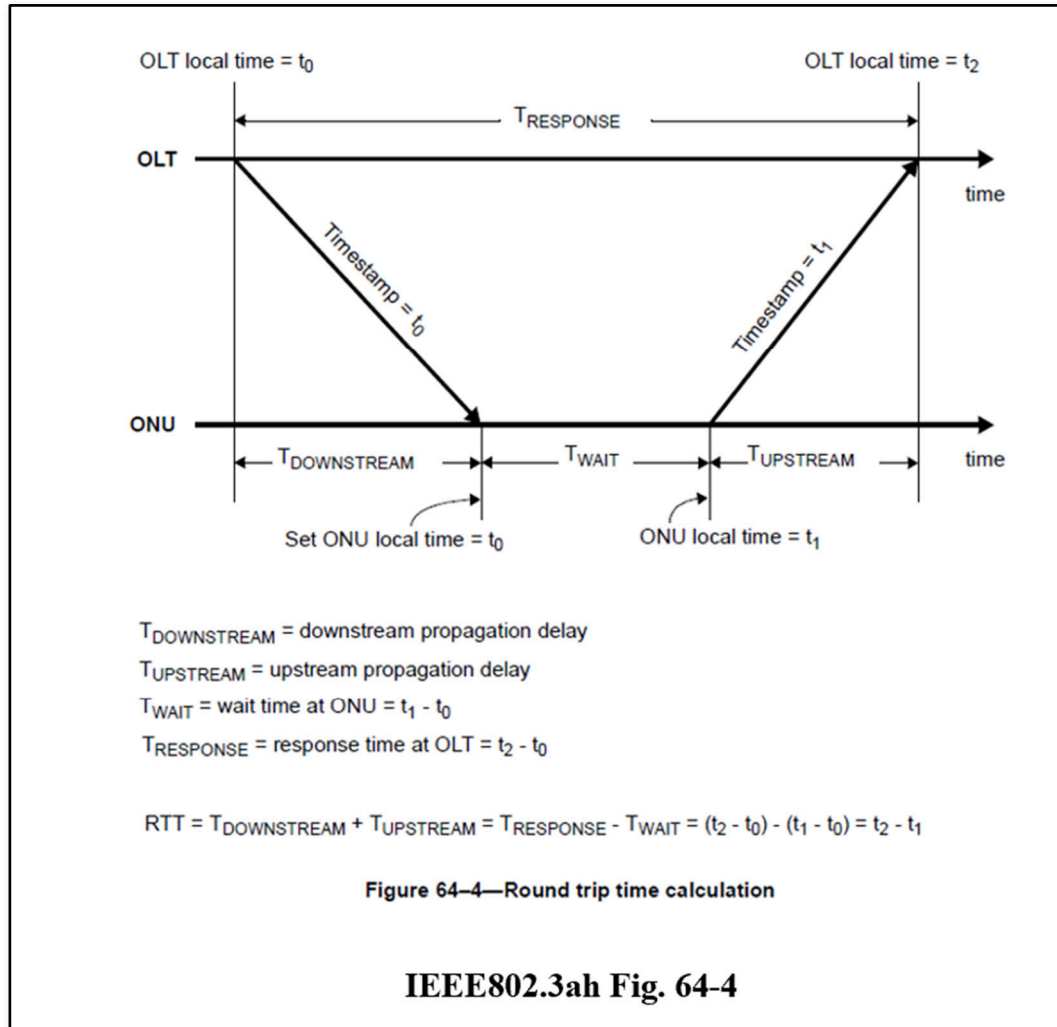
46. IEEE802.3ah defines ranging as a "procedure by which the propagation delay between a master (e.g., OLT) and slave (e.g., ONU) is measured. The round trip delay computation is performed by the OLT, using the timestamp in MPTP [Multi-Point Control Protocol] messages from the ONU." *Id.*, 4.

47. IEEE802.3ah further discloses that "ranging for compensating round trip time variation" can be performed in a "continuous" manner. DISH1005, 422.

IEEE802.3ah also notes that ranging is performed for all “discovered devices for improved network performance.” *Id.*

48. IEEE.802.3ah discloses a ranging procedure that involves sending messages back and forth between two nodes (an OLT and an ONU). **First**, the OLT sends a message to an ONU that includes both (i) a timestamp (which is used “to synchronize slaves (e.g., ONUs) with the master (OLT) and for the ranging process”) for the OLT’s local time and (ii) the start_time at which the ONU should respond. *Id.*, 4, 422, 455 (“An ONU will begin transmission when its localTime counter matches start_time value indicated in the GATE message.”). **Second**, the ONU “sets its counter according to the value in the timestamp field in the received” GATE message. *Id.*, 427. **Third**, when the ONU’s local time equals the received “start_time,” the ONU responds with a message including the time the response is sent. *Id.*, 428 (where FIG. 64-4 depicts the ONU transmitting its local time back to the OLT, where the local time includes a waiting period from the time that the ONU received the initial message from the OLT). **Fourth**, the OLT receives the message and uses it to calculate the “round trip delay [RTT]” —which comprises the “propagation delay”—“using the timestamp from . . . the ONU.” *Id.*, 4, 427-28. **Finally**, RTT (including propagation delay) is used to adjust at least one of the local nodes’ clocks. *Id.*, 427 (explaining that the “client can use this RTT for the ranging process”).

49. An exemplary implementation of the ranging process described in IEEE802.3ah is depicted below:



50. Figure 64-4 shows the message sent from OLT to ONU, the reply sent by ONU, the times those messages are sent, and some information contained in those messages. *Id.*, FIG. 64-4. The figure also describes the calculation of RTT and propagation delay based on the ranging procedure. *Id.*

51. IEEE802.3ah is analogous art to the '681 Patent for the reasons described below. *See* below, ¶¶52-53.

52. IEEE802.3ah and the '681 Patent are in substantially similar fields. Both IEEE802.3ah and the '681 Patent describe techniques for improving network efficiency in wired networks. DISH-1005, v, 4; DISH-1001, 1:15-18. For example, in its “Field of Disclosure,” the '681 Patent describes its “present disclosure” as relating to “networks, and more particularly, some embodiments relate to using range estimates to improve efficiency in networks, particularly networking over coaxial cable.” DISH-1001, 1:15-18. IEEE802.3ah uses range estimates to improve network efficiency and is intended for implementation in wired networks. DISH-1005, v, 4.

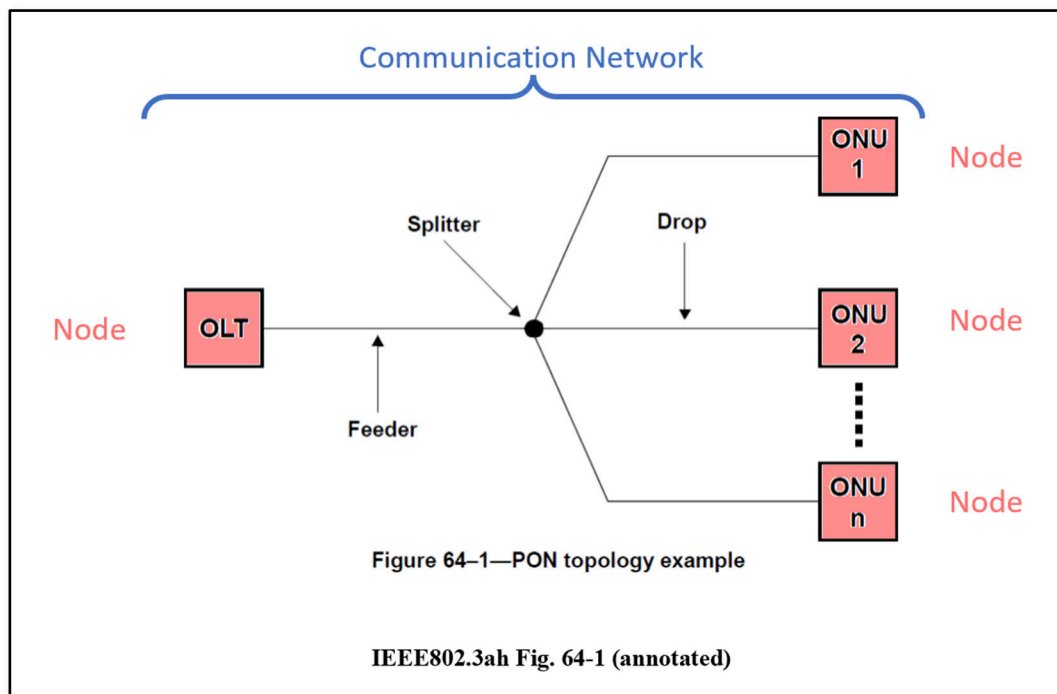
53. IEEE802.3ah is also similar to the '681 Patent because it addresses the same problem using the same technique. Both IEEE802.3ah and the '681 Patent recognized the need for synchronizing the node clocks in a network to increase network efficiency by avoiding packet collisions, and both IEEE802.3ah and the '681 Patent addressed this need by disclosing a back-and-forth ranging mechanism. *Id.*, 427; *see, e.g.*, DISH-1001, Claim 1.

2. Independent Claim 1

[1.pre] “A method for synchronizing a plurality of nodes on a communication network, comprising:”

54. I have been asked to consider whether IEEE802.3ah renders obvious the preamble of claim 1, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 1 is deemed to be a limitation, it is my opinion that IEEE802.3ah discloses this limitation.

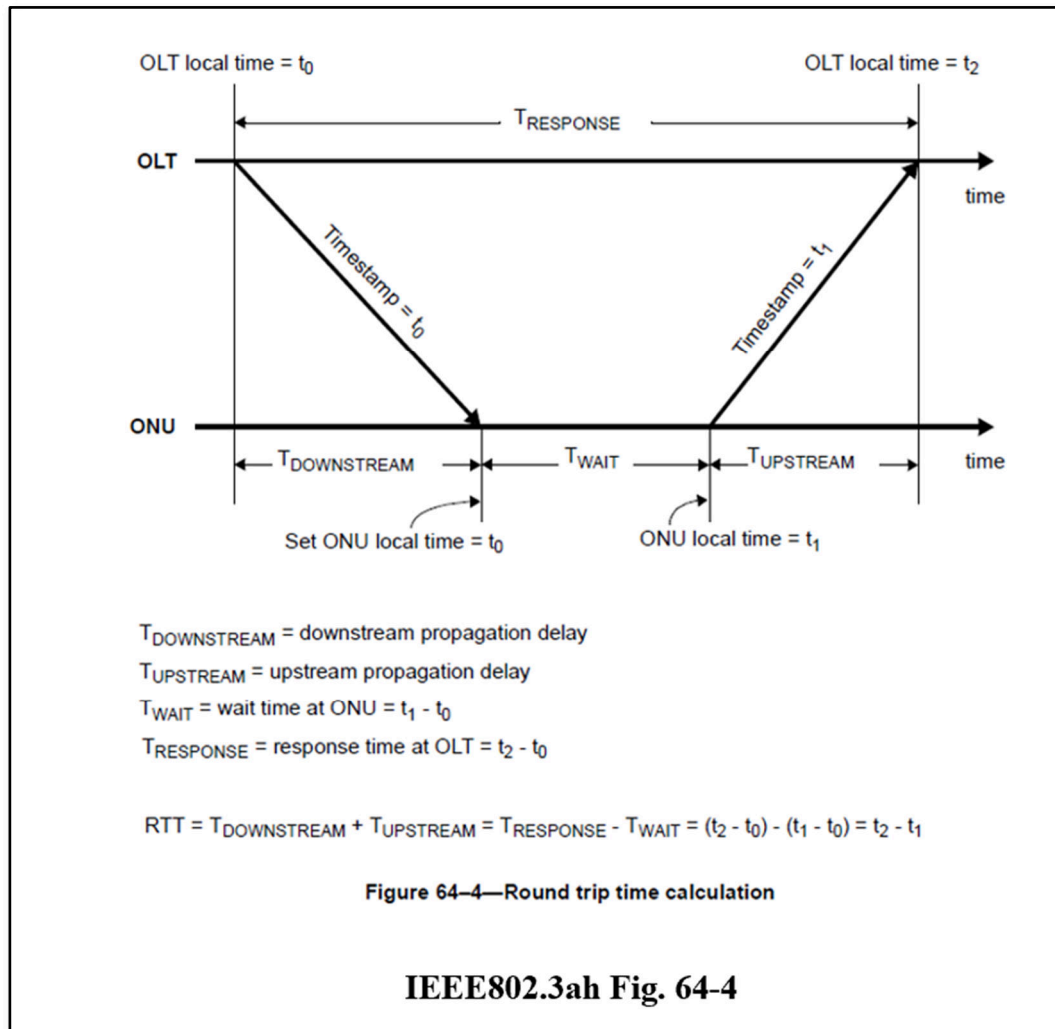
55. Specifically, IEEE802.3ah provides a communication network that comprises a plurality of nodes. FIG. 64-1 depicts an example topology where the network includes an OLT node and multiple ONU nodes in a communication network:



56. These nodes communicate with each other via transmissions, and this network is designed to be used for communication purposes, as described in the title of IEEE802.3ah: “Telecommunications and information exchange between system—Local and metropolitan area networks.” *Id.*, Cover; *see also id.*, 421 (“Topics dealt with in this clause include allocation of upstream transmission resources to different ONUs, discovery and registration of ONUs into the network ...”). A POSITA would understand that the network having multiple nodes, such as the one depicted in FIG. 64-1 of IEEE802.3ah to be a communication network with multiple nodes.

57. IEEE802.3ah also teaches that the multiple nodes are synchronized with each other. For example, IEEE802.3ah states that “[n]ew devices are discovered in the network and allowed transmission through the Discovery Processing function” which includes synchronizing the nodes’ clocks using ranging. *Id.*, 439; *see* DISH-1005, 427 (describing the ranging process begins “[w]hen either device [OLT or ONU] transmits an MPCPDU”). IEEE803.2ah further explains that ranging is a “procedure by which the propagation delay between master (e.g., OLT) and slave (e.g., ONU) is measured.” *Id.*, 4. Ranging relies on “timestamps” sent between the nodes, which are “used to synchronize slaves (e.g., ONUs) with the master (OLT).” *Id.* Thus, once the “[n]ew devices” are “allowed transmission,” the “propagation delay between master (e.g., OLT)” and the “[n]ew device” must be

measured, which involves the synchronization of the clocks of the OLT and the new device. The synchronization process is depicted in FIG. 64-4, below.



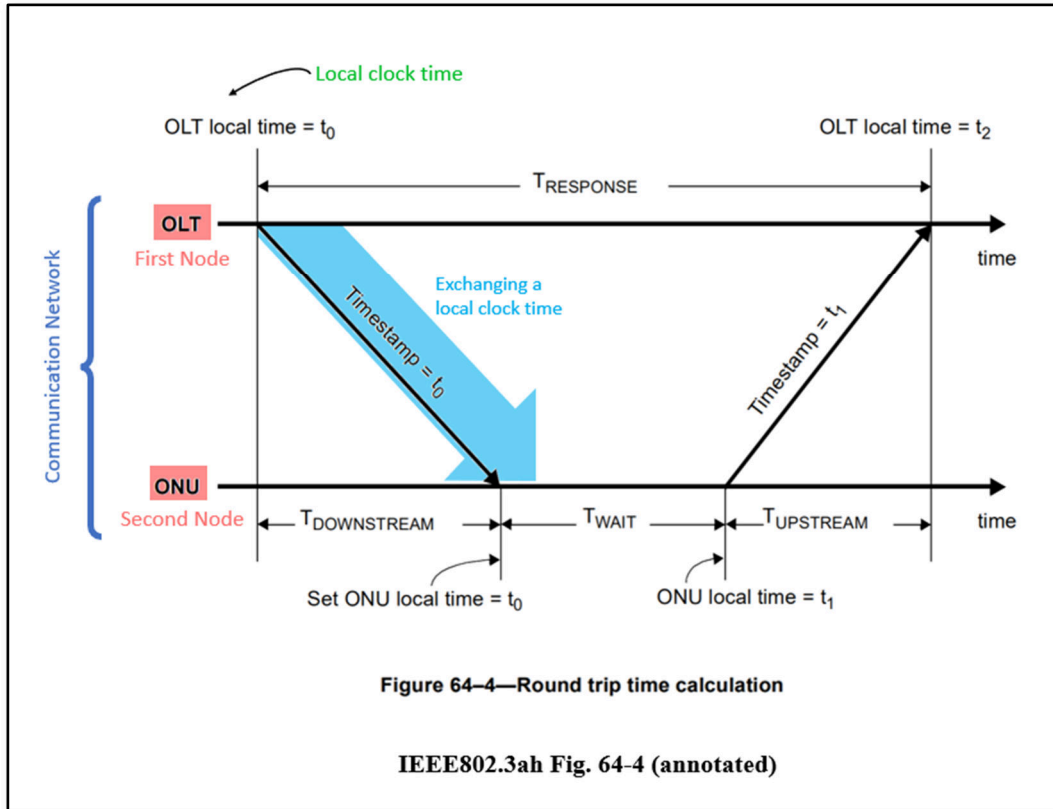
58. As a result, it is my opinion that IEEE802.3ah discloses the preamble of claim 1.

[1.a] “exchanging a local clock time between a first node and a second node over the communication network, wherein the exchange comprises:”

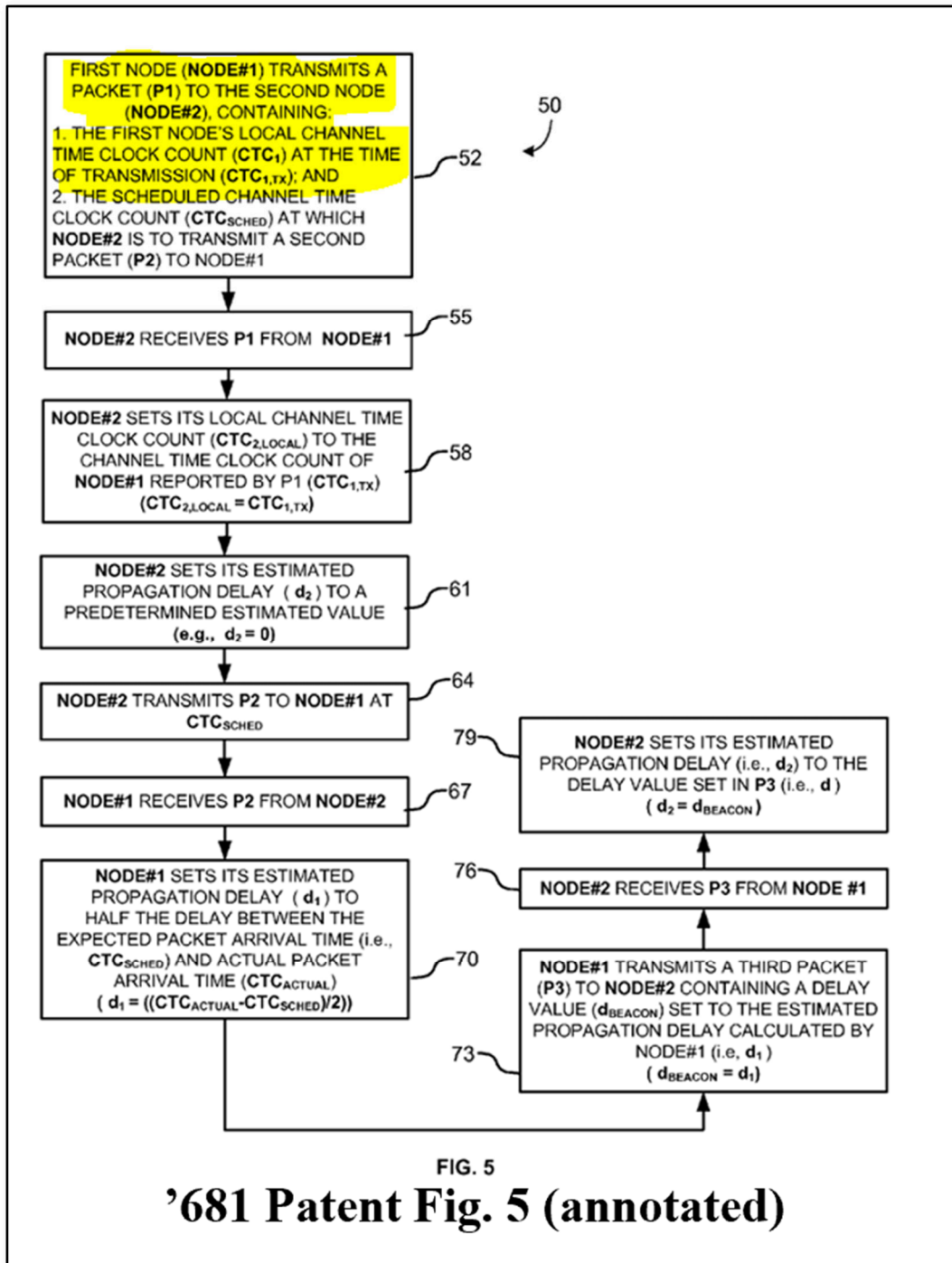
59. It is my opinion that IEEE802.3ah discloses this limitation.

60. IEEE802.3ah states that during the “[r]anging and [t]iming process,” both the OLT and the ONU have “counters” that “provide a local time stamp,” and the OLT node will send a GATE message to an ONU node including the OLT’s “local clock stamp” (i.e., “a first packet clock time set to the local clock time of the first node at transmission time”) during the “Ranging and Timing Process.” *Id.*, 427-28. When any node transmits a Multi-Point Control Protocol Data Unit (“MPCPDU”) to another node, “it maps its counter value into the timestamp field. The time of transmission ... is taken as the reference time used for setting the timestamp value.” *Id.* For example, when the OLT is transmitting a MPCPDU to an ONU, the OLT includes a timestamp that refers to the local time at the OLT when the “first octet of the MPCPDU frame from the MAC Control to the MAC.” *Id.*, 427-28.

61. Figure 64-4 depicts this local clock time exchange, showing that the OLT node sends a message to the ONU node including the OLT’s local transmission time (depicted in Fig.64-4 as t_0):



62. This is similar to the '681 Patent, which discloses a “first node (Node#1)” that transmits “a first network packet P1 to a second node (Node#2),” where the “network packet P1 comprises: (1) Node#1’s local channel time clock count (CTC_1) at the time of the P1’s transmission ($CTC_{1,TX}$).” DISH1001, 6:50-66. This is depicted in FIG. 5 of the '681 Patent below:



63. As a result, it is my opinion that IEEE802.3ah discloses this limitation.

[1.a.i] “transmitting a first packet from the first node to the second node, wherein the first packet includes a first packet clock time set to the local clock time of the first node at transmission time, and includes a scheduled arrival clock time, and”

64. It is my opinion that IEEE802.3ah discloses this limitation.

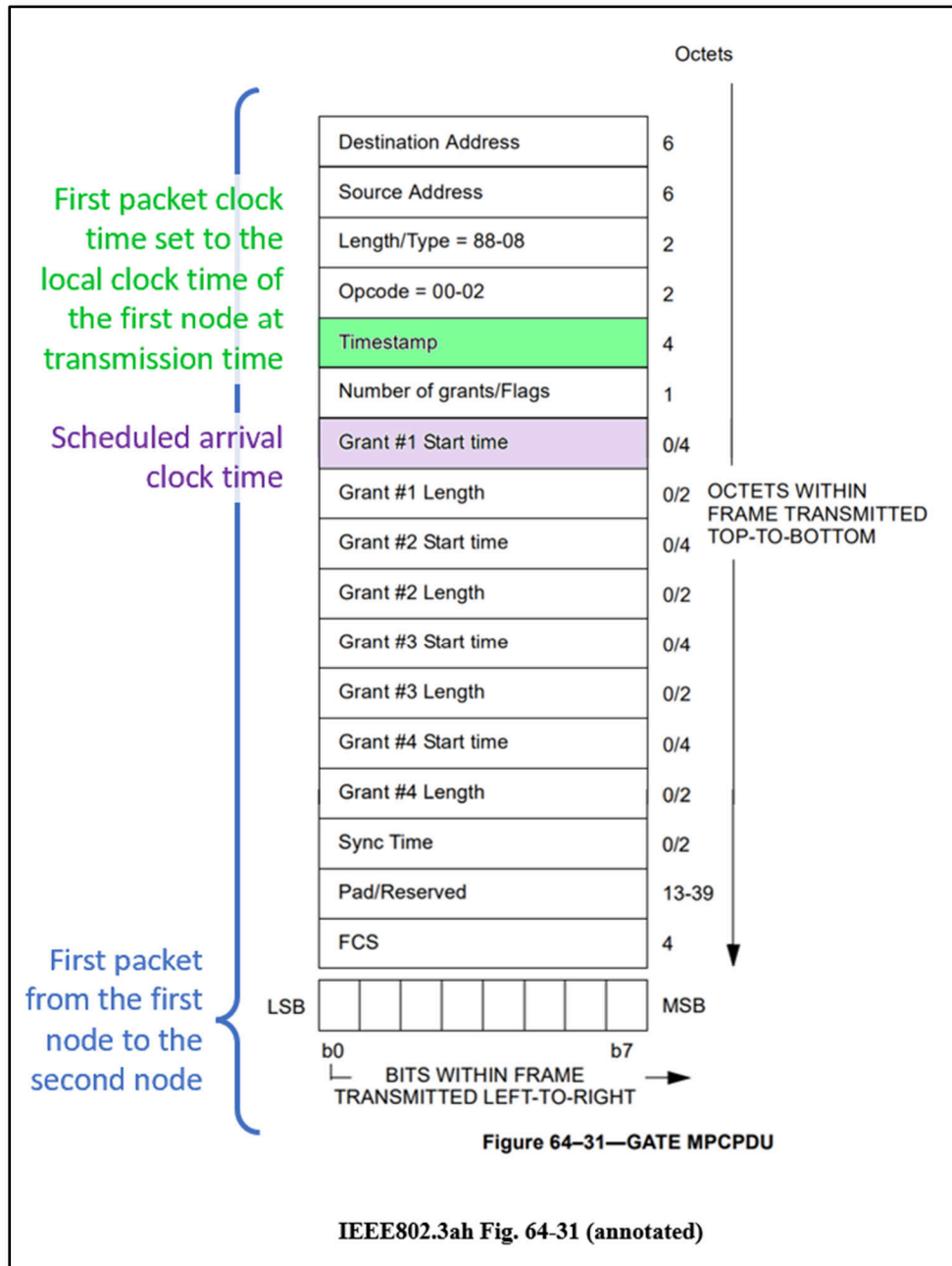
65. As I discuss above in relation to claim limitation [1.a], IEEE802.3ah/s description of the process by which new network nodes are learned discloses “exchanging a local clock time between a first node and a second node over the communication network.” *See above*, ¶¶59-63.

66. IEEE802.3ah further describes how an OLT node communicates with a newly learned ONU node. DISH-1005, 464. To learn a new ONU node, an OLT node in the IEEE802.3ah network sends out a “GATE message,” which includes both (i) the OLT’s local lock time at transmission and (ii) the scheduled response time for the ONU node. *Id.*

67. The “GATE message” is “an instantiation of the Generic MPCPDU,” which, as discussed above in relation to claim limitation [1.a], includes the OLT’s local time (t0) when the message was sent. *See above*, ¶¶59-63. Thus, the “GATE message” in IEEE802.3ah includes a first packet clock time set to the local clock time of the first node at transmission time, as depicted by “Timestamp” in Figure 64-31 of IEEE802.3ah, as required by this claim limitation. *See above*, §VII(A)(2)[1a].

68. Regarding the claimed “scheduled arrival clock time,” the “GATE message” further grants “transmission windows to ONUs for both discovery messages and normal transmission.” DISH-1005, 464. To do so, the “GATE message” includes a Grant Start Time in each GATE message used to schedule when the ONU node must respond. *Id.* The Grant Start Time thus limits an ONU to only begin transmission when “its localTime counter matches start_time value indicated in the GATE message” (i.e., the Grant Start Time). *Id.*, 455. As shown in [1.a.ii], ONU will first set its local clock to be the time of transmission of the first packet. Afterward, ONU will begin transmission when its localTime counter matches the start_time value in the GATE message. Notably, any of the Grant Start Times included in a GATE message satisfies this limitation, because each Grant Start Time triggers the ONU to respond. Thus, each Grant Start Time can qualify as a “scheduled arrival clock time.” Thus, the “GATE message” in IEEE802.3ah includes a scheduled arrival time.

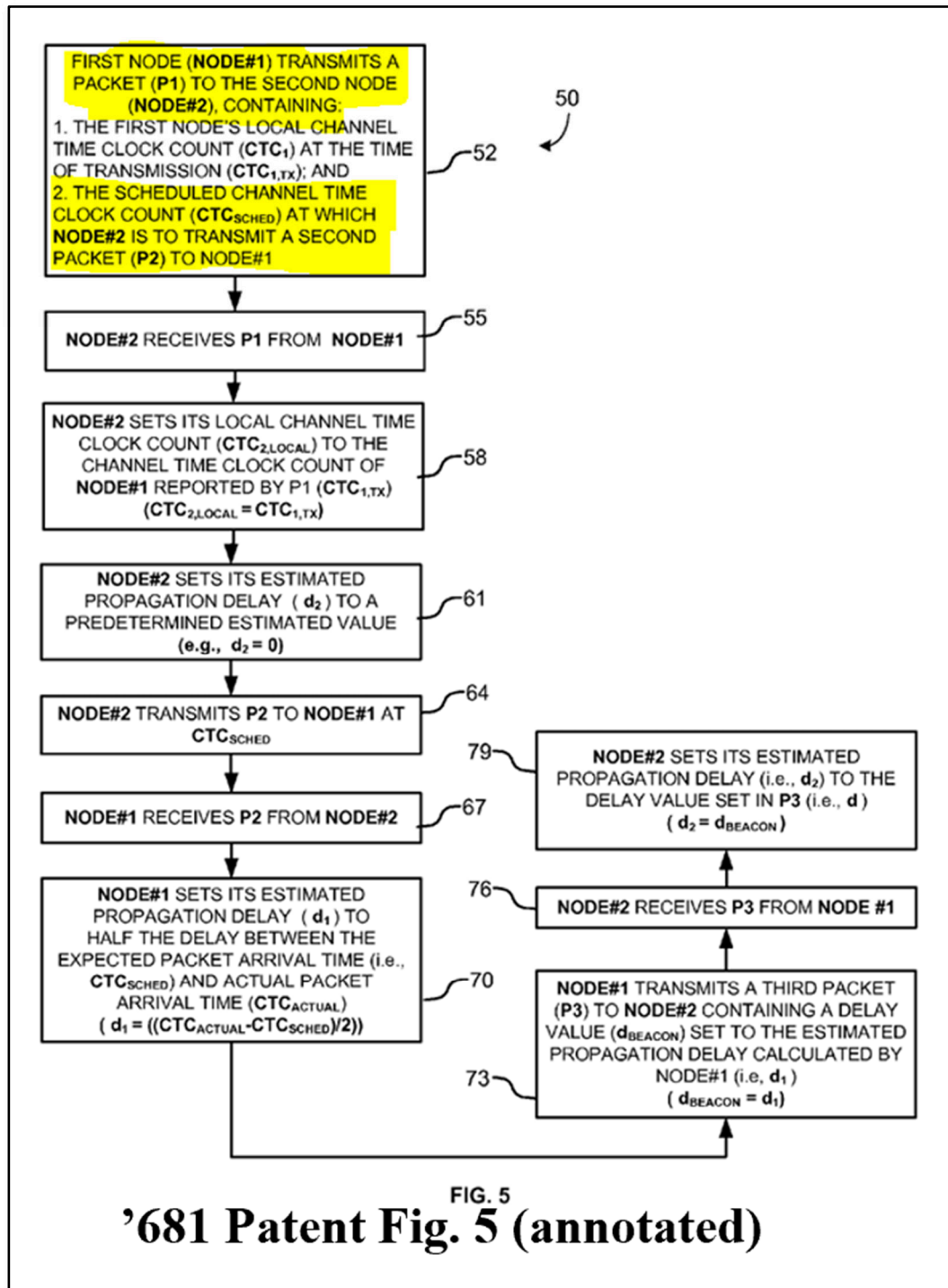
69. This is further evidenced by FIG. 64-31 of IEEE802.3ah, which depicts the contents of a “GATE message.” *Id.*, FIG. 64-31. As depicted below, the first packet clock time set to the local clock time of the first node at transmission time is marked in yellow, and the scheduled arrival clock time is marked in green. *Id.*



70. This is similar to the '681 Patent, which discloses a “first node (Node#1)” that transmits a first network packet P1 to a second node (Node#2),” where the “network packet P1 comprises:” “(2) a scheduled channel time clock count

at which Node#2 is to transmit a second network packet P2 to Node#1 (CTC_{SCHED}).”

DISH-1001, 6:50-7:1. This is depicted in FIG. 5 of the '681 Patent below:



71. The “GATE message” described by IEEE802.3ah meets the claimed limitation, which requires the transmission of a packet. The ’681 Patent defines “packet” broadly, explaining that it can be “one of several packet types, “including, but not limited to, data packets, control packets, and probe packets.” DISH-1001, 6:48-63. For example, a node may “communicate[] the schedule to each client node in ‘Media Access Packets’ (MAPs), where each MAP is a packet of information. *Id.*, 2:39-43. Similarly, the GATE message of IEEE802.3ah is a protocol data unit (PDU), including a header and a payload, that is sent at the Media Access Control (“MAC”) level; therefore, it is a data packet as described by the patent. DISH-1005, 463. Thus, a POSITA would understand that the “GATE message” in IEEE802.3ah is a “packet” within the meaning of the ’681 Patent and meets the “packet” limitation of the claim.

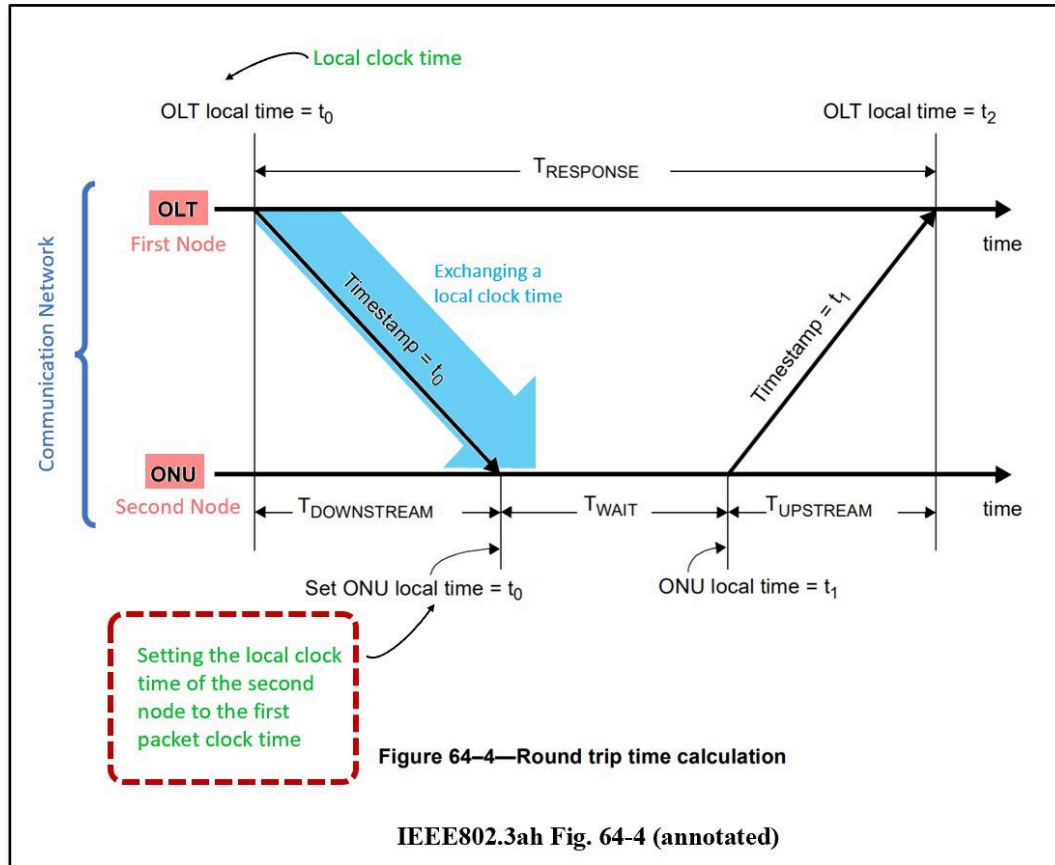
72. As a result, it is my opinion that IEEE802.3ah discloses this limitation.

[1.a.ii] “setting the local clock time of the second node to the first packet clock time;”

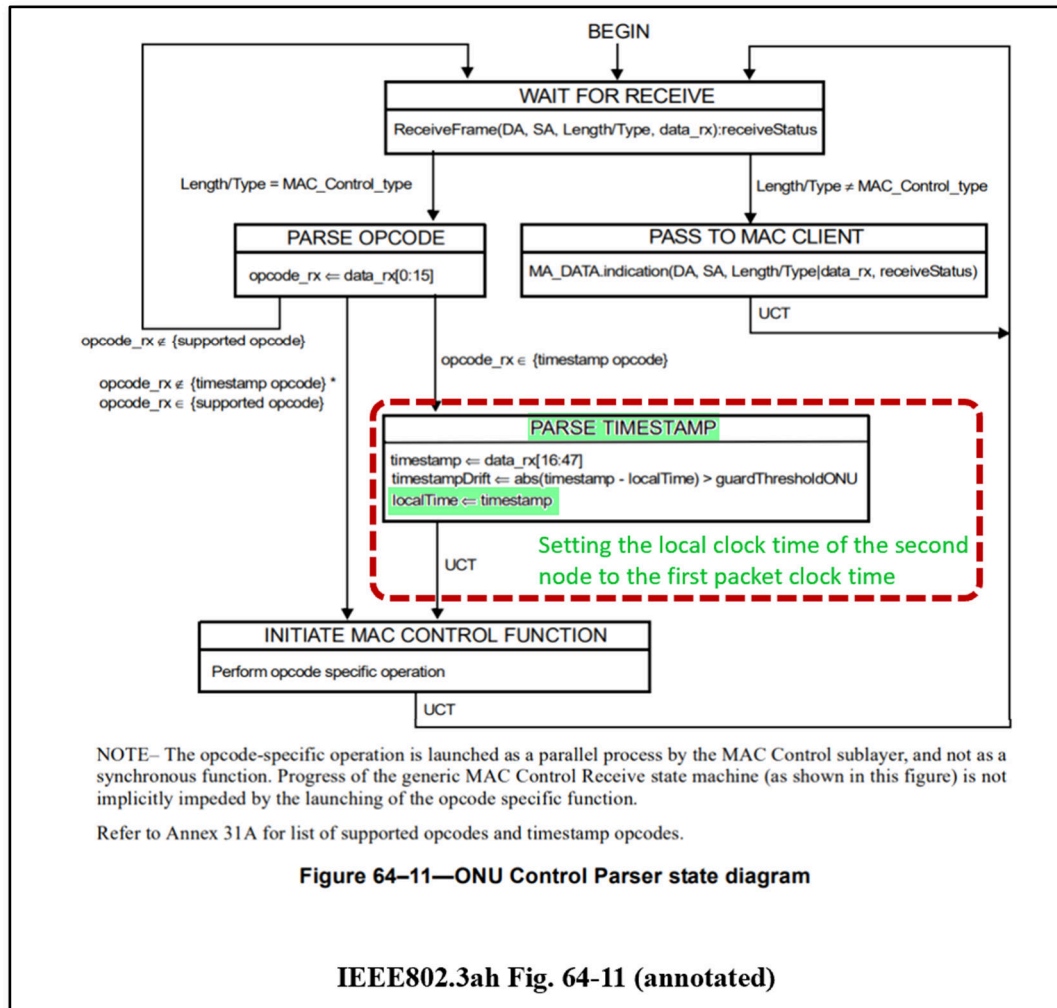
73. It is my opinion that IEEE802.3ah discloses this limitation.

74. As explained above, the OLT in IEEE802.3ah transmits its local time t_0 to an ONU. *See above*, ¶¶64-72. IEEE802.3ah further discloses that “[w]hen the ONU receives MPCPDUs, it sets its counter according to the value in the timestamp field in the received MPCPDU,” where the timestamp field maps the first node’s

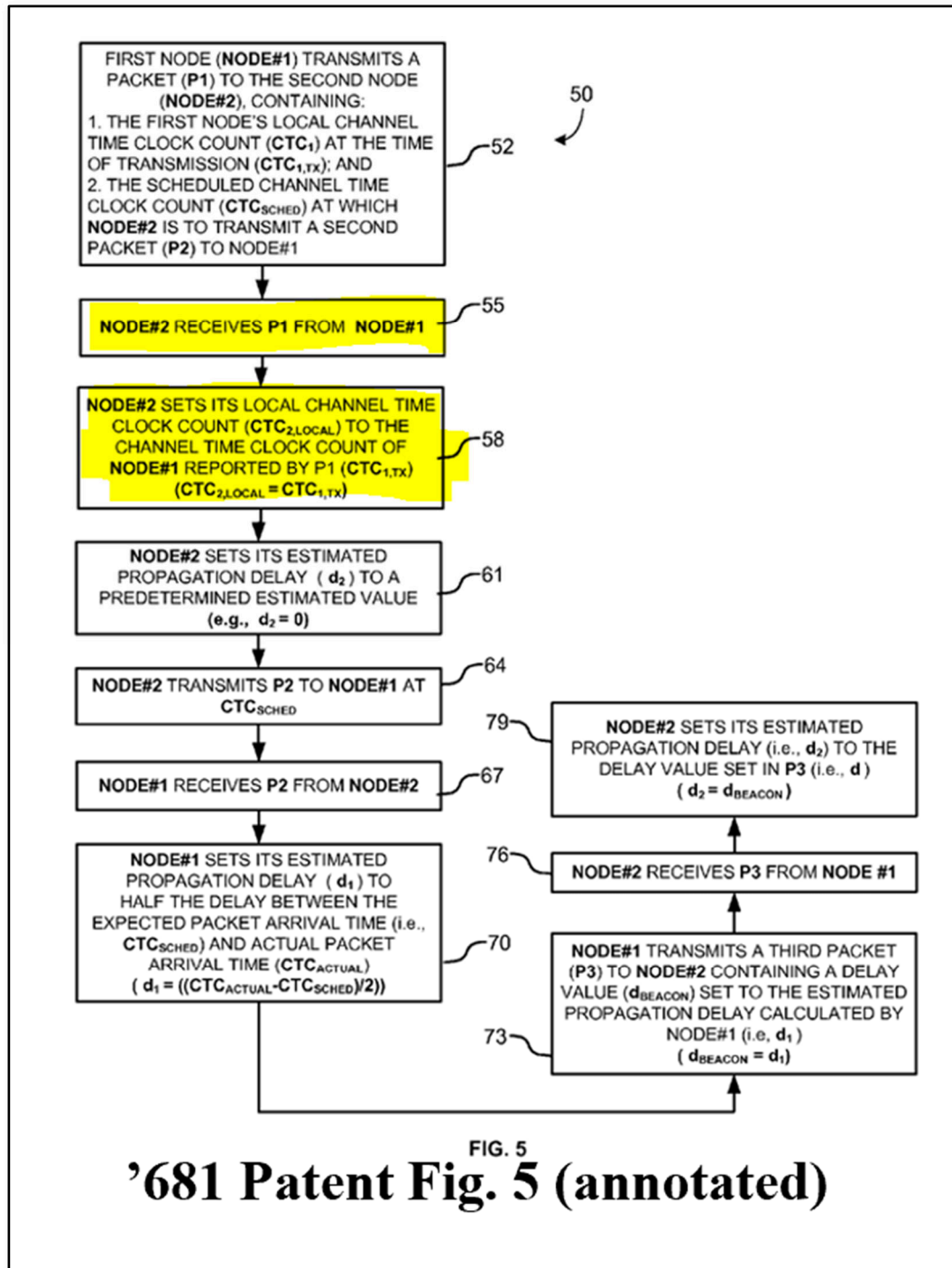
local clock time at the time of transmission. DISH-1005, 427. This is depicted pictorially in FIG. 64-4.



75. IEEE802.3ah includes another figure to reinforce the fact that the second node sets its local time to match the local clock time of the first node that it has received. When the ONU receives the message from the OLT, the ONU “parse[s] [the] timestamp” in the message and sets the ONU’s local time to be equal to the timestamp by marking “localTime <= timestamp.” *Id.*, FIG. 64-11.



76. This is similar to the '681 Patent, which states that “[a]fter Node#2 receives the network packet P1 from Node#1 (operation 55), Node#2 at operation 58 sets its local channel time clock count ($CTC_{2,LOCAL}$) to the channel time clock count of Node#1 as reported within P1 (i.e., $CTC_{1,TX}$). DISH-1001, 7:10-13. This is depicted in FIG. 5 of the '681 Patent below:



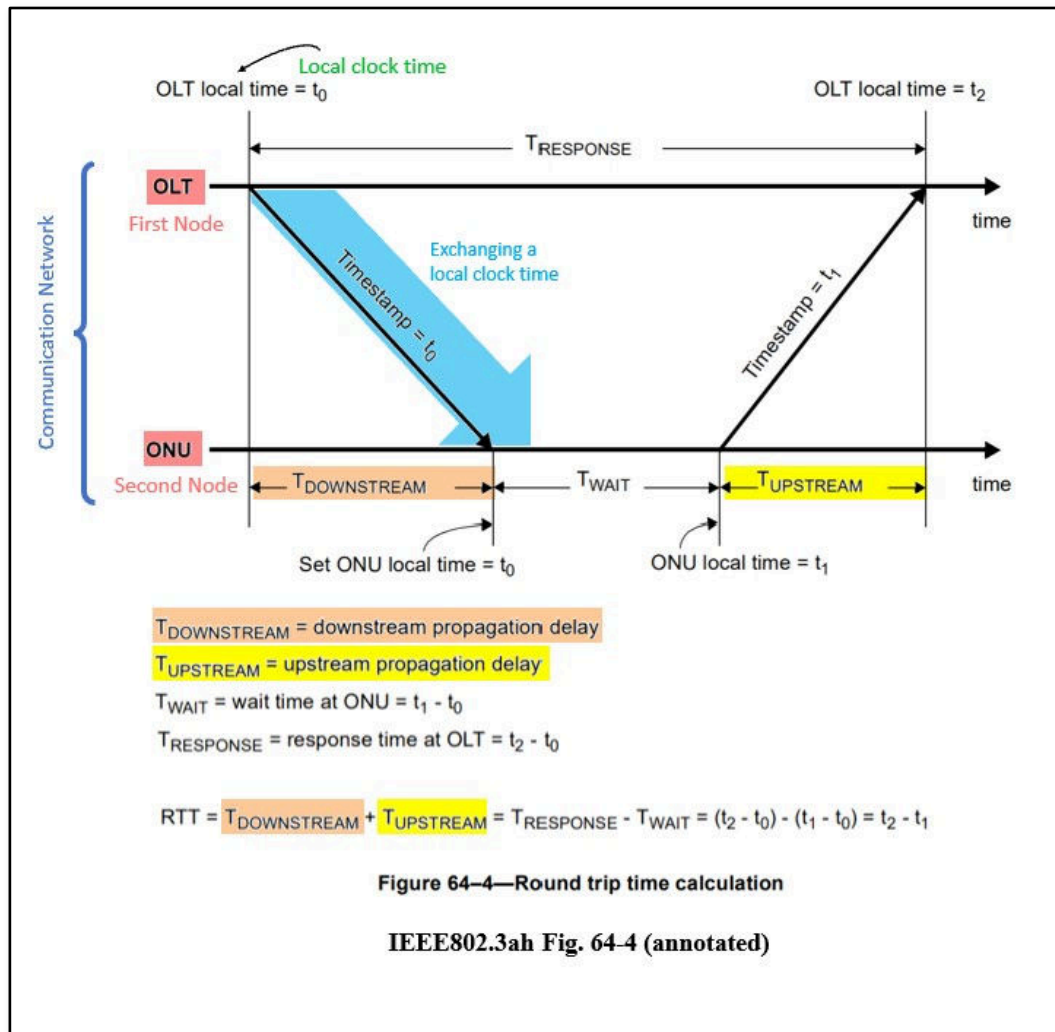
77. As a result, it is my opinion that IEEE802.3ah discloses this limitation.

[1.b] “performing a ranging method between the first and second nodes based on the local clock time exchanged, wherein the ranging method results in an estimated propagation delay between the first and second node, and wherein the ranging method comprises:”

78. It is my opinion that IEEE802.3ah discloses or renders obvious this limitation.

79. IEEE802.3ah teaches the use of “[r]anging,” which it defines as a “procedure by which the propagation delay between a master (e.g., OLT) and slave (e.g., ONU) is measured.” DISH-1005, 4. It further notes that the round trip delay computation is performed by the OLT, using the timestamp in MPCP [Multi-Point Control Protocol] messages from the ONU.” *Id.* The round trip time (also known as the round trip delay) is “equal to the difference between the timer value [the OLT’s local clock time when it receives a response from the ONU] and the value in the timestamp field [the local time at the ONU when the ONU was scheduled to respond].” *Id.*, 427. Notably, the value in the timestamp field is affected by the local time stamp exchanged in the first packet, as explained below in relation to limitation [1.b.i]. See below §VII(A)(2)[1.b.i]. Notably, the value in the timestamp field and, thus, the “ranging method between the first and second nodes,” is “based on the local timestamp exchanged” in the first packet as explained in [1.b.i]. Accordingly, IEEE802.3ah bases the ranging method on the local clock time exchanged between the OLT and the ONU.

80. As depicted in FIG. 64-4, the round-trip time is the sum of downstream propagation delay (time from node 1 to 2, Fig.64-4's $T_{\text{DOWNSTREAM}}$) and upstream propagation delay (time from node 2 to 1, Fig.64-4's T_{UPSTREAM}). *Id.*, FIG. 64-4. "The round-trip delay computation is performed by the OLT, using the timestamp in MPCP messages from the ONU." *Id.*, 4.



81. A POSITA would have understood that IEEE802.3ah's ranging method includes calculations of an estimated propagation delay because the downstream

propagation delay and the upstream propagation delay are included in RTT. *Id.*, 4. Thus, a POSITA would have understood IEEE802.3ah's ranging method to result in "an estimated propagation delay" (i.e., $T_{UPSTREAM}$ and $T_{DOWNSTREAM}$).

82. A POSITA would have understood that IEEE802.3ah's ranging method "results in an estimated propagation delay" based on the logic of the ranging procedure. In [1.a.ii], the ONU set its clock to the timestamp received in the first GATE message. That timestamp contained the time the OLT node sent the GATE message. Because the message took n seconds to travel from the OLT to the ONU node, the ONU node's clock will be n seconds later than the OLT's clock. Accordingly, a POSITA would have found it logical and obvious to synchronize OLT and ONU's clocks by adjusting ONU's clock by n (the time to travel from OLT to ONU i.e., the downstream propagation delay). The logic of IEEE802.3ah's ranging protocol dictates that propagation delay, not RTT, would be used.

83. A POSITA also would have found it obvious to implement a method resulting in "estimated propagation delay" in IEEE802.3ah. A POSITA would have understood that IEEE802.3ah at least suggests the use of an "estimated propagation delay" in its ranging method based on its RTT calculation including these characteristics. Further, a POSITA would have understood that implementing such a method would allow the system to adjust the local clock by precisely the amount of time that the OLT and ONU's clocks differ. A POSITA would have had a

reasonable expectation of success in implementing a “ranging method [that] results in an estimated propagation delay” in IEEE802.3ah because a POSITA would have understood such a “ranging method” was already calculated by IEEE802.3ah. A POSITA would also have understood that either the downstream propagation delay or the upstream propagation delay in IEEE802.3ah could be the claimed “propagation delay,” particularly in light of Figure 64-4, because propagation delay is necessarily calculated for the ranging procedure. A POSITA would have found it obvious to rely on IEEE802.3ah’s ranging procedure to output downstream and upstream propagation delays. *Id.*

84. As a result, it is my opinion that IEEE802.3ah discloses or renders this limitation obvious.

[1.b.i] “transmitting a second packet from the second node to the first node, wherein the second packet is transmitted from the second node at the scheduled arrival clock time, and wherein the second packet is received by the first node at an actual arrival clock time,”

85. It is my opinion that IEEE802.3ah discloses or renders obvious this limitation.

86. As described above in relation to claim limitation [1.a.i], the ranging procedure disclosed in IEEE802.3ah includes a network node synchronization procedure that relies on ranging which is initiated when an OLT node sends a GATE message to an ONU node. *See above*, ¶¶64-72. The GATE message includes a “scheduled arrival clock time,” which refers to a time when the ONU node is

instructed to respond. *See id.*; *see also* DISH-1005, 4 (explaining that the GATE message instructs the ONU “to transmit at a specific time”). Specifically, the “ONU will begin transmission when its localTime counter matches [the] start_time value indicated in the GATE message.” DISH-1005, 455. For example, the unicast channel messages during the discovery handshake are sent by the ONU when its local clock is equal to the grant start time. *Id.*, Figs. 64-14, 64-29.

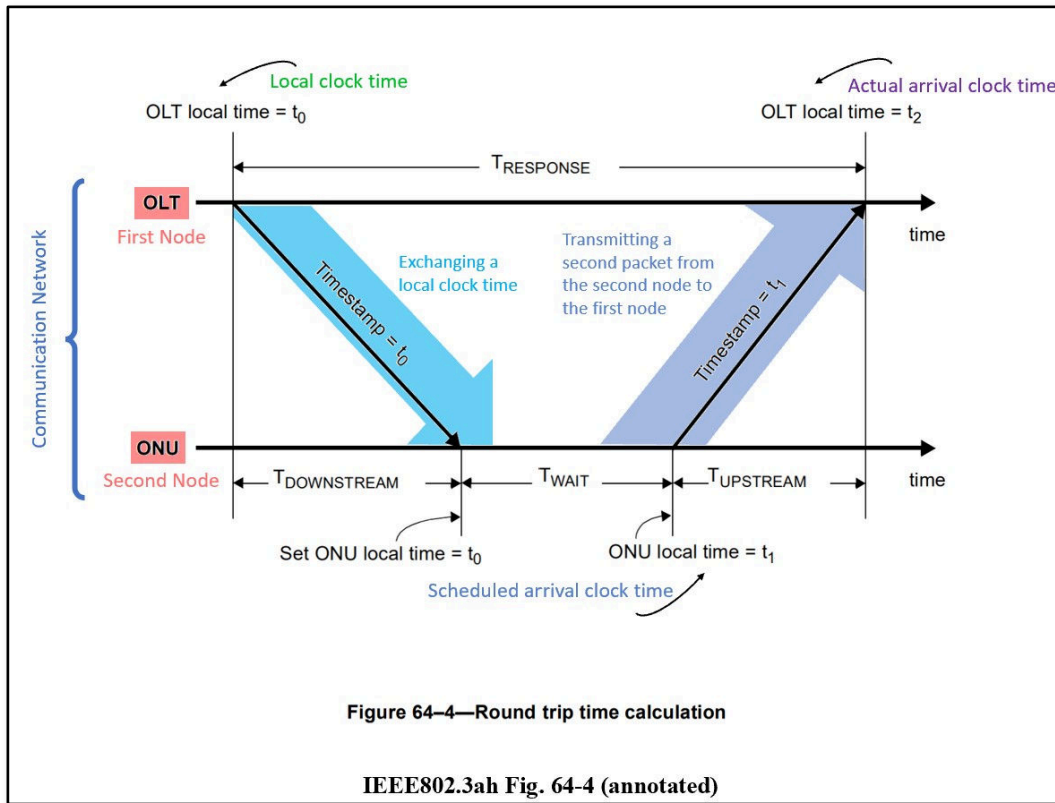
87. Like all messages from ONUs, this message is transmitted to the OLT. *Id.*, 421 (“In the upstream direction (from the ONUs to the OLT), the signal transmitted by an ONU would only reach the OLT, but not other ONUs.”). Accordingly, the ONU is instructed to transmit a responsive packet (the second packet from the second node to the first node) at the grant “start_time” (the scheduled arrival clock time).

88. Thus, based on the instructions from the OLT in the GATE message, the ONU transmits a responsive packet from the ONU (the claimed second node) to the OLT (the claimed first node) at the “start_time value” (the claimed scheduled arrival clock time). *Id.*

89. Because MPCPDU messages map the local time at which they are sent to the timestamp field, and the second packet is instructed to be sent at the “scheduled arrival clock time,” this second packet will include the original “scheduled arrival clock time” in its timestamp field. *Id.*, 427, 465. Indeed, that

start_time is included in the responsive packet sent by the second node as its timestamp. The ONU sends MPCPDU messages as part of ranging. *Id.*, 427 (describing that “the OLT receives MPCPDU” from ONUs during ranging). When a node “transmits an MPCPDU, it maps its counter value into the timestamp field.” DISH-1005, 427. Because the responsive packet was sent at the start_time communicated via the GATE message, the responsive packet will include the start_time in its time-of-sending timestamp. DISH-1005, 427.

90. After the second packet leaves the ONU, it takes time (i.e., the upstream propagation delay $T_{UPSTREAM}$) for the second packet to arrive at the OLT. *Id.*, FIG. 64-4. As depicted in FIG. 64-4 below, when the second packet leaves the ONU at t_1 local time, it arrives at the OLT at local time t_2 (i.e., an actual arrival clock time). *Id.*

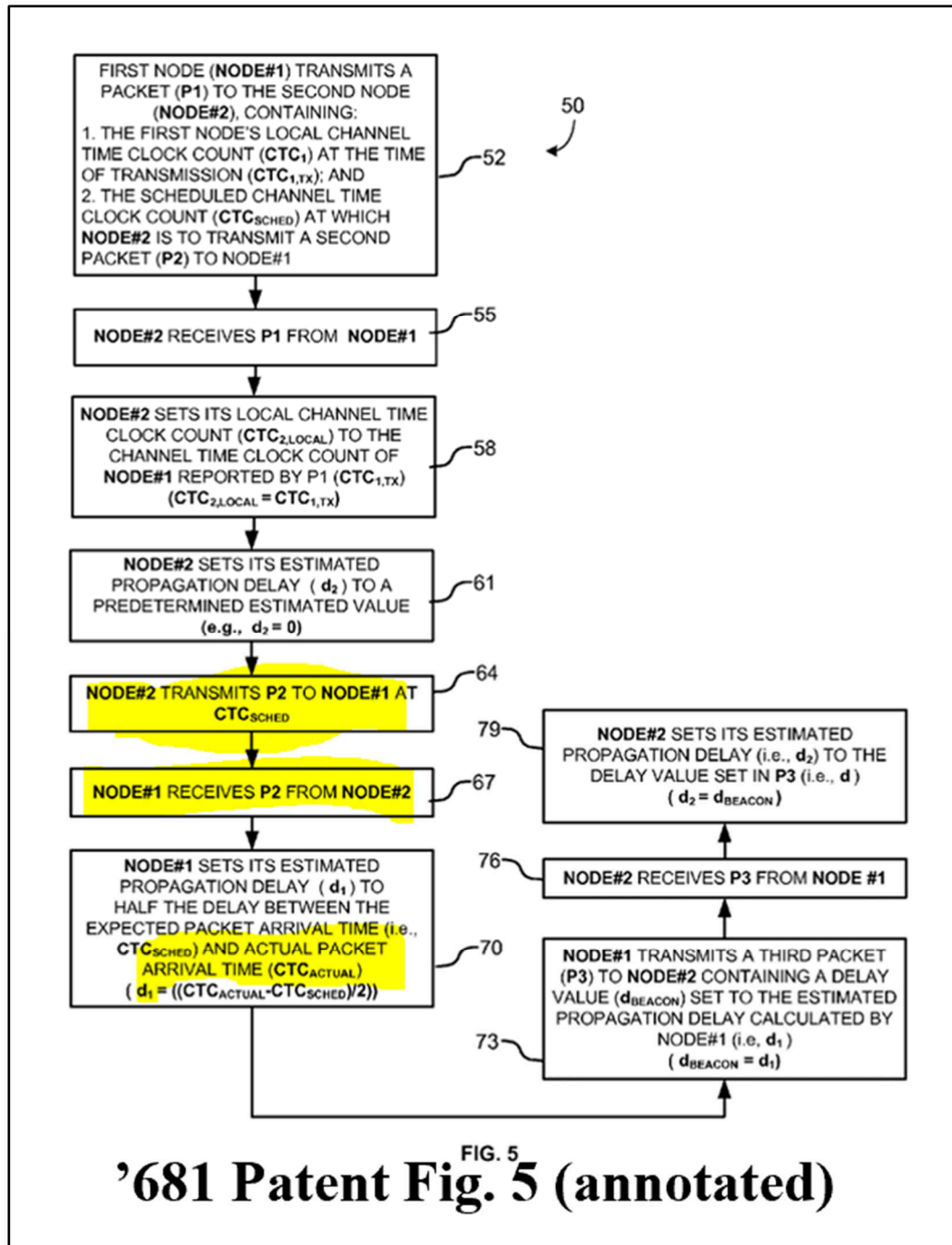


See also *id.*, 427 (“When the OLT receives MPCPDUs, it uses the timestamp value [corresponding to the scheduled arrival clock time] to calculate or verify a round-trip time between the OLT and the ONU. The RTT is equal to the difference between the timer value [corresponding to the actual arrival clock time] and the value in the timestamp field [corresponding to the scheduled arrival clock time].”).

91. Figure 64-4 depicts the second packet being sent from the ONU to the OLT, showing that this second packet will be sent at the scheduled arrival clock time (t_1) and arrive at the second node (OLT) at the actual arrival clock time (t_2). A POSITA would have understood that t_2 corresponds to the claimed “actual arrival

clock time” because it is the first node’s clock time when the second message actually arrives.

92. This is similar to the '681 Patent, in which “Node #2 then transmits a network packet P2 to Node#1 at the scheduled channel time clock count (CTC_{SCHED}) indicated in network packet P1,” and Node #2 then notes the “actual packet arrival time (CTC_{ACTUAL}).” DISH-1001, 7:16-24. This is depicted in FIG. 5 of the '681 Patent below:



93. As a result, it is my opinion that IEEE802.3ah discloses or renders this limitation obvious.

[1.b.ii] “calculating and storing the estimated propagation delay at the first node, wherein calculating the estimated propagation delay is based on the scheduled arrival clock time and the actual arrival time, and”

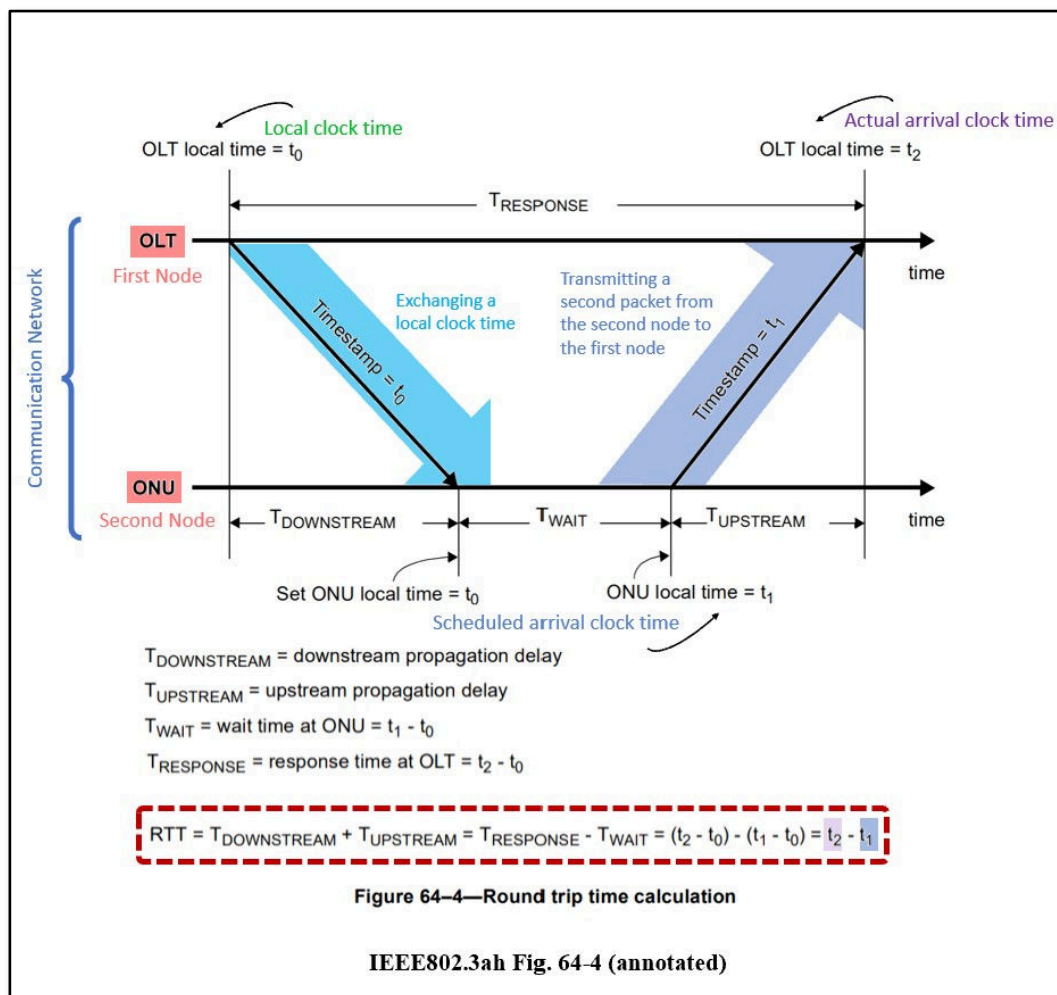
94. It is my opinion that IEEE802.3ah renders obvious this limitation.

95. As discussed above in [1.b], IEEE802.3ah teaches ranging to measure RTT and, included therein, propagation delay. As discussed in [1.b], calculating and using propagation delay would have been understood and is rendered obvious by IEEE802.3ah.

96. IEEE802.3ah’s OLT (the first node) calculates RTT, which includes propagation delay, based on “scheduled arrival clock time” (t_1) and “actual arrival clock time” (t_2). DISH-1005, FIG. 64-4. IEEE802.3ah notes that the round trip delay computation is “performed by the OLT” (where the OLT is the first node), using the timestamp in MPCP messages from the ONU.” DISH-1005, 4. The round trip time (also known as the round trip delay) is “equal to the difference between the timer value and the value in the timestamp field.” *Id.*, 427. The timer value refers to the OLT’s local clock time when it receives a response from the ONU (i.e., the actual arrival time, and the value in the timestamp field refers to the ONU’s local clock time when the ON was scheduled to respond (i.e., the scheduled arrival clock time). *Id.* As discussed above with respect to [1.b.i], the “timestamp in MPCP messages from the ONU” corresponds to the “scheduled arrival clock time.” Specifically, ONU generates t_1 when the second packet is transmitted. DISH-1005,

427. The second packet is transmitted at the “grant start time” transmitted by OLT.
Id., 455. These values correspond to the “scheduled arrival clock time” of the claims because they are the response time transmitted by OLT and the time that ONU actually responded.

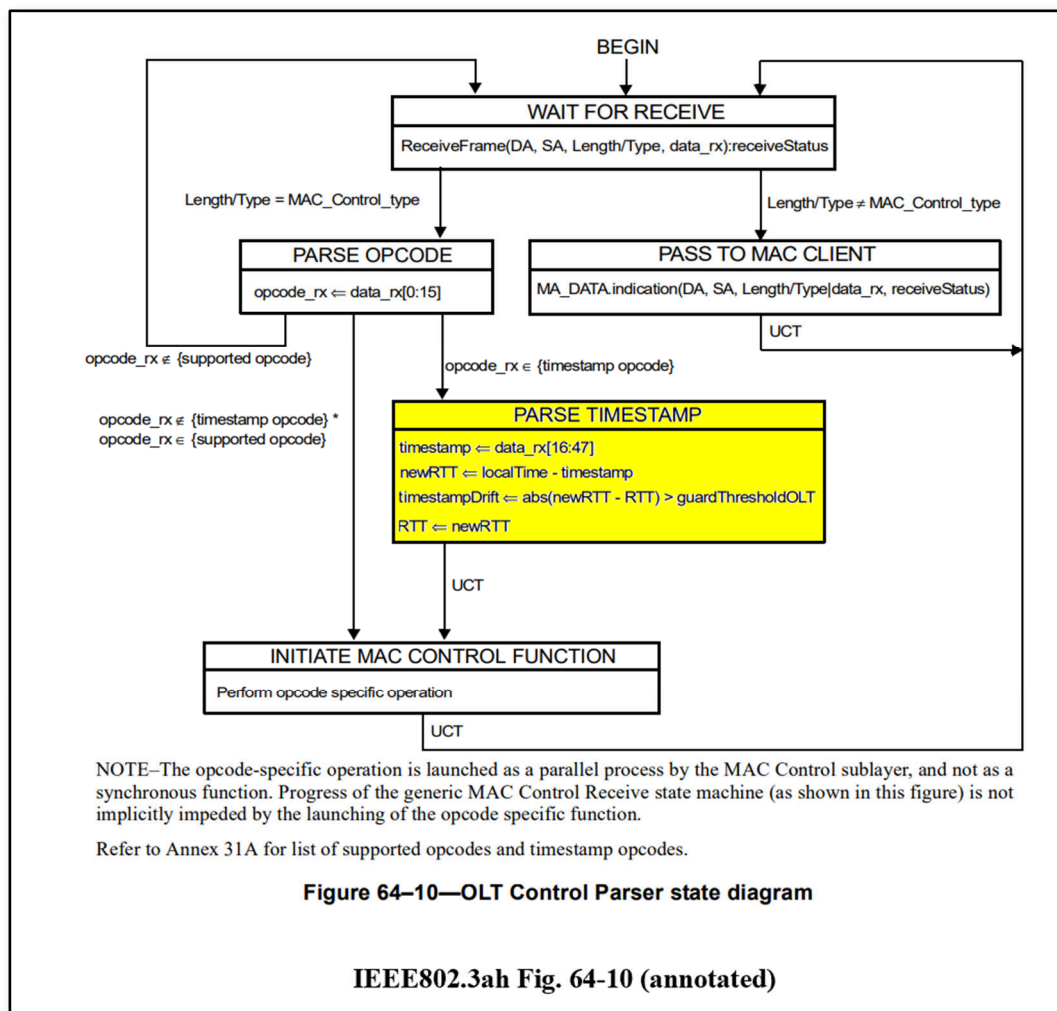
97. The two delays (the downstream propagation delay and the upstream propagation delay) are depicted in FIG. 64-4 as shown below:



98. Thus, a POSITA would have understood that the calculation of propagation delay in IEEE802.3ah is performed at the OLT and is based on the timer

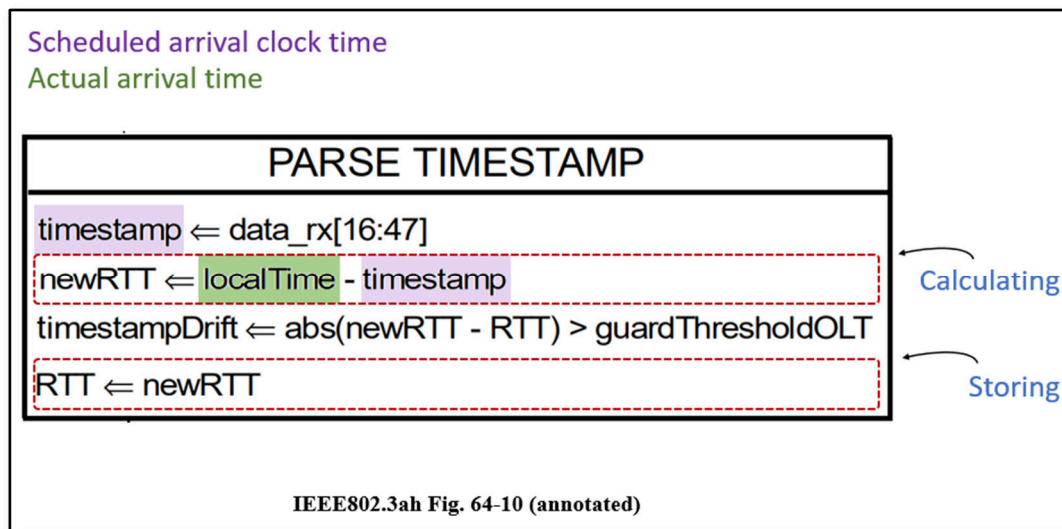
value (i.e., the scheduled arrival clock time) and the value in the timestamp field in the second packet (i.e., the actual arrival time).

99. Figure 64-10 details the calculation of RTT. OLT calculates variable “newRTT” by subtracting “timestamp” (t_1) from “localTime” (t_2) and then stores the result in “RTT.” DISH-1005, Fig.64-10. As discussed in [1.b.i], localTime is the “actual arrival clock time” and the second packet’s timestamp corresponds to the “scheduled arrival clock time.”



As discussed above, localTime indicates the actual arrival time and the timestamp corresponds to the scheduled arrival time.

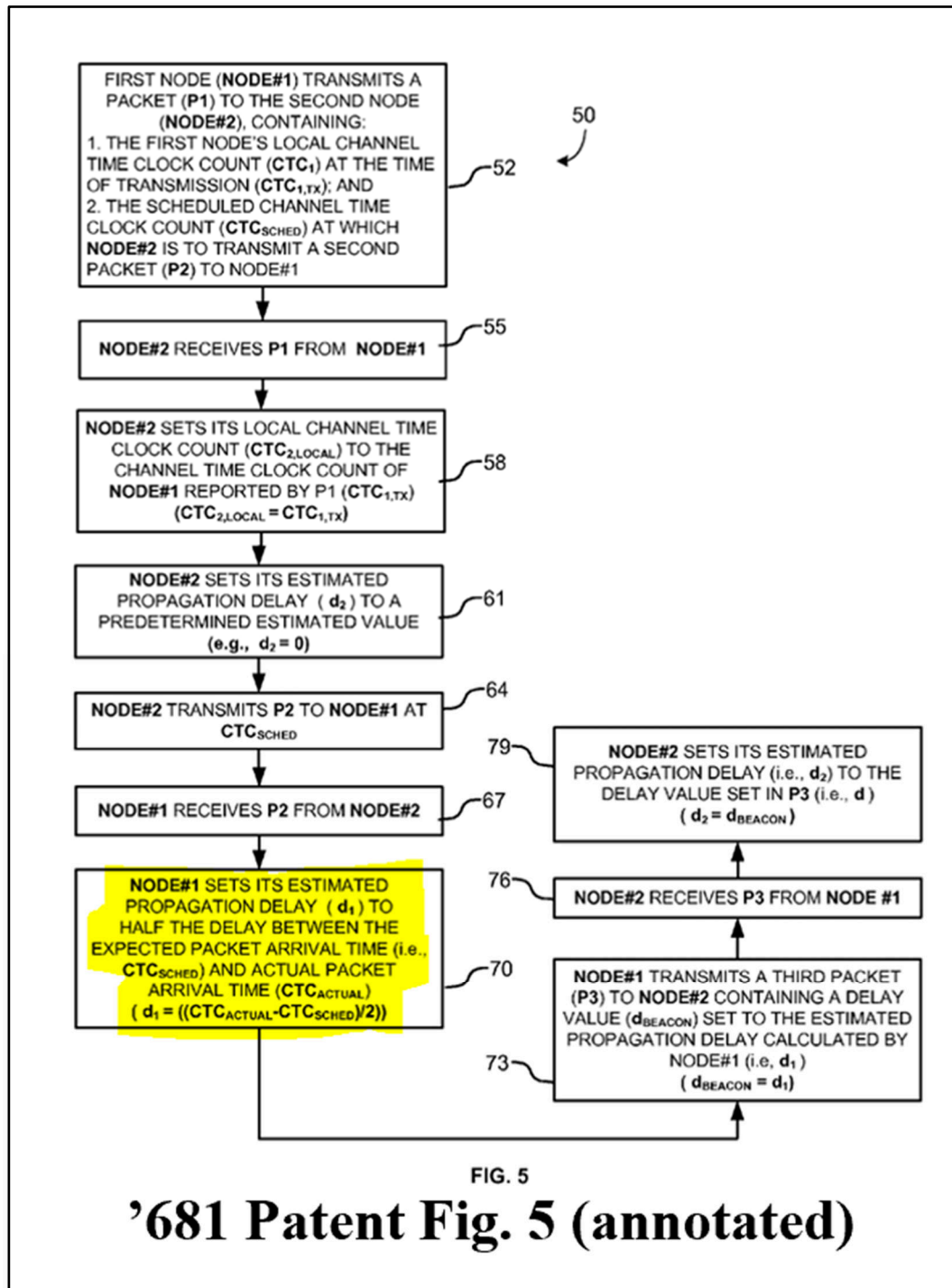
100. As depicted in FIG. 64-10, when the newRTT value has been calculated based on the localTime and the timestamp, the “newRTT” value is then stored in the “RTT variable.”



101. FIG. 64-10 therefore makes clear that RTT (which includes upstream and downstream propagation delays) is stored at OLT. For example, the RTT “variable holds the measured Round Trip Time to the ONU.” *Id.*, 432. A POSITA, therefore, would have understood IEEE802.3ah to disclose “storing the estimated propagation delay at the first node. *Id.*, FIG. 64-10.

102. This is similar to the '681 Patent, in which “Node#1 sets its estimated propagation delay (d_1) to half delay between the expected packet arrival time ($\text{CTC}_{\text{SCHED}}$) and the actual packet arrival time ($\text{CTC}_{\text{ACTUAL}}$). Accordingly, $d_1 =$

$(CTC_{ACTUAL} - CTC_{SCHED})/2$.” DISH-1001, 7:20-28. The propagation delay can be stored locally at the first node as d_1 . *Id.*, 7:31-32. This is depicted in FIG. 5 of the '681 Patent below:



103. It also would have been obvious to a POSITA to store the estimated propagation delay at the first node. A POSITA would have been motivated to store IEEE802.3ah's propagation delay because it would have been needed for subsequent use as described in [1.b]. A POSITA would have experienced a reasonable expectation of success in implementing this functionality based on IEEE802.3ah's teaching of storing RTT.

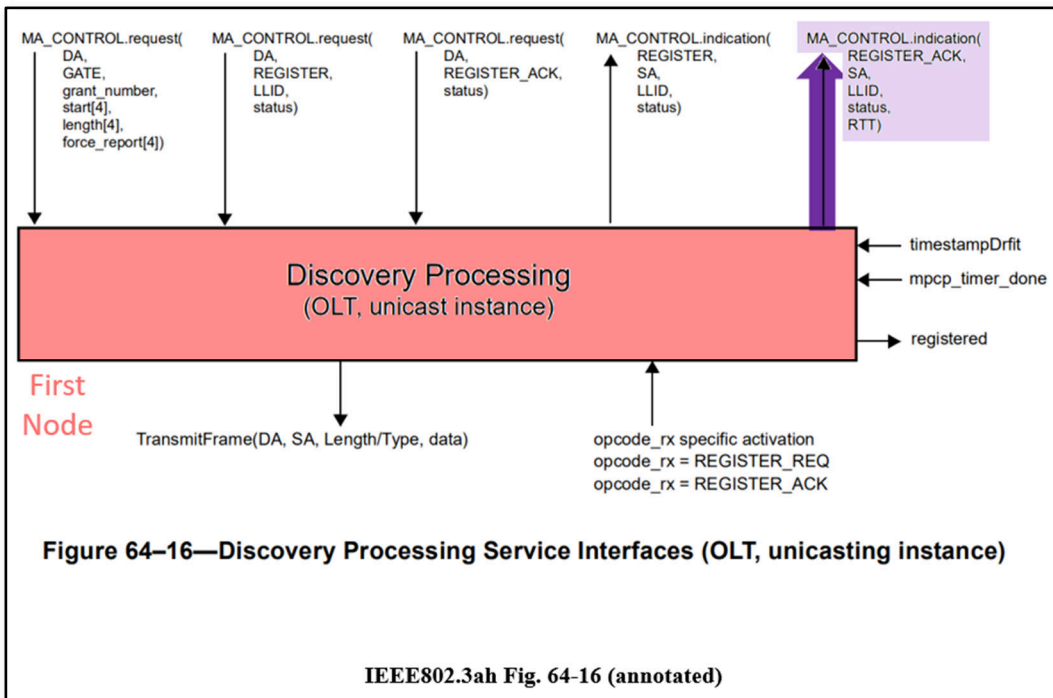
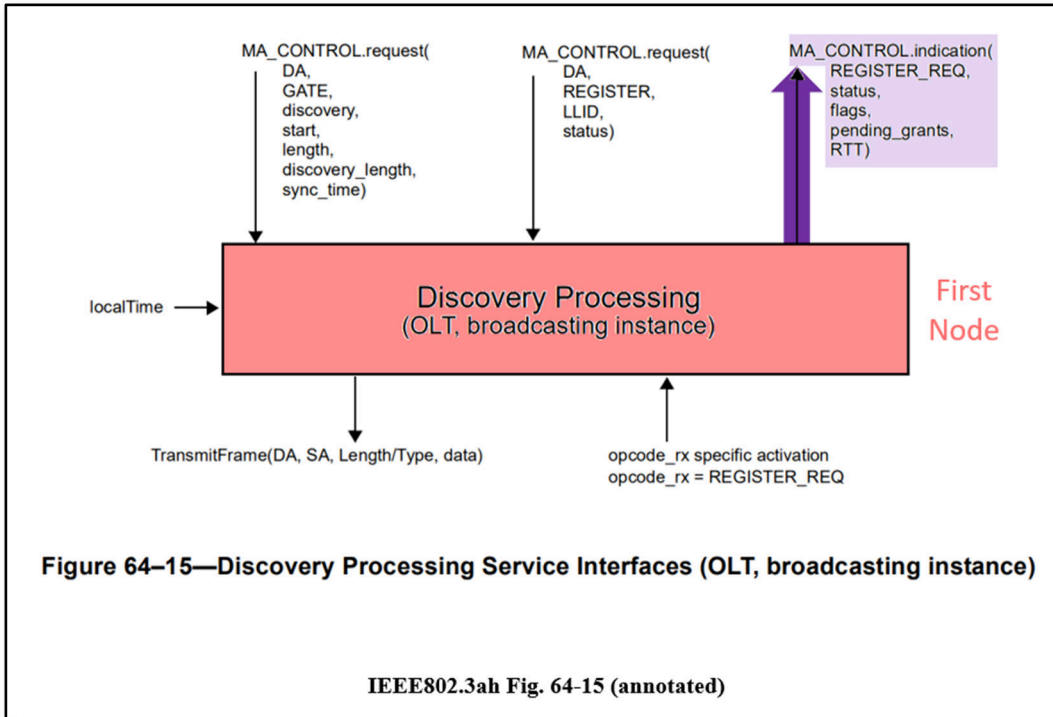
104. As a result, it is my opinion that IEEE802.3ah renders this limitation obvious.

[1.b.iii] “transmitting a third packet from the first node to the second node, wherein the third packet comprises the estimated propagation delay; and”

105. It is my opinion that IEEE802.3ah renders obvious this limitation.

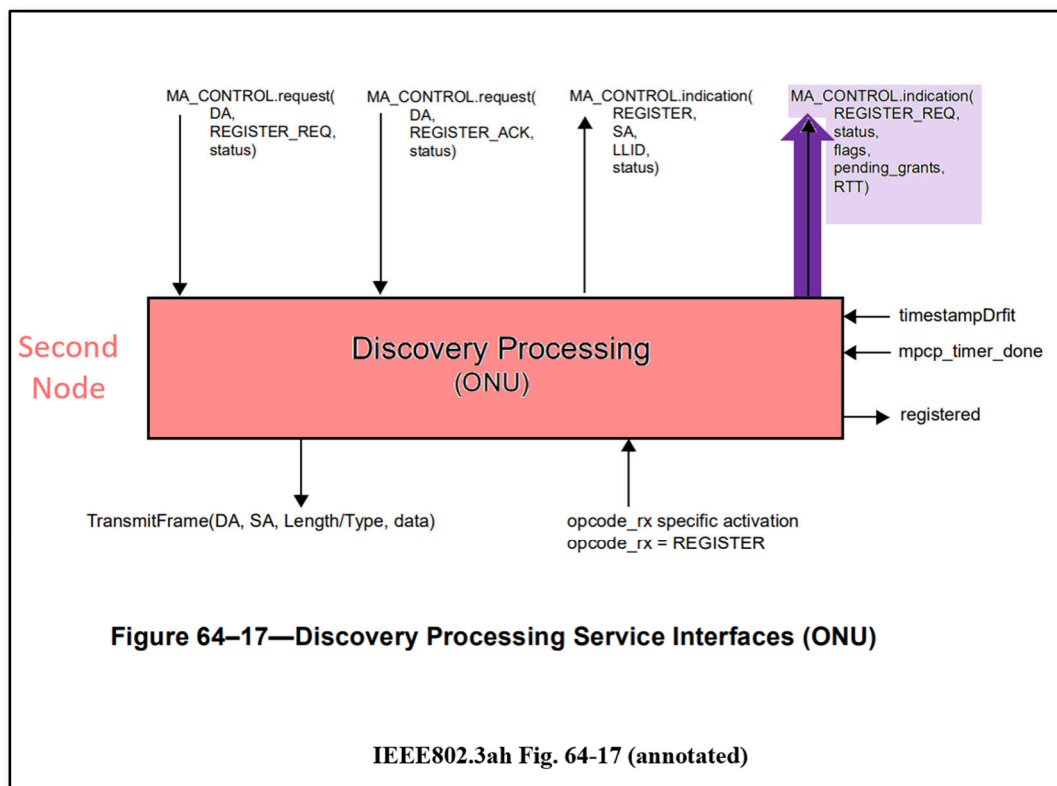
106. IEEE802.3ah states that after the RTT (round trip time) is calculated, the RTT value is “notified to the client via the MA_CONTROL.indication primitive,” such that “client can use this RTT for the ranging process.” DISH-1005, 427. The primitive is “issued by the Discovery Process to notify the client.” *Id.*, 446.

107. This is shown by Figures 64-15 and 64-16.



108. IEEE802.3ah clarifies the contents of these primitive messages, explaining that they are “generated by the Discovery Process in the OLT” and include “[t]he measured *round trip time* to/from the ONU.” *Id.*, 446.

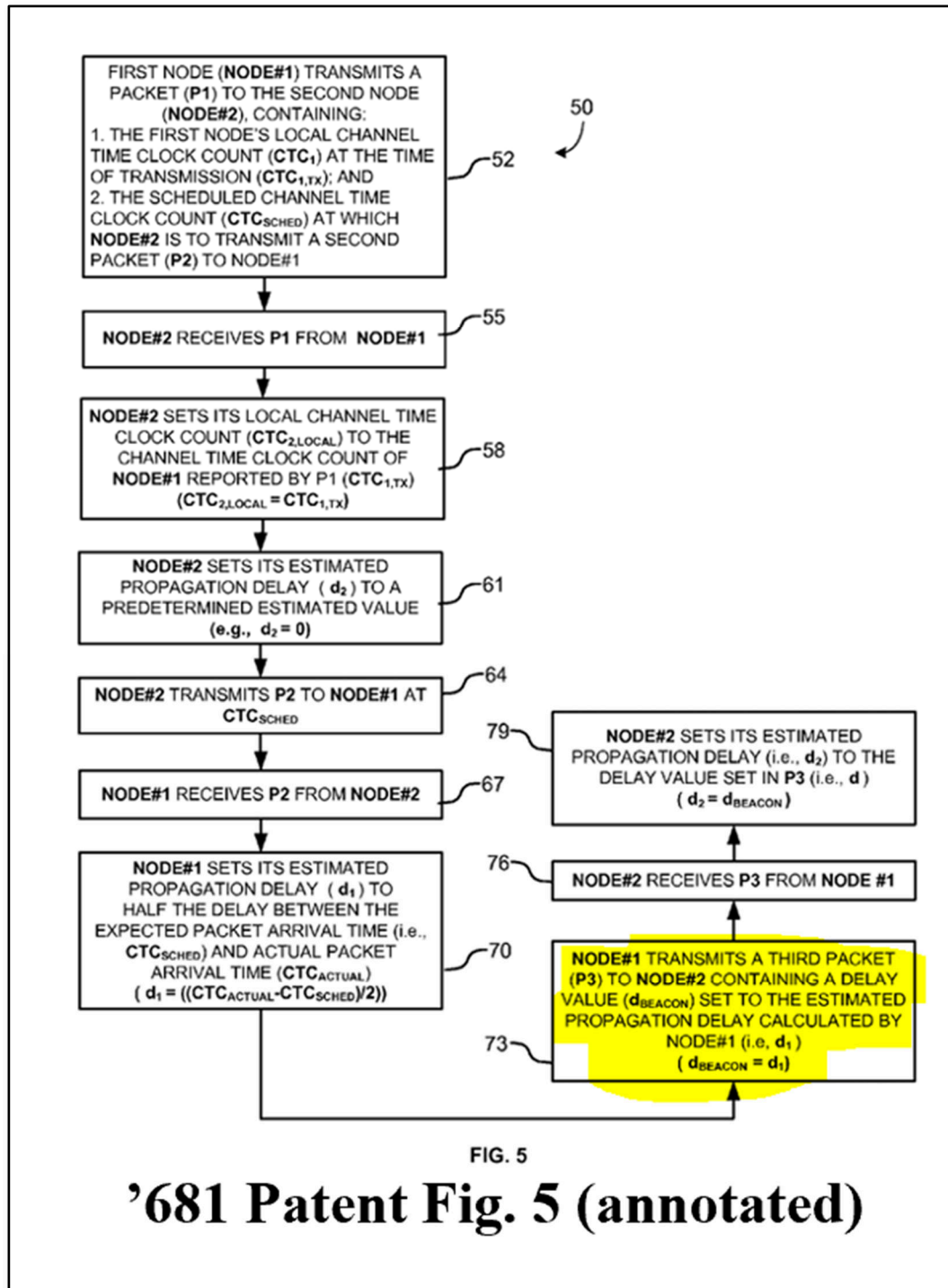
109. Additionally, Figure 64-17 teaches that the ONU node can also possess RTT and also can notify that value via the MA_CONTROL.indication. DISH-1005, Fig. 64-17.



110. A POSITA would have understood that, in order for the ONU node to possess the calculated RTT, the OLT node must transmit it. IEEE802.3ah is clear that “[w]hen *the OLT* receives MPCPDUs, *it* uses the received timestamp value to calculate or verify a round trip time between the OLT and the ONU.” DISH-1005,

427. Accordingly, a POSITA would have understood that the OLT node necessarily transmits RTT to ONU as part of a “third packet” (after it has been measured) for ONU to possess it. DISH-1007 ¶¶27,34 (disclosing the propagation of timing information).

111. This is similar to the '681 Patent, which states that “Node#1 then transmits this calculated estimated propagation delay (d_1) to Node#2 in a third network packet,” where the “third network packet P3 stores the calculated delay (d_1).” DISH-1001, 7:29-34. This is depicted in FIG. 5 of the '681 Patent below:



112. A POSITA would have found “transmitting a third packet ... compris[ing] the estimated propagation delay,” obvious. As discussed above, a POSITA would have understood it to be required to “transmit ... the estimated

propagation delay” to ONU for ONU to know what that propagation delay was. *See* above, ¶110. This system would have been more efficient because the ONU would be informed of the propagation delay between the nodes and would have used it for subsequent transmissions. A POSITA would have reasonably expected success because, as discussed above, IEEE802.3ah already disclosed transmitting from OLT to ONU.

113. As a result, it is my opinion that IEEE802.3ah renders this limitation obvious.

[1.c] “adjusting the local clock time of either the first or second node based on the estimated propagation delay, thereby resulting in a synchronized local clock time between the first and second node.”

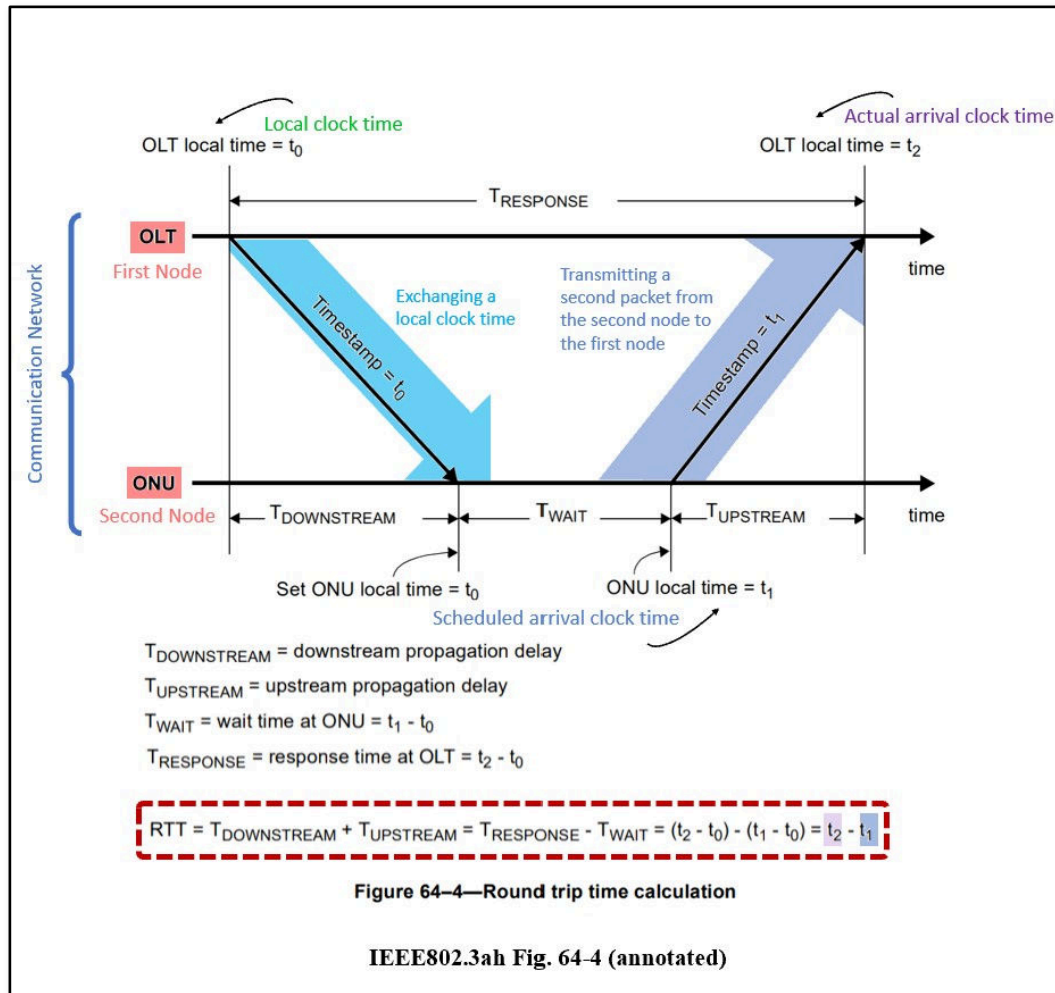
114. It is my opinion that IEEE802.3ah renders obvious this limitation.

115. IEEE802.3ah states that nodes in the IEEE802.3ah network perform “[c]ontinuous ranging for compensating round trip time variation” to ensure that nodes’ local clocks remain synchronized. DISH-1005, 422. This synchronization is the result of the ranging process. *Id.*, 427. After the RTT (round trip time) is calculated, the RTT value is “notified to the client via the MA_CONTROL.indication primitive,” such that “client can use this RTT for the ranging process.” DISH-1005, 427.

116. A POSITA would have understood that, to compensate for propagation delay, which has caused the local clock at ONU to be offset by the time taken for the

GATE message to be transmitted from the OLT to the ONU, at least one of the nodes' local clocks would have to be adjusted. Indeed, without the adjustment of the ONU's local clock time, the output of the ranging process would not be applied to the nodes. As described above, this adjustment necessarily relies on either the downstream propagation or upstream propagation delay, not the round-trip time value. Accordingly, IEEE802.3ah renders obvious the adjustment of the local clock time of at least one of the nodes based on the propagation delay, thus synchronizing the clocks of the first and second nodes.

117. In Figure 64-4, the local clock time of the ONU is set to t_0 , (i.e., the time according to OLT that OLT transmitted the GATE message) immediately upon receipt of the message. DISH-1005, Fig.64-4. Because the GATE message took some time to travel from OLT to ONU, OLT will no longer be at time t_0 . The difference in their local clocks will be the time it took to travel from OLT to ONU, i.e., downstream propagation delay. The difference will not be the time it takes to travel from OLT to ONU and back to OLT, i.e., RTT. It thus would have been obvious to a POSITA to adjust the local clock time of a node using propagation delay instead of RTT .

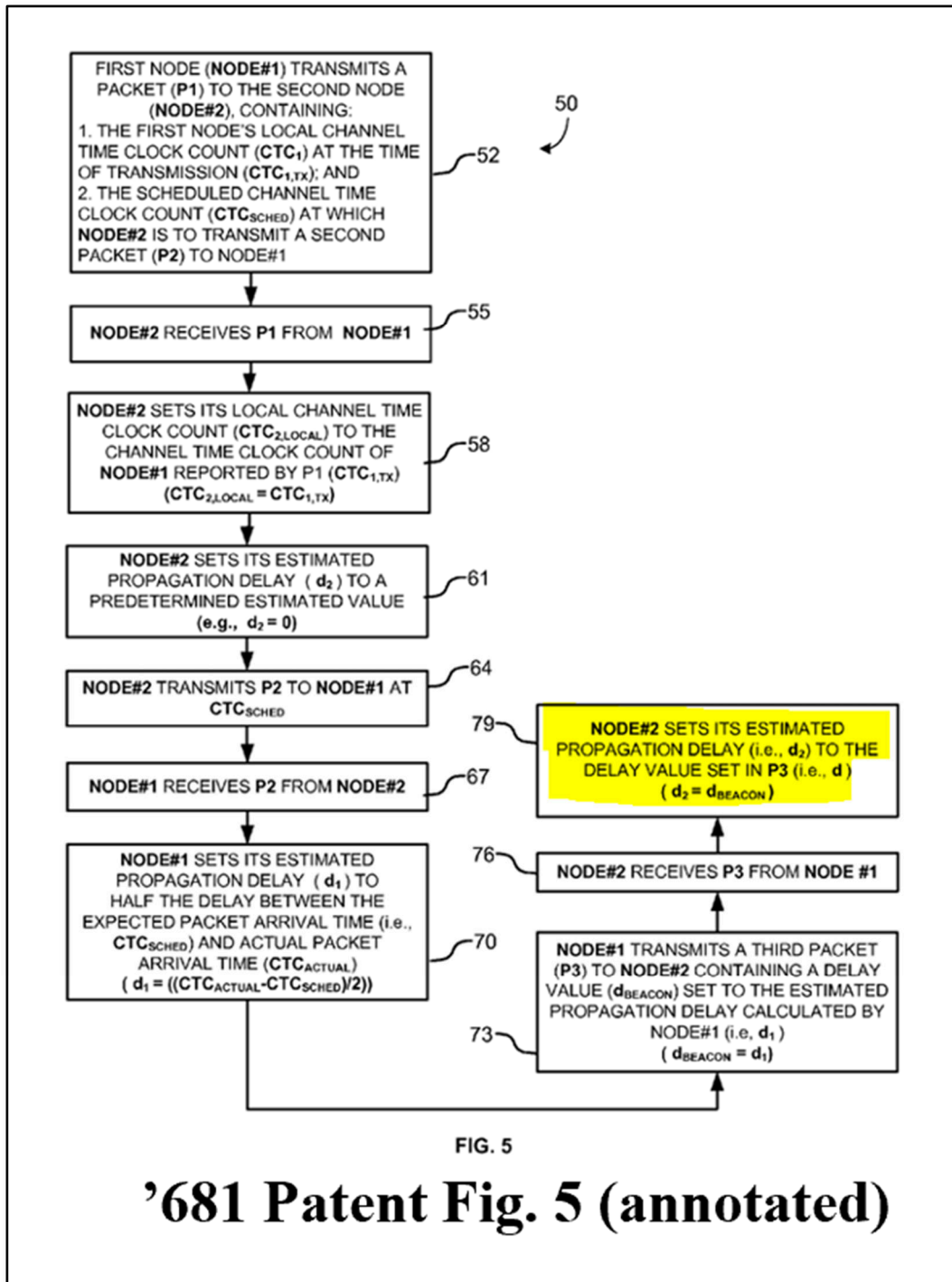


118. A POSITA further would have understood that IEEE802.3ah contemplates synchronizing local clock times between the nodes based on IEEE802.3ah's Report Processing functionality. For example, IEEE802.3ah teaches that "[f]ine control of the network bandwidth distribution can be achieved using feedback mechanisms supported in the Report Processing function." DISH-1005, 439. This Report Processing mandates that "Reports shall be generated periodically, even when no request for bandwidth is being made. This keeps a watchdog timer in the OLT from expiring and deregistering the ONU. For proper operation of this

mechanism the OLT shall grant the ONU periodically.” *Id.* 452. A POSITA would have understood that this teaches a periodic synchronization using the range procedure discussed above and, as a result, that synchronization between the node clocks was required.

119. A POSITA would have had a reasonable expectation of success in adjusting the first or second node by the propagation delay because IEEE802.3ah already describes adjusting the local clock of the ONU (described in [1.a.ii]). Therefore, a POSITA would have understood that the first or second node’s local clock could have been further adjusted by the propagation delay (i.e., substitution of one known element—propagation delay plus timestamp—for another—timestamp—to obtain predictable results).

120. This is similar to the ’681 Patent, which states that “Node#2 can accurately synchronize its local channel time clock count (CTC₂) to that of Node#1 (CTC₁).” DISH-1001, 7:44-46. This is depicted in FIG. 5 of the ’681 Patent below:



121. As a result, it is my opinion that IEEE802.3ah renders this limitation obvious.

122. For the reasons discussed above, IEEE802.3ah therefore renders obvious claim 1.

3. Dependent Claim 2

[2] “The method of claim 1, further comprising using the synchronized local clock time in subsequent packet transmissions between the first and second nodes.”

123. It is my opinion that IEEE802.3ah discloses claim 2.

124. A POSITA would understand that IEEE802.3ah’s ranging procedure, which is described above, allows for the clock times—or counter values—across nodes to remain synchronized, as described in analyzing claim 1 above. As a result of this synchronization, all future messages will include synchronized timestamps. Specifically, IEEE802.3ah teaches that, when either OLT or ONU “transmits an MPCPDU, it maps its counter value into the timestamp field.” DISH-1005, 4, 427. Accordingly, each time a message is sent following synchronization, that message will include the synchronized local clock time in the timestamp field. Therefore, the synchronized local clock time would be used in subsequent packet transmissions.

125. As a result, it is my opinion that IEEE802.3ah discloses this claim.

4. Dependent Claim 3

[3] “The method of claim 1, wherein adjusting the local clock times comprises storing the estimated propagation delay at the second node.”

126. It is my opinion that IEEE802.3ah renders claim 3 obvious.

127. As discussed above with respect to, for example, [1.b]-[1.c], a POSITA would have found it obvious to rely on propagation delay to adjust local clock time based on IEEE802.3ah's teachings. *See* above, ¶¶78-122.

128. A POSITA would have found it obvious that the second node would store propagation delay in order to use it. A POSITA would have been motivated to store the value, and had a reasonable expectation of success, based on IEEE802.3ah's teachings that OLT stores RTT for use during calculations. *See* DISH-1005, 431-32 (storing RTT at OLT during calculations). A POSITA would have implemented that procedure in ONU to store propagation delay while using it.

129. As a result, it is my opinion that IEEE802.3ah renders this claim obvious.

5. Dependent Claim 6

[6] "The method of claim 1, wherein the first node is a network coordinator."

130. It is my opinion that IEEE802.3ah discloses claim 6.

131. The '681 Patent states that the "network coordinator (NC) is relied upon to schedule all traffic on the network, thereby allocating the network bandwidth and avoiding packet collisions." DISH-1001, 2:37-39. Thus, the OLT in IEEE802.3ah performs the same functions of scheduling network traffic as the network coordinator in the '681 Patent.

132. IEEE802.3ah, for example, discloses that an OLT node acts as a network coordinator. The claimed “first node” in the IEEE802.3ah network is the OLT node, which is “the master entity in a P2MP network.” DISH-1005, 4. The OLT (“master”) performs various functions, such as “issu[ing]” grants to “ONUs (slaves),” which illustrates that the OLT schedules traffic on the network to avoid collisions. *Id.*

133. As a result, it is my opinion that IEEE802.3ah discloses this claim.

6. Dependent Claim 7

[7] “The method of claim 1, wherein the second node is a new node and the method is performed as part of admission of the second node to the communication network.”

134. It is my opinion that IEEE802.3ah discloses claim 7.

135. IEEE802.3ah states that “[n]ew devices are discovered in the network and allowed transmission through the Discovery Processing function.” DISH-1005, 439. Discovery “is the process whereby newly connected or off-line ONUs are provided access.” *Id.*, 440-41. The ranging procedure in IEEE802.3ah occurs during the discovery process. *Id.*, 439. Because transmissions of the new node are only allowed after the Discovery Processing function (i.e., after the new node has been admitted to the network), and the Discovery Processing function involves the ranging procedure, a POSITA would understand that the ranging procedure is necessarily performed as part of the admission of the new node to the network.

136. As a result, it is my opinion that IEEE802.3ah discloses this claim.

7. Dependent Claim 8

[8] “The method of claim 1, wherein the method is performed periodically to maintain synchronization between the first and second nodes.”

137. It is my opinion that IEEE802.3ah discloses claim 8.

138. IEEE802.3ah states that “[t]here may exist situations when the OLT requires that an ONU go through the discovery sequence again and reregister.” *Id.*, 441. As an example, “[f]ine control of the network bandwidth distribution can be achieved using feedback mechanisms supported in the Report Processing function. *Id.*, 439. The Report Processing mandates that “Reports shall be generated periodically, even when no request for bandwidth is being made. This keeps a watchdog timer in the OLT from expiring and deregistering the ONU. For proper operation of this mechanism, the OLT shall grant the ONU periodically.” *Id.*, 452. The Report Processing thus discloses the recommendation for continuous and periodic ranging in order to ensure synchronization of local clock times across the nodes in a network. A POSITA would understand that this teaches a periodic synchronization using the range procedure discussed above.

139. As a result, it is my opinion that IEEE802.3ah discloses this claim.

8. Dependent Claim 9

[9] “The method of claim 1, wherein the construction network is a mesh network.”

140. It is my opinion that IEEE802.3ah renders claim 9 obvious.

141. The '681 Patent explains that a “[m]esh topology” is one where “any node can communicate directly with any other node in the network.” DISH-1001, 1:46-47. As an example, the patent describes that “one Mesh topology is defined by the MoCA 1.0 standard.” *Id.*, 2:2-3. Based on a POSITA’s understanding of IEEE802.3ah teachings, a POSITA would have been motivated and found it obvious for IEEE802.3ah’s network to be a mesh network because IEEE802.3ah is widely applicable to “subscriber access networks,” which a POSITA would understand to include coaxial cable networks, that may implement a mesh topology. A POSITA would have reasonably expected success because IEEE802.3ah is intended to interface with a home network (e.g., a mesh network) and therefore expected to be compatible with mesh networks.

142. As a result, it is my opinion that IEEE802.3ah renders this claim obvious.

9. Dependent Claim 10

[10] “The method of claim 1, wherein the communication network operates in accordance with a Multimedia over Coax Alliance (MoCA) standard.”

143. It is my opinion that IEEE802.3ah renders claim 10 obvious.

144. The '681 Patent explains that “one Mesh topology is defined by the MoCA 1.0 standard.” *Id.*, 2:2-3. Further, the patent acknowledges that the disclosures of the MoCA 1.0 standard and MoCA 1.x specification were already generally known in the art. DISH-1001, 1:59-2:3. Based on a POSITA’s

understanding of MoCA’s disclosures and IEEE802.3ah teachings, a POSITA would have been motivated and found it obvious for IEEE802.3ah’s network to be operating in accordance with a MoCA standard because IEEE802.3ah is widely applicable to “subscriber access networks,” which a POSITA would understand to include coaxial cable networks that comply with a MoCA standard. A POSITA would have reasonably expected success because IEEE802.3ah is intended to interface with a home network (e.g., a network implementing MoCA) and therefore expected to be compatible with MoCA networks.

145. As a result, it is my opinion that IEEE802.3ah renders this claim obvious.

B. Ground 1B - IEEE802.3ah-Shvodian (Claims 11-13, 16-23, 26-33, and 36-40)

1. Overview of Shvodian

146. Shvodian describes systems and methods for determining RTT “between a source node and a destination node” in a “home” network. DISH-1006, ¶¶[0001]-[0002].

147. Shvodian teaches a node (e.g., the source node) capable of instructing that a ranging procedure be performed between two other devices (e.g., a network bridge and the destination node). Shvodian’s “source node may be a content provider,” while the “destination node may be a content sink.” *Id.*, ¶[0002]. The “source node and the destination node” can be connected to each other via “a

network bridge” using “existing cable infrastructure.” *Id.*, ¶[0003]. The “existing cable infrastructure” can be a coaxial cable network. *See id.*, ¶[0016] (identifying “splitter 120” as a coaxial splitter), *id.*, ¶[0023] (identifying “first communication medium 130” as a coaxial cable).

148. Shvodian describes multiple approaches for determining RTT. *See id.*, ¶¶[0032]-[0040]. In one approach, the “source node” measures RTT by “transmit[ting] an RTT measurement packet to the destination node via the network bridges,” and “receiv[ing] a response from ... the destination node.” *Id.*, ¶¶[0034]-[0035].

149. In another approach, RTT is measured using “a combination of [RTT] measurements and ranging operations between elements within the network. That is, measuring [RTT] between the source node and the first bridge, performing ultra wide band ranging operation between the first bridge and the second bridge, measuring [RTT] between the second bridge and the destination node, and then reporting each of the [RTTs] and the ranging to the content source.” *Id.*, ¶[0040]. This approach “require[s] a level of trust of both the first and second bridges in order to ensure that neither bridge is attempting to device the content source into believing that it is in the network when an actuality it is a remote device obtaining access through, for example, a router.” *Id.*

150. Shvodian, the '681 Patent, and IEEE802.3ah are analogous art because they relate to the same field. The '681 Patent describes its field of disclosure as: “networks, and more particularly, some embodiments relate to using range estimates to improve efficiency in networks, particularly networking over coaxial cable.” DISH-1001, 1:15-19; *see also* DISH-1005, v, 4. Similarly, Shvodian’s field is “transmissions between a source node and a destination node in a network,” such as a “1394-over-coax bridged network,” to determine RTT. DISH-1006, ¶¶[0001]-[0002], [0035].

151. Shvodian and the '681 Patent and IEEE802.3ah are analogous art also because Shvodian’s disclosure of calculating RTT is reasonably pertinent to the problem which was faced by the inventors of the '681 Patent and IEEE802.3ah. As discussed above, the '681 Patent is focused on improving network efficiency by determining propagation delay between nodes and then synchronizing local clocks of the nodes in light of the propagation delay. DISH-1001, 14:17-49. One way to determine propagation delay is by first determining RTT, and Shvodian discloses a method for determining RTT. *See id.*, ¶¶[0032]-[0040].

2. A POSITA Would Have Been Motivated to Combine IEEE802.3ah and Shvodian

152. The IEEE802.3ah-Shvodian combination includes the networking protocol of IEEE802.3ah implemented with the teachings of Shvodian. For example, the combination incorporates Shvodian’s teachings regarding the structure

of a coaxial cable network, such that one device causes the ranging protocol of IEEE802.3ah to be implemented between two other nodes.

153. A POSITA would have been motivated to combine IEEE802.3ah and Shvodian because they both address the same problem of determining RTT. Indeed, IEEE802.3ah recognized that propagation delay could be calculated by first determining RTT. DISH-1005, FIG. 64-4.

154. To the extent that Patent Owner asserts that IEEE802.3ah does not render obvious the “network device” in claim 11 that comprises a “controller” that causes the ranging procedure to be performed, a POSITA would have been motivated to implement Shvodian’s ranging between external nodes.

155. Both references disclose the measurement of RTT. Indeed, IEEE802.3ah discloses that ranging is used to calculate RTT. DISH-1005, 427. Shvodian teaches that the performance of the ranging procedure to measure RTT between a source node and a destination node can be performed in two ways: (1) measured directly between the source node and a destination node, as caused by the source node, or (2) the source node measures RTT between it and a first bridge, then the source node measures RTT between a second bridge and the destination node, and then the source node sums those values.

156. To the extent that Patent Owner asserts IEEE802.3ah does not specify what device initiates the ranging procedure (or the structural relationship between

devices involved in ranging), Shvodian teaches the claimed network structures and implementations for performing ranging in those network structures. Based on Shvodian's teachings, a POSITA would have been motivated to have a network device include the structure of a device module and memory coupled to a controller that performs IEEE802.3ah's clock synchronization functions because this would further IEEE802.3ah's goals toward configuring nodes in a point-to-multipoint topology in an inexpensive implementation.

157. A POSITA would have had a reasonable expectation that the IEEE802.3ah-Shvodian combination would have succeeded. The IEEE802.3ah network and the Shvodian network were designed to interface with home-based electronics networks and each other. Shvodian notes that its apparatuses and methods were "applicable to any wired ... communication network elements," including various IEEE protocols and coaxial cable networks. *See* DISH-1006, ¶¶[0015]-[0016]. IEEE802.3ah was designed to interface directly with these home-based networks. A POSITA would thus have understood Shvodian's network to be compatible with IEEE802.3ah's ranging protocol.

158. Shvodian and IEEE802.3ah also both use RTT as part of performing ranging. DISH-1006, ¶¶[0032]-[0040]. Accordingly, Shvodian's teachings regarding how ranging devices in a network may be organized would clarify the implementation of IEEE802.3ah's ranging technique.

159. Given the straightforward application of Shvodian’s teachings to IEEE802.3ah’s ranging protocol, a POSITA would have expected the IEEE802.3ah-Shvodian combination to be successful.

3. Independent Claim 11

[11.pre] “A network device, comprising:”

160. I have been asked to consider whether IEEE802.3ah-Shvodian renders obvious the preamble of claim 11, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 11 is deemed to be a limitation, it is my opinion that IEEE802.3ah-Shvodian discloses this limitation.

161. Specifically, Shvodian discloses a “source node” in a “coaxial cable” network. DISH-1006, ¶¶[0032], [0023]. A POSITA would have understood that a source node in a network is a network device.

162. As a result, it is my opinion that IEEE802.3ah-Shvodian discloses this limitation.

[11.a] “a controller;”

163. It is my opinion that, in IEEE802.3ah-Shvodian, Shvodian discloses this limitation.

164. Shvodian clarifies that the “source node” is also known as “network element 140A,” which includes “an apparatus 200” that includes “a controller 210”

that “can be one of a variety of different processors including general purpose processors, custom processors, controllers, compact eight-bit processors or the like.” DISH-1006, ¶¶[0019], [0032].

165. As a result, it is my opinion that IEEE802.3ah-Shvodian discloses this limitation.

[11.b] “a device module;”

166. It is my opinion that, in IEEE802.3ah-Shvodian, Shvodian discloses this limitation.

167. According to the '681 Patent, a device module “is a black-box representation of the functionality that can be performed by the network device 520 and that may vary depending on that the nature of the actual device.” DISH-1001, 12:48-51. Shvodian discloses that the “source node” is also known as “network element 140A,” which can be a “set top box.” DISH-1006, ¶¶[0019], [0032]. A POSITA would have understood that the “source node” would thus have necessarily included components to allow it to perform functionalities in accordance with the nature of the “source node,” such as components to enable a set top box to function.

168. As a result, it is my opinion that IEEE802.3ah-Shvodian discloses this limitation.

[11.c] “memory coupled to the controller;”

169. It is my opinion that, in IEEE802.3ah-Shvodian, Shvodian discloses this limitation.

170. Shvodian clarifies that the “source node” is also known as “network element 140A,” which includes “an apparatus 200” that includes “a memory 215.” DISH-1006, ¶¶[0019], [0032].

171. As a result, it is my opinion that IEEE802.3ah-Shvodian discloses this limitation.

[11.d] “computer executable program code on a non-transitory computer readable medium configured to cause the controller to perform the functions of:”

172. It is my opinion that, in IEEE802.3ah-Shvodian, Shvodian discloses this limitation.

173. Shvodian clarifies that the “source node” is also known as “network element 140A,” which includes “an apparatus 200” that includes “a memory 215.” DISH-1006, ¶¶[0019], [0032]. The “memory 215” can include “instructions such as computer programs which can be used for configuring the controller 210 to control the operation of the apparatus 200.” *Id.*, ¶[0019].

174. As a result, it is my opinion that IEEE802.3ah discloses this limitation.

[11.e] “exchanging local clock times between a first node and a second node over a communication network, wherein the exchange comprises:”

175. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

176. Shvodian recognizes that RTT between a source node and a destination node can be determined as “a combination of [RTT] measurements and ranging operations between elements within the network. That is, measuring [RTT] between the source node and the first bridge, performing ultra wide band ranging operation between the first bridge and the second bridge, measuring [RTT] between the second bridge and the destination node, and then reporting each of the round trip times and the ranging to the content source.” DISH-1006, ¶[0040]. Thus, in the IEEE802.3ah-Shvodian network, the “source node” is the claimed “network device” (*see* [11.pre] *supra*), the “second bridge” is the claimed “first node,” and the “destination node” is the claimed “second node.”

177. This limitation is identical to [1.a] except that it recites “exchanging local clock times.” As described above in [1.a], node 1’s local clock time is transmitted to node 2. As described above in [1.b.i], node 2 sends a second message to node 1 including a timestamp, which lists node 2’s local time at the time of sending. Accordingly, multiple local clock times are exchanged.

178. Because limitation [11.e] is substantively similar to limitation [1.a], it is my opinion that IEEE802.3ah-Shvodian additionally renders this limitation

obvious for the reasons explained above with respect to claim limitation [1.a]. *See* above, ¶¶59-63.

[11.e.i] “transmitting a first packet from the first node to the second node, wherein the first packet includes a first packet clock time set to the local clock time of the first node at transmission time, and includes a scheduled arrival clock time, and”

179. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

180. Because limitation [11.e.i] is substantively similar to limitation [1.a.i], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [1.a.i]. *See* above, ¶¶64-72.

[11.e.ii] “setting the local clock time of the second node to the first packet clock time;”

181. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

182. Because limitation [11.e.ii] is substantively similar to limitation [1.a.ii], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [1.a.ii]. *See* above, ¶¶73-77.

[11.f] “performing a ranging method between the first and second nodes based on the local clock times exchanged between the first and second nodes, wherein the ranging method results in an estimated propagation delay between the first and second nodes, and wherein the ranging method comprises:”

183. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

184. This limitation differs from [1.b] substantively in that it recites “performing a ranging method between the first and second nodes based on the local clock times exchanged *between the first and second nodes*.” As discussed in [11.e], multiple clock times are exchanged. The ranging method is based on these multiple clock times in that the first local clock time is used to reset the second node’s local clock and the second local clock time, is used to perform the ranging calculation. *See* above (discussing [1.a.ii] and [1.b.ii]).

185. Because limitation [11.f] is substantively similar to limitation [1.b], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [1.b]. *See* above, ¶¶78-84.

[11.f.i] “transmitting a second packet from the second node to the first node, wherein the second packet is transmitted from the second node at the scheduled arrival clock time, and wherein the second packet is received by the first node at an actual arrival clock time,”

186. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

187. Because limitation [11.f.i] is substantively similar to limitation [1.b.i], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [1.f.1]. *See* above, ¶¶85-93.

[11.f.ii] “calculating and storing the estimated propagation delay at the first node, wherein calculating the estimated propagation delay is based on the scheduled arrival clock time and the actual arrival time, and”

188. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

189. Because limitation [11.f.ii] is substantively similar to limitation [1.b.ii], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [1.b.ii]. *See* above, ¶¶94-104.

[11.f.iii] “transmitting a third packet from the first node to the second node, wherein the third packet comprises the estimated propagation delay; and”

190. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

191. Because limitation [11.f.iii] is substantively similar to limitation [1.b.iii], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [1.b.iii]. *See* above, ¶¶105-113.

[11.g] “adjusting the local clock times of either the first and second nodes based on the estimated propagation delay, thereby resulting in a synchronized local clock time at the first and second nodes.”

192. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

193. Because limitation [11.g] is substantively similar to limitation [1.c], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [1.c]. *See above*, ¶¶114-122.

194. For the reasons discussed above, IEEE802.3ah-Shvodian therefore renders obvious claim 11.

4. Independent Claim 21

[21.pre] “A computer program product comprising a non-transitory computer usable medium having computer readable program code embodied therein for synchronizing a plurality of nodes on a communication network, the compute program product comprising computer readable program code configured to cause a device to”

195. I have been asked to consider whether IEEE802.3ah-Shvodian renders obvious the preamble of claim 21, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 21 is deemed to be a limitation, it is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

196. Because limitation [21.pre] is substantively similar to limitation [11.d], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the

reasons explained above with respect to claim limitation [11.d]. *See* above, ¶¶172-174.

[21.a] “exchange local clock times between a first node and a second node over a communication network, wherein the exchange comprises:”

197. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

198. Because limitation [21.a] is substantively similar to limitation [11.e], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e]. *See* above, ¶¶175-178.

[21.a.i] “transmitting a first packet from the first node to the second node, wherein the first packet includes a first packet clock time set to the local clock time of the first node at transmission time, and includes a scheduled arrival clock time, and”

199. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

200. Because limitation [21.a.i] is substantively similar to limitation [11.e.i], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e.i]. *See* above, ¶¶179-182.

[21.a.ii] “setting the local clock time of the second node to the first packet clock time;”

201. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

202. Because limitation [21.a.ii] is substantively similar to limitation [11.e.ii], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e.ii]. *See* above, ¶¶181-182.

[21.b] “perform a ranging method between the first and second nodes based on the local clock times exchanged between the first and second nodes, wherein the ranging method results in an estimated propagation delay between the first and second nodes, and wherein the ranging method comprises:”

203. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

204. Because limitation [21.b] is substantively similar to limitation [11.f], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f]. *See* above, ¶¶183-185.

[21.b.i] “transmitting a second packet from the second node to the first node, wherein the second packet is transmitted from the second node at the scheduled arrival clock time, and wherein the second packet is received by the first node at an actual arrival clock time,”

205. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

206. Because limitation [21.b.i] is substantively similar to limitation [11.f.i], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.i]. *See above*, ¶¶186-187.

[21.b.ii] “calculating and storing the estimated propagation delay at the first node, wherein calculating the estimated propagation delay is based on the scheduled arrival clock time and the actual arrival time, and”

207. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

208. Because limitation [21.b.ii] is substantively similar to limitation [11.f.ii], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.ii]. *See above*, ¶¶188-189.

[21.b.iii] “transmitting a third packet from the first node to the second node, wherein the third packet comprises the estimated propagation delay; and”

209. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

210. Because limitation [21.b.iii] is substantively similar to limitation [11.f.iii], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.iii]. *See above*, ¶¶190-191.

[21.c] “adjust the local clock times of either the first and second nodes based on the estimated propagation delay, thereby resulting in a synchronized local clock time at the first and second nodes.”

211. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

212. Because limitation [21.c] is substantively similar to limitation [11.g], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.g]. *See above*, ¶¶192-194.

213. For the reasons discussed above, IEEE802.3ah-Shvodian therefore renders obvious claim 21.

5. Independent Claim 31

214. I have been asked to consider whether IEEE802.3ah renders obvious claim 31. To the extent that Claim 31 can be practiced by an embodiment that practices Claim 1, Claim 31 is obvious in light of IEEE802.3ah.

[31.pre] “A network interface module, comprising:”

215. I have been asked to consider whether IEEE802.3ah-Shvodian renders obvious the preamble of claim 31, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 31 is deemed to be a limitation, it is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

216. As discussed above, with respect to [11.pre], the “source node” in Shvodian is a “network device.” *See* above, ¶¶160-162. Because the “source node” in Shvodian also includes “an interface 205,” it is a “network interface module.” DISH-1006, ¶[0019].

217. Because limitation [31.pre] is substantively similar to limitation [11.pre], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.pre]. *See* above, ¶¶160-162.

[31.a] “a controller;”

218. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

219. Because limitation [31.a] is substantively similar to limitation [11.a], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.a]. *See* above, ¶¶163-165.

[31.b] “memory coupled to the controller;”

220. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

221. Because limitation [31.b] is substantively similar to limitation [11.c], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the

reasons explained above with respect to claim limitation [11.c]. *See* above, ¶¶166-168.

[31.c] “computer executable program code on a non-transitory computer readable medium configured to cause the controller to perform the functions of:”

222. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

223. Because limitation [31.c] is substantively similar to limitation [11.d], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.d]. *See* above, ¶¶172-174.

[31.d] “exchanging local clock times between a first node and a second node over a network, wherein the exchange comprises:”

224. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

225. Because limitation [31.d] is substantively similar to limitation [11.e], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e]. *See* above, ¶¶175-178.

[31.d.i] “transmitting a first packet from the first node to the second node, wherein the first packet includes a first packet clock time set to the local clock time of the first node at transmission time, and includes a scheduled arrival clock time, and”

226. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

227. Because limitation [31.d.i] is substantively similar to limitation [11.e.i], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e.i]. *See above*, ¶¶179-180.

[31.d.ii] “setting the local clock time of the second node to the first packet clock time;”

228. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

229. Because limitation [31.d.ii] is substantively similar to limitation [11.e.ii], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e.ii]. *See above*, ¶¶181-182.

[31.e] “performing a ranging method between the first and second nodes based on the local clock times exchanged between the first and second nodes, wherein the ranging method results in an estimated propagation delay between the first and second nodes, and wherein the ranging method comprises:”

230. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

231. Because limitation [31.e] is substantively similar to limitation [11.f], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f]. *See* above, ¶¶183-185.

[31.e.i] “transmitting a second packet from the second node to the first node, wherein the second packet is transmitted from the second node at the scheduled arrival clock time, and wherein the second packet is received by the first node at an actual arrival clock time,”

232. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

233. Because limitation [31.e.i] is substantively similar to limitation [11.f.i], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.i]. *See* above, ¶¶186-187.

[31.e.ii] “calculating and storing the estimated propagation delay at the first node, wherein calculating the estimated propagation delay is based on the scheduled arrival clock time and the actual arrival time, and”

234. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

235. Because limitation [31.e.ii] is substantively similar to limitation [11.f.ii], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.ii]. *See* above, ¶¶188-189.

[31.e.iii] “transmitting a third packet from the first node to the second node, wherein the third packet comprises the estimated propagation delay; and”

236. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

237. Because limitation [31.e.iii] is substantively similar to limitation [11.f.iii], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.iii]. *See above*, ¶¶190-191.

[31.f] “adjusting the local clock times of either the first and second nodes based on the estimated propagation delay, thereby resulting in a synchronized local clock time at the first and second nodes.”

238. It is my opinion that IEEE802.3ah-Shvodian renders obvious this limitation.

239. Because limitation [31.f] is substantively similar to limitation [11.g], it is my opinion that IEEE802.3ah-Shvodian renders this limitation obvious for the reasons explained above with respect to claim limitation [11.g]. *See above*, ¶¶192-194.

240. For the reasons discussed above, IEEE802.3ah therefore renders obvious claim 31.

6. Dependent Claim 12, 22, and 32

[12] “The network device of claim 11, wherein the computer executable program code is further configured to cause the controller to use the synchronized local clock time in subsequent packet transmissions between the first and second nodes.”

241. I have reviewed claims 12, 22, and 32, and I conclude that claims 12, 22, and 32 recite similar claim limitations to claim 2.

242. As such, it is my opinion that IEEE802.3ah-Shvodian discloses these claims for the same reasons that IEEE802.ah discloses claim 2.

7. Dependent Claims 13, 23, and 33

[13] “The network device of claim 11, wherein adjusting the local clock times comprises storing the estimated propagation delay at the second node.”

243. I have reviewed claims 13, 23, and 33, and I conclude that claims 13, 23, and 33 recite similar claim limitations to claim 3.

244. As such, it is my opinion that IEEE802.3ah-Shvodian renders these claims obvious for the same reasons that IEEE802.ah renders claim 3 obvious.

8. Dependent Claims 16, 26, and 36

[16] “The network device of claim 11, wherein the first node is a network coordinator.”

245. I have reviewed claims 16, 26, and 36, and I conclude that claims 16, 26, and 36 recite similar claim limitations to claim 6.

246. As such, it is my opinion that IEEE802.3ah-Shvodian discloses these claims for the same reasons that IEEE802.ah discloses claim 6.

9. Dependent Claims 17, 27, and 37

[17] “The network device of claim 11, wherein the second node is a new node and the method is performed as part of admission of the second node to the communication network.”

247. I have reviewed claims 17, 27, and 37, and I conclude that claims 17, 27, and 37 recite similar claim limitations to claim 7.

248. As such, it is my opinion that IEEE802.3ah-Shvodian discloses these claims for the same reasons that IEEE802.ah discloses claim 7.

10. Dependent Claims 18, 28, and 38

[18] “The network device of claim 11, wherein the functions of exchanging local clock times, performing the ranging method, and adjusting the local clock times are performed periodically to maintain synchronization between the first and second nodes.”

249. I have reviewed claims 18, 28, and 38, and I conclude that claims 18, 28, and 38 recite similar claim limitations to claim 8.

250. As such, it is my opinion that IEEE802.3ah-Shvodian discloses these claims for the same reasons that IEEE802.ah discloses claim 8.

11. Dependent Claims 19, 29, and 39

[19] “The network device of claim 11, wherein the communication network is a mesh network.”

251. I have reviewed claims 19, 29, and 39, and I conclude that claims 19, 29, and 39 recite similar claim limitations to claim 9.

252. As such, it is my opinion that IEEE802.3ah-Shvodian renders these claims obvious for the same reasons that IEEE802.ah renders claim 9 obvious.

12. Dependent Claims 20, 30, and 40

[20] “The network device of claim 11, wherein the communication network operates in accordance with a Multimedia over Coax Alliance (MoCA) standard.”

253. I have reviewed claims 20, 30, and 40, and I conclude that claims 20, 30, and 40 recite similar claim limitations to claim 10.

254. As such, it is my opinion that IEEE802.3ah-Shvodian renders these claims obvious for the same reasons that IEEE802.ah renders claim 10 obvious.

C. [GROUND 2A] – IEEE802.3ah in view of Frei (Claims 1-3, 6-10)

1. Overview of Frei

255. Frei refers to U.S. Patent Application Publication No. 2007/0140127 A1, which was published on June 21, 2007 and is entitled “Method and apparatus for efficient transfer of data over a network.” DISH-1006, Cover.

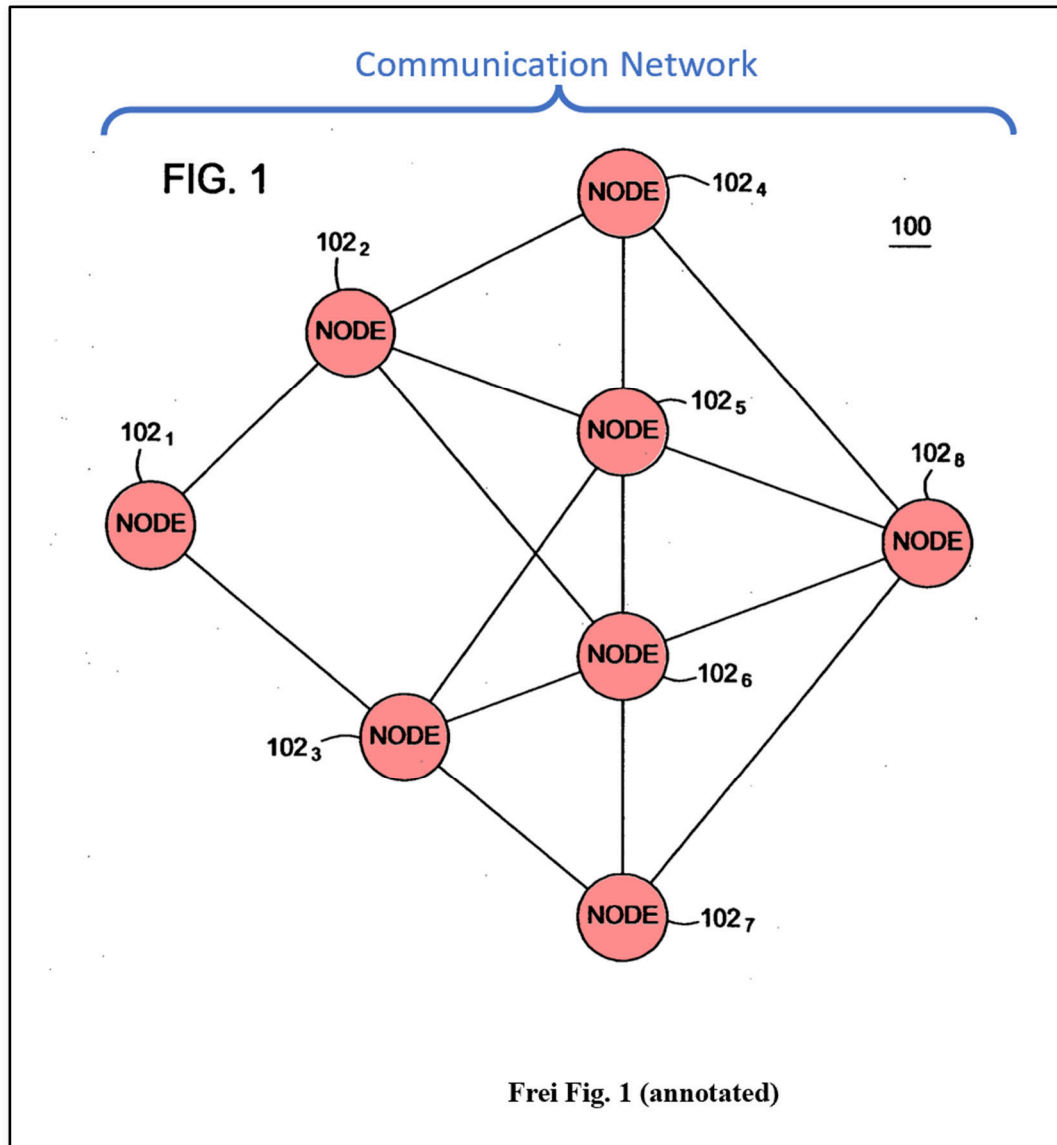
256. Frei discloses a network that “determines the propagation delay between . . . connected nodes” and “utilizes this information to more efficiently transfer data through the network.” *Id.*, Abstract. At a high level, Frei seeks to “improv[e] the efficiency of a network and/or provid[e] network monitoring and management capability.” *Id.*, ¶[0009].

257. Frei recognizes that in some networks, nodes “receive[] and transmit[] data only during specific time slots,” and “[i]n a network where the distance between source and destination is unknown, the time slot must accommodate the worst case propagation delay.” *Id.*, ¶¶[0006]-[0007]. To prevent data collisions, the time slot

that accommodates the worst case propagation delay in the event of a larger distance between source and destination may end up being longer than necessary, thus creating network inefficiency. *Id.*, ¶¶[0007]-[0008].

258. Frei solves the problem of time slots that are longer than necessary by using a ranging procedure between nodes. “To avoid such transmission inefficiency,” Frei explains that “the propagation delay may be measured by using time synchronized nodes and sending time of transmission information between nodes.” *Id.*, ¶¶[0007], [0027].

259. Figure 1 of Frei, which “is a graphical depiction of one embodiment of a network 100 comprising connected nodes 102,” depicts such nodes. *Id.*, ¶[0017].



Frei then states that a “block diagram of node 102,” which may be “one or more individual computers, wireless devices, ... or any other digital device that may benefit from connection to a computer or communications network,” includes a “CPU” [central processing unit] and a “memory” to store “various forms of software and files, such as, an operating system (OS) 210 and communication software 212,”

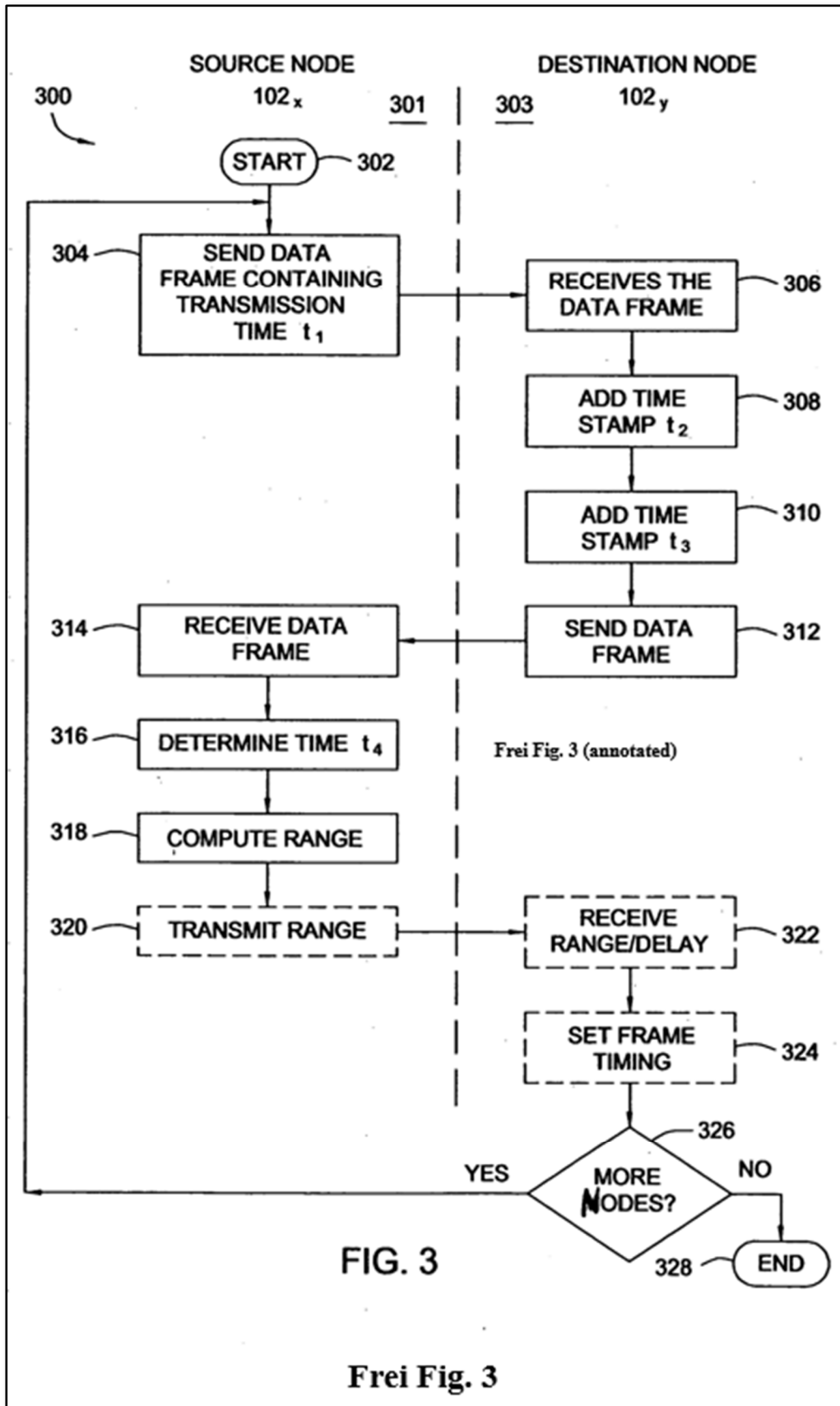
where the “communications software 212 is executed by the CPU 202”). *Id.*, ¶¶ [0019]-[0020].

260. Such a procedure allows any node to “compute the propagation delay by subtracting the current time from the time of transmission.” *Id.*, ¶[0007]. Since each node is now able to learn of the propagation delay and synchronize its local time, the nodes no longer have to accommodate the worst case propagation delay.

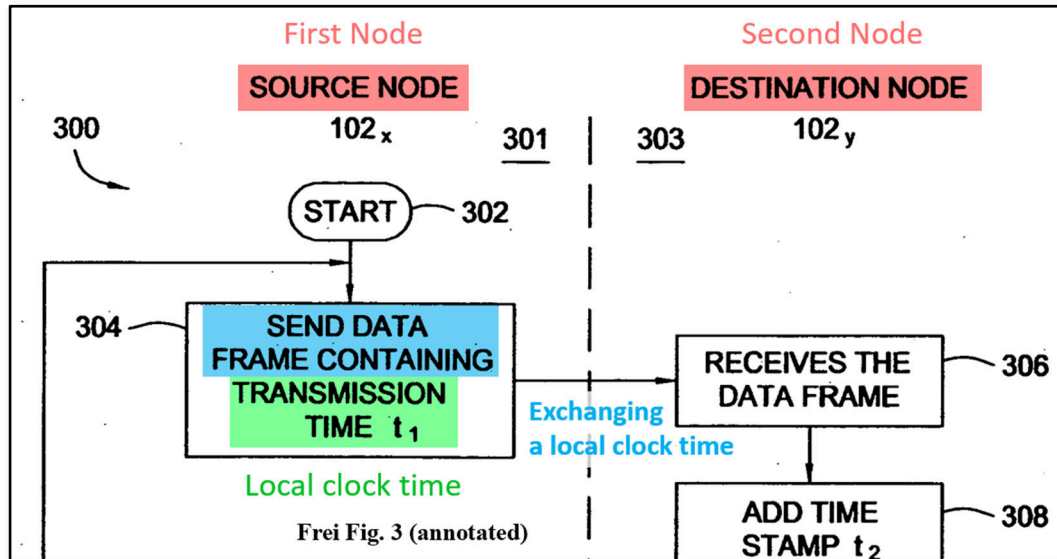
261. Similar to the procedures in the ’681 Patent and IEEE802.3ah, synchronization of the local clock times of each node involves back-and-forth messages between two nodes. *Id.*, ¶¶[0029]-[0036]. In Frei’s ranging procedure, “the propagation delay may be measured by using time synchronized nodes and sending time of transmission information between nodes.” *Id.*, ¶[0007]. As a result, “any node can compute the propagation delay by subtracting the current time from the time of transmission.” *Id.* Propagation delay is then broadcast to the second node and used to synchronize its clock. *Id.*, ¶[0037].

262. Frei discloses an example involving a source node and a destination node. *Id.*, ¶¶[0029]-[0037]. The result is “synchronization of the destination node with the source node.” DISH-1007, ¶[0041]; *see id.* (“Ideally, because the clock of the source node has been synchronized with the clock of the destination node and offset by the propagation time between nodes, the received timestamp at the destination node should match the transmitted timestamp from the source node.”).

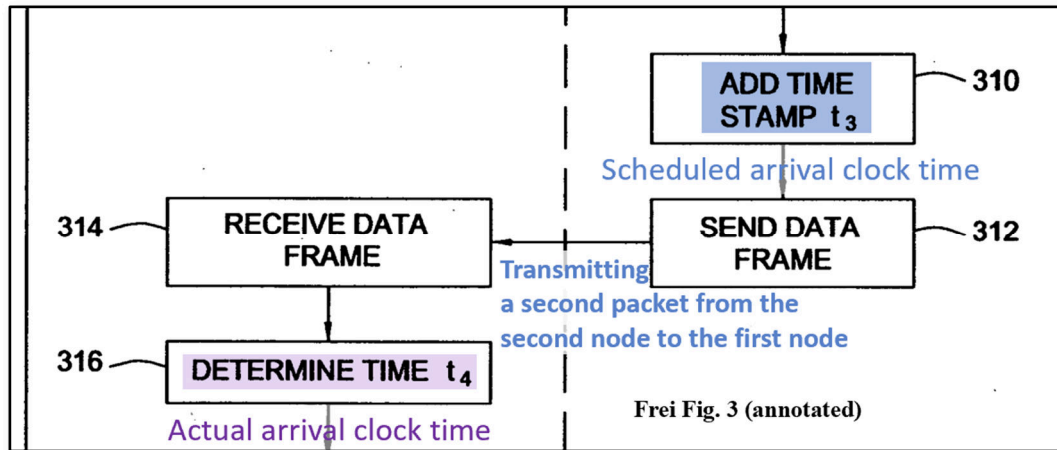
263. This procedure is described step-by-step in Figure 3 of Frei.



264. A source node 102_x transmits a synchronization message” over the communication network of Figure 1, which “contains a time of transmission t_1 . The transmission is addressed to destination node 102_y .” *Id.*, ¶[0029]. That packet arrives at t_2 . *Id.*, ¶[0030]. This is shown below.



265. The “destination node 102_y stamps the message with timestamp 410 containing the transmission time, t_3 . Then, at step 312, the destination node transmits a data frame 404 to the source node 102_x ” at time t_3 . *Id.*, ¶[0033]. Then, “the source node 102_x receives the data frame 404 and, at step 316, the node 102_x determines the local time of complete reception of the data frame, time t_4 .” *Id.*, ¶[0034]. This is shown below.



266. After step 316, Frei calculates propagation delay, which is “well-known” to be “the time lag between the departure of transmitted data from a source node 102₁ and the arrival of the transmitted data at a destination node 102₂”:

$$\text{Propagation delay} = (t_4 - t_1 - (t_3 - t_2)) / 2$$

Id., ¶[0023], [0034].

267. The “source node 102_x transmits the range and/or the propagation delay to the destination node 102_y.” *Id.*, ¶¶[0037], [0024]. “The destination node 102₂ uses the delay to delay the timeslot in which the destination node 102₂ will listen for a transmission from the source node 102₁.” *Id.* This allows “synchronization between the two nodes [to be] achieved without a common time base.” *Id.*, ¶[0025].

268. As an initial matter, Frei is analogous art to the ’681 Patent, IEEE802.3ah, and Shvodian for the reasons described below.

269. A POSITA seeking to improve IEEE802.3ah's ranging technique would have looked to other references in the same field of endeavor. IEEE802.3ah, Shvodian, and Frei, like the '681 Patent, relate to network efficiency. Frei states that the disclosure relates to "a network and, more specifically, to the efficient transfer of data through a network, as well as techniques for monitoring and management of a network." *Id.*, ¶[0002]. Frei clarifies that "[t]hose skilled in the art will realize from [Frei's] disclosure that other network topologies, both wired and wireless, may find benefit by using the present invention." DISH-1007, ¶[0017]. Thus, a POSITA would have understood that Frei is therefore intended for implementation in wired networks.

270. The '681 Patent and the other references seek to on improve network efficiency by minimizing unused bandwidth, or silent time. DISH-1001, 3:1-14 (stating networks become less efficient when nodes are not synchronized as a result of "several factors" "including but not limited to: delay in transmission ..., propagation delay ..., receive delay ..., [and] clock drifts between nodes"). This matches the motivation of Frei. Frei describes, "where the distance between source and destination is unknown, the time slot must accommodate the worst case propagation delay." DISH-1007, ¶[0007]. This "causes a portion of the time slot to be unutilized and the transmission of data is not as efficient as possible." *Id.*, ¶[0006]. Frei "avoid[s] such transmission inefficiency," by "comput[ing] the

propagation delay.” *Id.*, ¶[0007]. Like the ’681 Patent and other references, this procedure also corrects for “clock drift between the source node and the destination node,” (*id.*, ¶[0041]), and provides for accurate scheduling. (*see id.*, ¶[0035]).

271. That Frei can also be implemented in wireless networks does not prevent it from serving as analogous art. Frei implements a ranging solution to overcome challenges present in both wireless and wired networks, expressly indicating that it can be implemented in a wired network; these are the challenges recited by the patent. Accordingly, a POSITA would have considered Frei to be analogous art.

2. A POSITA Would Have Been Motivated to Combine IEEE802.3ah(-Shvodian) and Frei

272. A POSITA would have been motivated to modify IEEE802.3ah(-Shvodian)’s system to incorporate the teachings of Frei with a reasonable expectation of success.

273. The IEEE802.3ah-Frei and IEEE802.3ah-Shvodian-Frei combinations include the networking protocol disclosed by IEEE802.3ah(-Shvodian) with clarification from Frei regarding certain implementation details. For example, the combination incorporates Frei’s calculation of propagation delay from round-trip time and transmission of propagation delay to the second node.

274. Further, a POSITA would have been motivated to combine IEEE802.3ah(-Shvodian) and Frei because (i) they address the same network

efficiency problems by providing similar node synchronization protocols, which implement back-and-forth ranging; and (ii) because they all provide ranging techniques including RTT and propagation delay.

275. First, all references were published close in time to address network efficiency problems facing the industry. This is the same problem addressed and same solution offered by the '681 patent: “According to various embodiments of the disclosure, systems, methods and apparatuses are provided for *using ranging to improve network efficiency*.” DISH-1001, Abstract. A POSITA would have been motivated to consider other references at the time to address network efficiency in ranging protocols.

276. Next, all three references disclose the use of ranging to measure the RTT. IEEE802.3ah discloses that ranging is used to calculate RTT, which includes propagation delay, (DISH-1005, 4, 427), as does Shvodian (DISH-1006, ¶[0040] (explaining one approach to measuring RTT)). As described above, it would have been obvious to a POSITA from IEEE802.3ah(-Shvodian) to use propagation delay to synchronize network nodes because it is the amount that the secondary node's clock would need to be adjusted to match the first node's clock.

277. To the extent that IEEE802.3ah and/or Shvodian does not render obvious the calculation and transmission of propagation delay, a POSITA would have been motivated to look to references like Frei for clarification. Frei teaches a

ranging procedure similar to IEEE802.3ah(-Shvodian), which—as described above with respect to Frei’s disclosure—uses times associated with the departure and arrival of messages exchanged between nodes to determine RTT. *See* above, ¶¶[0040]-[0053], [0146]-[0151]. After RTT has been determined using IEEE802.3ah(-Shvodian)’s method, a POSITA would have been motivated to look to Frei, which expressly calculates propagation delay by dividing RTT in half and transmitting that propagation delay to other nodes for use. DISH-1007, ¶[0034].

$$\text{Propagation delay}=(t_4-t_1-(t_3-t_2))/2$$

278. It is my opinion that a POSITA would have had a reasonable expectation that the IEEE802.3ah(-Shvodian)-Frei combination would produce a successful outcome. First, the references teach similar, compatible ranging protocols including calculation of RTT; a POSITA would therefore have expected a combination to be successful. As described above, the teachings of IEEE802.3ah(-Shvodian) suggest that ranging may be used to calculate propagation delay; Frei provides this explicit calculation. DISH-1005, 4; DISH-1007, ¶[0034]. As described above, a POSITA would have understood that propagation delay (rather than RTT) would be used to adjust the nodes’ local clocks. A POSITA would have

had no difficulty implementing the calculation performed by Frei (dividing by two) after RTT is calculated in IEEE802.3ah(-Shvodian).

279. A POSITA would therefore have had no difficulty calculating the propagation delay from the round trip time, regardless of whether the propagation delay was converted from round trip time before or after the propagation delay was transmitted to the second node.

280. Because Frei teaches the straightforward application of the concept of dividing the round trip time in two to obtain the propagation delay, a POSITA would have expected the IEEE.802.3(-Shvodian)/Frei combination to be successful.

3. Independent Claim 1

281. It is my opinion that the combination of IEEE802.3ah and Frei renders obvious this claim. As I explained above, IEEE802.3ah alone renders obvious each and every claim limitation of this claim (*see* above, ¶¶54-122), and claim limitations [1.pre], [1.a], [1.a.i], [1.b], [1.b.i], [1.b.ii], [1.b.iii], and [1.c] are also supported by Frei, as explained below, further demonstrating that the IEEE802.3ah-Frei combination renders claim 1 obvious.

[1.pre] “A method for synchronizing a plurality of nodes on a communication network, comprising:”

282. I have been asked to consider whether IEEE802.3ah-Frei renders obvious the preamble of claim 1, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 1

is deemed to be a limitation, it is my opinion that IEEE802.3ah-Frei teaches or renders obvious this limitation because IEEE802.3ah teaches or renders obvious this limitation (*see above*, ¶¶54-58).

[1.a] “exchanging a local clock time between a first node and a second node over the communication network, wherein the exchange comprises:”

283. It is my opinion that IEEE802.3ah-Frei teaches or renders obvious this limitation because it is my opinion that IEEE802.3ah teaches or renders obvious this limitation (*see above*, ¶¶59-63).

[1.a.i] “transmitting a first packet from the first node to the second node, wherein the first packet includes a first packet clock time set to the local clock time of the first node at transmission time, and includes a scheduled arrival clock time, and”

284. It is my opinion that IEEE802.3ah-Frei teaches or renders obvious this limitation because it is my opinion that IEEE802.3ah teaches or renders obvious this limitation (*see above*, ¶¶64-72).

[1.a.ii] “setting the local clock time of the second node to the first packet clock time;”

285. It is my opinion that IEEE802.3ah-Frei teaches or renders obvious this limitation because it is my opinion that IEEE802.3ah teaches or renders obvious this limitation (*see above*, ¶¶73-77).

[1.b] “performing a ranging method between the first and second nodes based on the local clock time exchanged, wherein the ranging method results in an estimated propagation delay between the first and second node, and wherein the ranging method comprises:”

286. It is my opinion that IEEE802.3ah-Frei renders obvious this limitation. In addition to my earlier opinion that IEEE802.3ah renders obvious this limitation (*see above*, ¶¶78-84), it is my opinion that Frei renders obvious this limitation.

287. In addition to IEEE802.3ah’s calculation of RTT, Frei teaches dividing RTT in half to calculate propagation delay. DISH-1007, ¶[0034].

288. Frei explains that, “[a]s is well-known, propagation delay is the time lag between the departure of transmitted data from a source node 102₁ and the arrival of the transmitted data at a destination node 102₂.” DISH-1007, ¶[0023]. To calculate propagation delay, as discussed above, the method of Frei “begins at step 302 and proceeds to step 304 wherein a source node 102_x transmits a synchronization message 408,” which “contains a time of transmission t₁” based on the local clock time of the source node 102_x. DISH-1007, ¶[0029]. That packet arrives at t₂. *Id.*, ¶[0030]. Next, “the destination node 102_y stamps the message with timestamp 410 containing the transmission time, t₃,” which is transmitted at t₃, and then “the destination node transmits a data frame 404 to the source node 102_x” to arrive at t₄. *Id.*, ¶[0033].

289. As such, $(t_4 - t_1 - (t_3 - t_2))$ indicates the round-trip time. Frei then defines the propagation delay to be this round-trip time divided in half. DISH-1007, ¶¶0034]. The calculation of the propagation delay is as follows:

$$\text{Propagation delay} = (t_4 - t_1 - (t_3 - t_2)) / 2$$

Id., ¶¶0034].

290. A POSITA would have understood that Frei's method would be used to calculate propagation delay by dividing IEEE802.3ah's RTT in half and would have been motivated to use Frei's propagation delay given that, once nodes "are aware of the propagation delay between each other, each node can time the transmission of data" such that, "synchronization between the two nodes is achieved without a common time base." *Id.*, ¶¶0025]; *see id.*, ¶¶0024] ("Once determined, the source node 102₁ then transmits the propagation delay to the destination node 102₂.").

291. As explained above, the '681 Patent discloses the calculation of an estimated propagation delay as an output of the ranging procedure. *See* above, ¶¶78-113.

292. As a result, it is my opinion that IEEE802.3ah-Frei renders this limitation obvious.

[1.b.i] “transmitting a second packet from the second node to the first node, wherein the second packet is transmitted from the second node at the scheduled arrival clock time, and wherein the second packet is received by the first node at an actual arrival clock time,”

293. It is my opinion that IEEE802.3ah-Frei renders obvious this limitation because it is my opinion that IEEE802.3ah renders obvious this limitation (*see above*, ¶¶85-93).

[1.b.ii] “calculating and storing the estimated propagation delay at the first node, wherein calculating the estimated propagation delay is based on the scheduled arrival clock time and the actual arrival time, and”

294. It is my opinion that IEEE802.3ah-Frei renders obvious this limitation. In addition to my earlier opinion that IEEE802.3ah renders obvious this limitation (*see above*, ¶¶94-104), it is my opinion that Frei renders obvious this limitation.

295. As discussed above in [1.a.i], IEEE802.3ah discloses a “scheduled arrival clock time.” In addition to the teachings of IEEE802.3ah, Frei discloses estimating propagation delay at the first node by dividing RTT in half. At time t_4 , the first node receives a packet from the second node including the time that packet was sent. DISH-1007, ¶[0034]. Frei provides the calculation used to derive propagation delay.

$$\text{Propagation delay} = (t_4 - t_1 - (t_3 - t_2)) / 2$$

296. A POSITA would have found it obvious to use Frei's propagation delay methods with IEEE802.3ah and, effectively, dividing 802.3ah's RTT by 2 to determine the "estimated propagation delay." To perform this calculation, a POSITA would have understood that Frei stores the propagation delay. A POSITA would have understood that, in order to transmit propagation delay, it must be stored.

297. As explained above, the '681 Patent discloses the calculation and storage of the estimated propagation delay at the first node, where the estimated propagation delay is based in part on the actual arrival time. *See* above, ¶¶78-113.

298. As a result, it is my opinion that IEEE802.3ah-Frei renders this limitation obvious.

[1.b.iii] "transmitting a third packet from the first node to the second node, wherein the third packet comprises the estimated propagation delay; and"

299. It is my opinion that IEEE802.3ah-Frei discloses this limitation. In addition to my earlier opinion that IEEE802.3ah renders obvious this limitation (*see* above, ¶¶105-113), it is my opinion that Frei discloses this limitation.

300. In addition to the teachings of IEEE802.3ah, Frei states that "the source node 102_x transmits the range and/or the propagation delay to the destination node 102_y." DISH-1006, ¶[0037]; *see also id.*, ¶[0024] (the source node "transmits the propagation delay to the destination node"). A POSITA would thus have understood that when the propagation delay has been calculated at the source node,

the propagation delay would have been communicated to the destination node to allow the destination node to adjust for the propagation delay.

301. As explained above, the '681 Patent discloses the transmission of a packet from the first node to the second node that comprises the estimated propagation delay. *See* above, ¶¶78-113.

302. As a result, it is my opinion that IEEE802.3ah-Frei discloses this limitation.

[1.c] “adjusting the local clock time of either the first or second node based on the estimated propagation delay, thereby resulting in a synchronized local clock time between the first and second node.”

303. It is my opinion that IEEE802.3ah-Frei discloses this limitation. In addition to my earlier opinion that IEEE802.3ah renders obvious this limitation (*see* above, ¶¶114-122), it is my opinion that Frei discloses this limitation.

304. Frei states that “the source node 102₁ then transmits the propagation delay to the destination node 102₂. The destination node 102₂ uses the delay to delay the timeslot in which the destination node 102₂ will listen for a transmission from the source node 102₁.” DISH-1006, ¶[0024]; *see also id.*, ¶[0037] (“the destination node 324 sets the frame timing for reception of data from the source node 102_x such that data frames are efficiently utilized”).

305. As discussed above, IEEE802.3ah’s technique synchronizes nodes by changing the local clock times. A POSITA would have understood that, in the

context of IEEE802.3ah, the way to “delay the timeslot,” as disclosed by Frei, would be to adjust the nodes local clock time by the estimated propagation delay.

306. As explained above, the '681 Patent discloses the adjustment of at least one local clock time based on the estimated propagation delay to cause a synchronized local clock time between the first and second nodes. *See above*, ¶¶114-122.

307. As a result, it is my opinion that IEEE802.3ah-Frei discloses this limitation.

308. For the reasons discussed above, IEEE802.3ah-Frei renders obvious claim 1.

4. Dependent Claim 2

[2] “The method of claim 1, further comprising using the synchronized local clock time in subsequent packet transmissions between the first and second nodes.”

309. It is my opinion that IEEE802.3ah-Frei discloses claim 2 because it is my opinion that IEEE802.3ah discloses this limitation (*see above*, ¶¶123-125).

310. As a result, it is my opinion that IEEE802.3ah-Frei renders this claim obvious.

5. Dependent Claim 3

[3] “The method of claim 1, wherein adjusting the local clock times comprises storing the estimated propagation delay at the second node.”

311. It is my opinion that IEEE802.3ah-Frei renders claim 3 obvious because it is my opinion that IEEE802.3ah renders obvious this limitation (*see above*, ¶¶126-129).

312. As a result, it is my opinion that IEEE802.3ah-Frei renders this claim obvious.

6. Dependent Claim 6

[6] “The method of claim 1, wherein the first node is a network coordinator.”

313. It is my opinion that IEEE802.3ah-Frei discloses claim 6 because it is my opinion that IEEE802.3ah discloses this limitation (*see above*, ¶¶130-133).

314. As a result, it is my opinion that IEEE802.3ah-Frei renders this claim obvious.

7. Dependent Claim 7

[6] “The method of claim 1, wherein the second node is a new node and the method is performed as part of admission of the second node to the communication network.”

315. It is my opinion that IEEE802.3ah-Frei discloses claim 7 because it is my opinion that IEEE802.3ah discloses this limitation (*see above*, ¶¶134-136).

316. As a result, it is my opinion that IEEE802.3ah-Frei renders this claim obvious.

8. Dependent Claim 8

[8] “The method of claim 1, wherein the method is performed periodically to maintain synchronization between the first and second nodes.”

317. It is my opinion that IEEE802.3ah-Frei discloses claim 8 because it is my opinion that IEEE802.3ah discloses this limitation (*see above*, ¶¶137-139).

318. As a result, it is my opinion that IEEE802.3ah-Frei renders this claim obvious.

9. Dependent Claim 9

[9] “The method of claim 1, wherein the communication network is a mesh network.”

319. It is my opinion that IEEE802.3ah-Frei renders claim 9 obvious.

320. In addition to the teachings of IEEE802.3ah, Frei discloses that “[a]n exemplary network that may utilize and benefit from the present invention is a mesh network.” DISH-1006, ¶[0017].

321. As a result, it is my opinion that IEEE802.3ah-Frei renders this claim obvious.

10. Dependent Claim 10

[10] “The method of claim 1, wherein the communication network operates in accordance with a Multimedia over Coax Alliance Standard.”

322. It is my opinion that IEEE802.3ah-Frei renders claim 10 obvious because it is my opinion that IEEE802.3ah renders obvious this limitation (*see above*, ¶¶143-145).

323. As a result, it is my opinion that IEEE802.3ah-Frei renders this claim obvious.

D. [GROUND 2B] –IEEE802.3ah in view of Shvodian and further in view of Frei (Claims 11-13, 16-23, 26-33, and 36-40)

1. Independent Claim 11

324. I have been asked to consider whether the combination of IEEE802.3ah-Shvodian and Frei renders obvious claim 11. As I explained above, IEEE802.3ah-Shvodian alone renders obvious each and every claim limitation of this claim (*see above*, ¶¶160-194; *see also* §VII(C)(1)-(2) (providing overview of Frei and explaining motivation to combine IEEE802.3ah-Shvodian with Frei)), and claim limitations [11.f], [11.f.ii], [11.f.iii], and [11.g] are also supported by Frei, as explained below, further demonstrating that the IEEE802.3ah-Shvodian-Frei combination renders claim 11 obvious.

[11.pre] “A network device, comprising:”

325. I have been asked to consider whether IEEE802.3ah-Shvodian-Frei renders obvious the preamble of claim 11, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 11 is deemed to be a limitation, it is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation (*see above*, ¶¶160-162) because it is my opinion that IEEE802.3ah-Shvodian discloses this limitation.

[11.a] “a controller;”

326. It is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation because it is my opinion that IEEE802.3ah-Shvodian discloses this limitation (*see above*, ¶¶163-165).

[11.b] “a device module;”

327. It is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation because it is my opinion that IEEE802.3ah-Shvodian discloses this limitation (*see above*, ¶¶166-168).

[11.c] “memory coupled to the controller;”

328. It is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation because it is my opinion that IEEE802.3ah-Shvodian discloses this limitation (*see above*, ¶¶169-171).

[11.d] “computer executable program code on a non-transitory computer readable medium configured to cause the controller to perform the functions of:”

329. It is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation because it is my opinion that IEEE802.3ah-Shvodian discloses this limitation (*see above*, ¶¶172-174).

[11.e] “exchanging local clock times between a first node and a second node over a communication network, wherein the exchange comprises:”

330. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

331. Because limitation [11.e] is substantively similar to limitation [1.a], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [1.a]. *See above*, ¶¶175-178.

[11.e.i] “transmitting a first packet from the first node to the second node, wherein the first packet includes a first packet clock time set to the local clock time of the first node at transmission time, and includes a scheduled arrival clock time, and”

332. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

333. Because limitation [11.e.i] is substantively similar to limitation [1.a.i], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [1.a.i]. *See above*, ¶¶179-180.

[11.e.ii] “setting the local clock time of the second node to the first packet clock time; and”

334. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

335. Because limitation [11.e.ii] is substantively similar to limitation [1.a.ii], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [1.a.ii]. *See above*, ¶¶181-182.

[11.f] “performing a ranging method between the first and second nodes based on the local clock times exchanged between the first and second nodes, wherein the ranging method results in an estimated propagation delay between the first and second nodes, and wherein the ranging method comprises:”

336. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

337. Because limitation [11.f] is substantively similar to limitation [1.b], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [1.b]. *See above*, ¶¶183-185.

[11.f.i] “transmitting a second packet from the second node to the first node, wherein the second packet is transmitted from the second node at the scheduled arrival clock time, and wherein the second packet is received by the first node at an actual arrival clock time,”

338. It is my opinion that IEEE802.3ah-Shvodian-Frei teaches or renders obvious this limitation.

339. Because limitation [11.f.i] is substantively similar to limitation [1.b.i], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [1.f.1]. *See above*, ¶¶186-187.

[11.f.ii] “calculating and storing the estimated propagation delay at the first node, wherein calculating the estimated propagation delay is based on the scheduled arrival clock time and the actual arrival time, and”

340. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

341. Because limitation [11.f.ii] is substantively similar to limitation [1.b.ii], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [1.b.ii]. *See* above, ¶¶188-189.

[11.f.iii] “transmitting a third packet from the first node to the second node, wherein the third packet comprises the estimated propagation delay; and”

342. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

343. Because limitation [11.f.iii] is substantively similar to limitation [1.b.iii], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [1.b.iii]. *See* above, ¶¶190-191.

[11.g] “adjusting the local clock times of either the first and second nodes based on the estimated propagation delay, thereby resulting in a synchronized local clock time at the first and second nodes.”

344. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

345. Because limitation [11.g] is substantively similar to limitation [1.c], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [1.c]. *See above*, ¶¶192-194.

346. For the reasons discussed above, IEEE802.3ah-Shvodian-Frei therefore renders obvious claim 11.

2. Independent Claim 21

347. I have been asked to consider whether the combination of IEEE802.3ah-Shvodian and Frei renders obvious claim 21. As I explained above, IEEE802.3ah-Shvodian renders obvious each and every claim limitation of this claim (*see above*, ¶¶195-213), and claim limitations [21.b], [21.b.ii], [21.b.iii], and [21.c] are also supported by Frei, as explained below, further demonstrating that the IEEE802.3ah-Shvodian-Frei combination renders claim 21 obvious.

[21.pre] “A computer program product comprising a non-transitory computer usable medium having computer readable program code embodied therein for synchronizing a plurality of nodes on a communication network, the compute program product comprising computer readable program code configured to cause a device to”

348. I have been asked to consider whether IEEE802.3ah-Shvodian-Frei renders obvious the preamble of claim 21, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 21 is deemed to be a limitation, it is my opinion that IEEE802.3ah-

Shvodian-Frei discloses this limitation because it is my opinion that IEEE802.3ah-Shvodian discloses this limitation (*see above*, ¶¶195-196).

349. Because limitation [21.pre] is substantively similar to limitation [11.d], it is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation for the reasons explained above with respect to claim limitation [11.d]. *See above*, ¶329.

[21.a] “exchange local clock times between a first node and a second node over a communication network, wherein the exchange comprises:”

350. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

351. Because limitation [21.a] is substantively similar to limitation [11.e], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e]. *See above*, ¶¶330-331.

[21.a.i] “transmitting a first packet from the first node to the second node, wherein the first packet includes a first packet clock time set to the local clock time of the first node at transmission time, and includes a scheduled arrival clock time, and”

352. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

353. Because limitation [21.a.i] is substantively similar to limitation [11.e.i], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for

the reasons explained above with respect to claim limitation [11.e.i]. *See* above, ¶¶332-333.

[21.a.ii] “setting the local clock time of the second node to the first packet clock time;”

354. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

355. Because limitation [21.a.ii] is substantively similar to limitation [11.e.ii], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e.ii]. *See* above, ¶¶334-335.

[21.b] “perform a ranging method between the first and second nodes based on the local clock times exchanged between the first and second nodes, wherein the ranging method results in an estimated propagation delay between the first and second nodes, and wherein the ranging method comprises:”

356. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

357. Because limitation [21.b] is substantively similar to limitation [11.f], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f]. *See* above, ¶¶336-337.

[21.b.i] “transmitting a second packet from the second node to the first node, wherein the second packet is transmitted from the second node at the scheduled arrival clock time, and wherein the second packet is received by the first node at an actual arrival clock time,”

358. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

359. Because limitation [21.b.i] is substantively similar to limitation [11.f.i], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.i]. *See above*, ¶¶338-339.

[21.b.ii] “calculating and storing the estimated propagation delay at the first node, wherein calculating the estimated propagation delay is based on the scheduled arrival clock time and the actual arrival time, and”

360. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

361. Because limitation [21.b.ii] is substantively similar to limitation [11.f.ii], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.ii]. *See above*, ¶¶340-341.

[21.b.iii] “transmitting a third packet from the first node to the second node, wherein the third packet comprises the estimated propagation delay; and”

362. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

363. Because limitation [21.b.iii] is substantively similar to limitation [11.f.iii], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.iii]. *See above*, ¶¶342-343.

[21.c] “adjust the local clock times of either the first and second nodes based on the estimated propagation delay, thereby resulting in a synchronized local clock time at the first and second nodes.”

364. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

365. Because limitation [21.c] is substantively similar to limitation [11.g], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.g]. *See above*, ¶¶344-346.

366. For the reasons discussed above, IEEE802.3ah-Shvodian-Frei therefore renders obvious claim 21.

3. Independent Claim 31

367. I have been asked to consider whether the combination of IEEE802.3ah-Shvodian and Frei renders obvious claim 31. As I explained above, IEEE802.3ah-Shvodian renders obvious each and every claim limitation of this claim (*see above*, ¶¶214-240), and claim limitations [31.e], [31.e.ii], [31.e.iii], and

[31.f] are also supported by Frei, as explained below, further demonstrating that the IEEE802.3ah-Shvodian-Frei combination renders claim 31 obvious.

[31.pre] “A network interface module, comprising:”

368. I have been asked to consider whether IEEE802.3ah-Shvodian-Frei renders obvious the preamble of claim 31, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 31 is deemed to be a limitation, it is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation because it is my opinion that IEEE802.3ah-Shvodian discloses this limitation (*see above*, ¶¶215-217).

369. Because limitation [31.pre] is substantively similar to limitations [11.pre] (which requires a network device) and [11.b] (which requires a device module), it is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation for the reasons explained above with respect to claim limitations [11.pre] and [11.b]. *See above*, ¶¶325-327.

[31.a] “a controller;”

370. It is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation.

371. Because limitation [31.a] is substantively similar to limitation [11.a], it is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation for the reasons explained above with respect to claim limitation [11.a]. *See above*, ¶326.

[31.b] “memory coupled to the controller;”

372. It is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation.

373. Because limitation [31.b] is substantively similar to limitation [11.c], it is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation for the reasons explained above with respect to claim limitation [11.c]. *See* above, ¶328.

[31.c] “computer executable program code on a non-transitory computer readable medium configured to cause the controller to perform the functions of:”

374. It is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation.

375. Because limitation [31.c] is substantively similar to limitation [11.d], it is my opinion that IEEE802.3ah-Shvodian-Frei discloses this limitation for the reasons explained above with respect to claim limitation [11.d]. *See* above, ¶329.

[31.d] “exchanging local clock times between a first node and a second node over a network, wherein the exchange comprises:”

376. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

377. Because limitation [31.d] is substantively similar to limitation [11.e], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e]. *See* above, ¶¶330-331.

[31.d.i] “transmitting a first packet from the first node to the second node, wherein the first packet includes a first packet clock time set to the local clock time of the first node at transmission time, and includes a scheduled arrival clock time, and”

378. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

379. Because limitation [31.d.i] is substantively similar to limitation [11.e.i], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e.i]. *See above, ¶¶332-333.*

[31.d.ii] “setting the local clock time of the second node to the first packet clock time;”

380. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

381. Because limitation [31.d.ii] is substantively similar to limitation [11.e.ii], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.e.ii]. *See above, ¶¶334-335.*

[31.e] “performing a ranging method between the first and second nodes based on the local clock times exchanged between the first and second nodes, wherein the ranging method results in an estimated propagation delay between the first and second nodes, and wherein the ranging method comprises:”

382. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

383. Because limitation [31.e] is substantively similar to limitation [11.f], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f]. *See above*, ¶¶336-337.

[31.e.i] “transmitting a second packet from the second node to the first node, wherein the second packet is transmitted from the second node at the scheduled arrival clock time, and wherein the second packet is received by the first node at an actual arrival clock time,”

384. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

385. Because limitation [31.e.i] is substantively similar to limitation [11.f.i], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.i]. *See above*, ¶¶338-339.

[31.e.ii] “calculating and storing the estimated propagation delay at the first node, wherein calculating the estimated propagation delay is based on the scheduled arrival clock time and the actual arrival time, and”

386. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

387. Because limitation [31.e.ii] is substantively similar to limitation [11.f.ii], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.ii]. *See above*, ¶¶340-341.

[31.e.iii] “transmitting a third packet from the first node to the second node, wherein the third packet comprises the estimated propagation delay; and”

388. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

389. Because limitation [31.e.iii] is substantively similar to limitation [11.f.iii], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.f.iii]. *See above*, ¶¶342-343.

[31.f] “adjusting the local clock times of either the first and second nodes based on the estimated propagation delay, thereby resulting in a synchronized local clock time at the first and second nodes.”

390. It is my opinion that IEEE802.3ah-Shvodian-Frei renders obvious this limitation.

391. Because limitation [31.f] is substantively similar to limitation [11.g], it is my opinion that IEEE802.3ah-Shvodian-Frei renders this limitation obvious for the reasons explained above with respect to claim limitation [11.g]. *See above*, ¶¶344-346.

392. For the reasons discussed above, IEEE802.3ah-Shvodian-Frei therefore renders obvious claim 31.

4. Dependent Claims 12, 22, and 32

[12] “The network device of claim 11, wherein the computer executable program code is further configured to cause the controller to use the synchronized local clock time in subsequent packet transmissions between the first and second nodes.”

393. I have reviewed claims 2, 12, 22, and 32, and I conclude that claims 2, 12, 22, and 32 recite similar claim limitations.

394. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei discloses these claims for the same reasons that IEEE802.ah-Frei discloses claim 2.

5. Dependent Claims 13, 23, and 33

[13] “The network device of claim 11, wherein adjusting the local clock times comprises storing the estimated propagation delay at the second node.”

395. I have reviewed claims 3, 13, 23, and 33, and I conclude that claims 3, 13, 23, and 33 recite similar claim limitations.

396. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei renders these claims obvious for the same reasons that IEEE802.ah-Frei renders claim 3 obvious.

6. Dependent Claims 16, 26, and 36

[16] “The network device of claim 11, wherein the first node is a network coordinator.”

397. I have reviewed claims 6, 16, 26, and 36, and I conclude that claims 6, 16, 26, and 36 recite similar claim limitations.

398. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei discloses these claims for the same reasons that IEEE802.ah-Frei discloses claim 6.

7. Dependent Claims 17, 27, and 37

[17] “The network device of claim 11, wherein the second node is a new node and the functions are performed as part of admission of the second node to the communication network.”

399. I have reviewed claims 7, 17, 27, and 37, and I conclude that claims 7, 17, 27, and 37 recite similar claim limitations.

400. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei discloses these claims for the same reasons that IEEE802.ah-Frei discloses claim 7.

8. Dependent Claims 18, 28, and 38

[18] “The network device of claim 11, wherein the functions of exchanging local clock times, performing the ranging method, and adjusting the local clock times are performed periodically to maintain synchronization between the first and second nodes.”

401. I have reviewed claims 8, 18, 28, and 38, and I conclude that claims 8, 18, 28, and 38 recite similar claim limitations.

402. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei discloses these claims for the same reasons that IEEE802.ah-Frei discloses claim 8.

9. Dependent Claims 19, 29, and 39

[19] “The network device of claim 11, wherein the communication network is a mesh network.”

403. I have reviewed claims 9, 19, 29, and 39, and I conclude that claims 9, 19, 29, and 39 recite similar claim limitations.

404. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei renders these claims obvious for the same reasons that IEEE802.ah-Frei renders claim 9 obvious.

10. Dependent Claims 20, 30, and 40

[20] “The network device of claim 11, wherein the communication network operates in accordance with a Multimedia over Coax Alliance (MoCA) standard.”

405. I have reviewed claims 10, 20, 30, and 40, and I conclude that claims 10, 20, 30, and 40 recite similar claim limitations.

406. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei renders these claims obvious for the same reasons that IEEE802.ah-Frei renders claim 8 obvious.

E. [GROUND 3A] – IEEE802.3ah in view of Frei and further in view of Ovadia (Claims 9-10)

1. Overview of Ovadia

407. Ovadia was published on September 10, 2007 and is entitled “MoCA: Ubiquitous Multimedia Networking in the Home.” DISH-1008, Cover.

408. Ovadia describes the features and basic implementation of a home MoCA 1.0 network, in which a “multimedia signal enters the home via an optical termination unit (ONT).” DISH-1008, 1. The MoCA 1.0 environment can provide “reliable room-to-room, peer-to-peer, [and] full-mesh connectivity among all sources and sinks in the home.” *Id.*; *see id.*, 5.

409. Ovadia notes that a MoCA 1.0 “network supports communications up to 8 nodes,” and any “node can become a network coordinator.” *Id.*, 2-3. The network coordinator then “broadcasts beacons every 10 milliseconds to enable other MoCA nodes to detect the presence of a network, and join the network.” *Id.*, 3. Each “MoCA node must go through an admission process, before becoming part of the MoCA network,” and, upon admission, the network coordinator will “control[] all the transmissions in the network by broadcasting scheduled transmission opportunities to every node in a control packet called a MAP.” *Id.*

410. Ovadia is analogous to the '681 Patent and other references because they are from the same filed. The '681 Patent “relates to networks, and more particularly, some embodiments relate to using range estimates to improve efficiency in networks, particularly networking over coaxial cable.” DISH-1001, 1:15-18. IEEE802.3ah, Shvodian, and Frei likewise relate to multi-node communication networks implementing similar efficiency protocols. The patent specifically identifies MoCA 1.0 and MoCA 1.x as networks to which the patent’s efficiency teachings could be applied. *See* DISH-1001, 1:59-2:3, 2:44-59. Ovadia describes the properties of these MoCA 1.0 networks. *See generally* DISH-1008. Accordingly, Ovadia is analogous art to the '681 Patent.

2. A POSITA Would Have Been Motivated to Combine IEEE802.3ah, Shvodian, Frei, and Ovadia

411. A POSITA would have been motivated to modify IEEE802.3ah(-Shvodian)-Frei's system to incorporate the network environment of Ovadia with a reasonable expectation of success. For example, the combination incorporates Ovadia's express teachings regarding the properties of a MoCA network, such that the ranging protocol of IEEE802.3ah(-Shvodian)-Frei is implemented in a MoCA network.

412. The ranging method of IEEE802.3ah(-Shvodian)-Frei is designed for implementation in a wired network in a home, which includes MoCA 1.0 networks. DISH-1005, Cover, v (clarifying that IEEE802.3ah is intended for "local and metropolitan networks" and noting that IEEE802.3ah is also known as "Ethernet in the First Mile," which is intended to interface with end-user equipment in the home). In other words, IEEE802.3ah is designed to interface with the home. Ovadia provided details as to how MoCA could be implemented in such a home environment. DISH-1008, Abstract (describing MoCA as "rapidly emerging as the de-facto standard in North America for multimedia home networking"). As described here and above, all references, therefore, describe network interfaces related to a user's home.

413. Further, MoCA is designed to interface with Ethernet, since the "primary function of an intermediate device is [] bridging of user content between

the MoCA network and an external device using an industry standard interface such as Ethernet or USB. *Id.*, 3. Thus, a POSITA would have understood that the communication network of IEEE802.3ah, and also Shvodian and Frei, which are compatible with IEEE802.3ah, are intended to be compatible with the network of Ovadia.

414. A POSITA would have been motivated to apply the synchronization of nodes' clocks in communication networks where propagation delay can cause inaccuracy, such as in coaxial cable networks. *See* DISH-1001, 3:1-14 (recognizing inaccuracies in MoCA 1.0 clock time due to propagation delay); *see* DISH-1006, FIG. 3, DISH-1013, 12 (File Wrapper of '676 Provisional Application (which the '681 Patent claims priority to) discusses the preexisting MoCA 1.x standard and notes that "[p]ropagation delay is the largest source of inaccuracy in CTC synchronization and packet arrival time").

415. In light of this, a POSITA would have been motivated to modify the home network of Ovadia to benefit from the network efficiencies of IEEE802.3ah(-Shvodian)-Frei, which are intended for implementation in local and metropolitan networks. The efficiency ranging protocol of IEEE802.3ah was already being used in the network interfacing with the home; a POSITA would have been motivated to extend that efficiency into the adjacent network. For example, implementing similar protocols in networks that are communicating with each other can lead to superior

connection and compatibility. A POSITA would have been motivated to achieve such improved compatibility.

416. It is my opinion that a POSITA would have had a reasonable expectation that the IEEE802.3ah(-Shvodian)-Frei-Ovadia combination would produce a successful outcome. As explained above, the IEEE802.3ah(-Shvodian)-Frei network and the Ovadia network were designed to interface with the home and, in fact, interface with each other, as the IEEE802.3ah(-Shvodian)-Frei network is designed to operate adjacent to the home while the Ovadia network is designed to operate within the home. *See* above, ¶¶411-413. A POSITA would thus have expected that communicating protocols would benefit from mirroring efficiency schemes.

417. A POSITA would have also expected success given that MoCA 1.0 (Ovadia's subject-matter) already included a synchronization protocol. DISH-1001, 2:60-3:14. Accordingly, the home network of Ovadia would be improved by implementing the ranging protocol taught by IEEE802.3ah(-Shvodian)-Frei in lieu of its present procedure. A POSITA would have expected that a network system already designed to synchronize nodes would benefit from adjusting to adopt a ranging protocol to improve its accuracy.

418. Because IEEE802.3ah(-Shvodian)-Frei's teachings can be straightforwardly applied in the context of Ovadia's home environment network, a

POSITA would have expected the IEEE.802.3(-Shvodian)-Frei-Ovadia combination to be successful.

3. Dependent Claim 9

[9] “The method of claim 1, wherein the communication network is a mesh network.”

419. It is my opinion that IEEE802.3ah-Frei-Ovadia discloses claim 9.

420. Ovadia discloses a mesh network in accordance with the MoCA 1.0 standard, noting that the MoCA 1.0 standard “is based on distributed mesh network architecture” and has been “shown to provide a reliable room-to-room, peer-to-peer full mesh connectivity” between devices. DISH-1008, 2, 5.

421. The ’681 Patent explains that a “[m]esh topology” is one where “any node can communicate directly with any other node in the network.” DISH-1001, 1:46-47. An example of a “Mesh topology is defined by the MoCA 1.0 standard.” *Id.*, 2:2-3. Thus, Ovadia discloses a mesh network within the meaning of the ’681 Patent.

422. As a result, it is my opinion that IEEE802.3ah-Frei-Ovadia discloses this claim.

4. Dependent Claim 10

[10] “The method of claim 1, wherein the communication network operates in accordance with a Multimedia over Coax Alliance (MoCA) standard.”

423. It is my opinion that IEEE802.3ah-Frei-Ovadia discloses claim 10.

424. As explained above, Ovadia discloses implementation of the MoCA 1.0 standard. DISH-1008, 1-5. A POSITA would have understood and found it obvious to use a home network, as disclosed by Ovadia, to implement the ranging protocol taught by IEEE802.3ah-Frei-Ovadia. Ovadia further clarifies that a home network can be a MoCA network. DISH-1008, Abstract (MoCA was “rapidly emerging as the de-facto standard in North America for multimedia home networking”). It would thus have been obvious to a POSITA that a MoCA network, such as the one in Ovadia, would implement the ranging protocol taught by IEEE802.3ah-Frei.

425. As a result, it is my opinion that IEEE802.3ah-Frei-Ovadia discloses this claim.

F. [GROUND 3B] IEEE802.3ah in view of Shvodian, further in view of Frei, and further in view of Ovadia (Claims 19-20, 29-30, and 39-40)

1. Dependent Claims 19, 29, and 39

[19] “The network device of claim 11, wherein the communication network is a mesh network.”

426. I have reviewed claims 9, 19, 29, and 39, and I conclude that claims 9, 19, 29, and 39 recite similar claim limitations.

427. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei-Ovadia discloses these claims for the same reasons that IEEE802.ah-Frei-Ovadia discloses claim 9. *See also* §VII(E)(1)-(2) (providing overview of Ovadia and explaining motivation to combine IEEE802.3ah-Shvodian-Frei with Ovadia).

2. Dependent Claims 20, 30, and 40

[20] “The network device of claim 11, wherein the communication network operates in accordance with a Multimedia over Coax Alliance (MoCA) standard.”

428. I have reviewed claims 10, 20, 30, and 40, and I conclude that claims 10, 20, 30 and 40 recite similar claim limitations.

429. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei-Ovadia discloses these claims for the same reasons that IEEE802.ah-Frei-Ovadia discloses claim 10. *See also* §VII(E)(1)-(2) (providing overview of Ovadia and explaining motivation to combine IEEE802.3ah-Shvodian-Frei with Ovadia).

G. [GROUNDS 4A] – IEEE802.3ah in view of Frei and further in view of Smith (Claims 4-5)

1. Overview of Smith

430. Smith refers to U.S. Patent No. 7,821,958, which issued on October 26, 2010 and is entitled “Method for estimating and monitoring timing errors in packet data networks.” DISH-1009, Cover.

431. Smith describes a system and method for measuring the arrival time of packets in a network. *Id.*, 6:51-61. The procedure relies on the average delay between sending and receiving a packet, using a mechanism similar to and compatible with the networks employed by IEEE802.3ah(-Shvodian)-Frei. *Id.*

432. Smith noted that network node synchronization was critical for both wired and wireless networks. *See id.*, 1:38-65. To address this need, Smith proposed

a packet timing “solution[]” that accounts for “variations in network operation affecting the packet stream.” *Id.*, 1:58-65, 2:51-3:14, 4:37-50. This packet timing “solution[]” would be implementable in both wired networks (like T1) and wireless networks (like GSM). *Id.*, 1:38-65. Smith further recognized that its methodology was “generally applicable to any derived timing signals, such as IEEE 1588 Precision Time Protocol.” *Id.*, 5:58-6:2.

433. Similar to the ranging procedures that involve back-and-forth messages described in IEEE802.3ah, Shvodian, Frei, and the '681 Patent, Smith also adopts an approach where each packet's propagation delay is calculated using the difference between the “packet time-stamps” and the “packet arrival times.” *Id.*, 6:51-61. The ranging procedure in Smith is intended to account for “variations in network operation affecting the packet stream,” and so the “relative delay” in Smith may be derived from “a mean delay of the pseudowire packet arrival times,” instead of the “pseudowire packet arrival times.” *Id.*, 4:37-40, 6:51-61, 8:58-63, 9:8-13.

434. Smith is analogous art to the '681 Patent and other references for the reasons described below.

435. Like the '681 Patent and other references, which are directed to “networks” and “using range estimates to improve efficiency,” Smith is similarly directed to the “estimation and monitoring of timing errors from packet data networks.” DISH-1009, 1:7-13.

436. The '681 Patent recognized the need to accurately determine the time a packet arrives in order to use the claimed ranging method, involving sending messages back-and-forth between nodes and measuring the packets' arrival time, to "improve local clock time synchronization." DISH-1001, 3:54-58. This ranging involves sending messages back-and-forth between nodes and measuring the packets' arrival time. *Id.*, Claim 1. One facet of this problem's solution, accordingly, is how to measure the time a packet arrives. *See, e.g., id.*, 3:63-65. The patent describes multiple approaches, including measuring "arrival time of a received packet" according to "a mean delay of the received signal." *Id.*, 4:55-67.

437. These same factors and goals motivate Smith's procedures. Smith explains that proper functionality of networks can "rely on the synchronization" and "timings" of various network nodes and the messages sent between them. DISH-1009, 2:51-3:14. Accordingly, Smith discloses mechanisms for measuring the arrival time of various packets to account for delay and variation. *Id.*, 6:51-61. These include measuring the arrival time of transmitted messages based on the "mean delay." *Id.* In light of that, a POSITA would have considered Smith to be analogous art.

2. A POSITA Would Have Been Motivated to Combine IEEE802.3ah, Shvodian, Frei, and Smith

438. A POSITA would have been motivated to modify IEEE802.3ah(-Shvodian)-Frei's system to incorporate the system of Smith with a reasonable expectation of success.

439. The IEEE802.3ah(-Shvodian)-Frei-Smith combination includes the networking protocol of IEEE802.3ah(-Shvodian)-Frei combined with the teachings of Smith. For example, the combination incorporates Smith's express teachings regarding the use of mean delay to measure the arrival and transmission time of network packets. To ensure that propagation delay is accurately calculated by IEEE802.3ah(-Shvodian)-Frei, the claimed first packet clock time, scheduled arrival clock time, and the actual arrival clock time must be accurate. A POSITA would therefore have implemented the teachings of Smith, which is directed to the "estimation and monitoring of timing errors from packet data networks," to ensure that the measurement of the claimed times are precise. DISH-1009, 1:8-9. A POSITA would have recognized that relying on the "mean delay" taught by Smith, instead of the measured arrival time or transmission time, would merely require a simple additional step: averaging the previous arrival time delays and substituting that value into the procedure of IEEE802.3ah-Frei.

440. A POSITA would be motivated to combine IEEE802.3ah(-Shvodian)-Frei with Smith because they address the same problem—network timing

synchronization—using similar properties—actual packet timing compared against scheduled packet timing. For example, IEEE802.3ah(-Shvodian)-Frei improves network efficiency by measuring the delay in transmitting or receiving packets in a network. IEEE802.3ah(-Shvodian)-Frei precisely measures the time required to transmit messages between two nodes.

441. Further, because IEEE802.3ah(-Shvodian)-Frei must precisely measure the time required to transmit messages between nodes, a POSITA would have been motivated to implement a mechanism for precisely measuring the time of transmission or reception, such as the methodology provided by Smith to refine said measurement. DISH-1009, 4:54-67. This is particularly so because the ranging protocols in both IEEE802.3ah(-Shvodian)-Frei and Smith rely on scheduled message timings (the message “time-stamps” in Smith) and actual message timings (the “arrival times” in Smith). *Id.* Smith provides a methodology for refining that measurement. *Id.*

442. A POSITA would have further been motivated to combine the teachings of IEEE802.3ah(-Shvodian)-Frei with Smith given that they rely on the same properties. IEEE802.3ah(-Shvodian)-Frei’s ranging protocol relies on scheduled and actual message timing attributes. Similarly, Smith relies on message “time-stamps”—i.e., scheduled timing—and actual “arrival times.” *Id.*

443. It is my opinion that a POSITA would have had a reasonable expectation that the IEEE802.3ah(-Shvodian)-Frei-Smith combination would produce a successful outcome. As explained above, both IEEE802.3ah(-Shvodian)-Frei and Smith rely on the same properties. IEEE802.3ah(-Shvodian)-Frei's ranging protocol relies on scheduled and actual message timing attributes. *See generally* above, ¶¶255-406. Similarly, Smith relies on message "time-stamps"—i.e., scheduled timing—and actual "arrival times." DISH-1009, 4:54-67.

444. Accordingly, a POSITA working with IEEE802.3ah(-Shvodian)-Frei would have had available the relevant information necessary to implement Smith with a reasonable expectation of success. Given the straightforward application of Smith's teachings to the IEEE802.3ah(-Shvodian)-Frei combination, a POSITA would have expected the IEEE802.3ah(-Shvodian)-Frei-Smith combination to be successful.

3. Dependent Claim 4

[4] "The method of claim 1, wherein a transmission time of a transmitted packet is measured at 90% of peak amplitude of a transmission signal, 90% of peak power of a transmission signal, 90% of total power of a transmission signal, or a mean delay of a transmission signal."

445. It is my opinion that IEEE802.3ah-Frei-Smith discloses claim 4.

446. First, dependent claim 4 recites "a transmission time of a transmitted packet," which is in contrast to the claimed "arrival time of a received packet" in claim 5. Dependent claim 4 is thus associated with downstream propagation delay.

447. Smith discloses the measurement of an arrival time based on the “mean delay,” which is “derived from,” among other things, “either the fastest pseudowire packet arrival times, or a mean delay of the pseudowire packet arrival times.” DISH-1009, 6:51-61. The claim requires that the transmission time be measured at one of (1) 90% of peak amplitude of a transmission signal, (2) 90% of peak power of a transmission signal, (3) 90% of total power of a transmission signal, or (4) a mean delay of a transmission signal. A POSITA would thus have found it obvious to measure downstream propagation delay by measuring the “transmission time” based on the mean delay between two network nodes.

448. As a result, it is my opinion that IEEE802.3ah-Frei-Smith discloses this claim.

4. Dependent Claim 5

[5] “The method of claim 1, wherein an arrival time of a received packet is measured at 90% of peak amplitude of a received signal, 90% of peak power of a received signal, 90% of total power of a received signal, or a mean delay of a received signal.”

449. It is my opinion that IEEE802.3ah-Frei-Smith discloses claim 5.

450. First, dependent claim 5 recites “arrival time of a received packet,” which is in contrast to the claimed “a transmission time of a transmitted packet” in claim 4. Dependent claim 5 is thus associated with upstream propagation delay.

451. Smith discloses calculating a “relative delay” “derived from,” among other things, “either the fastest pseudowire packet arrival times, or a mean delay of

the pseudowire packet arrival times.” DISH-1009, 6:51-61. Smith discloses the measurement of an arrival time at the “mean delay.” *Id.* A POSITA would understand that the arrival time is measured at “a mean delay” to measure propagation delay. *Id.*

452. The claim requires that the arrival time be measured at one of (1) 90% of peak amplitude of a received signal, (2) 90% of peak power of a received signal, (3) 90% of total power of a received signal, or (4) a mean delay of a received signal. A POSITA would thus have found it obvious to measure upstream propagation delay by measuring the “arrival time” based on the mean delay between two network nodes.

453. As a result, it is my opinion that IEEE802.3ah-Frei-Smith discloses this claim.

H. [GROUND 4B] – IEEE802.3ah in view of Shvodian, further in view of Frei, and in further view of Smith (Claims 14-15, 24-25, and 34-35)

1. Dependent Claims 14, 24, and 34

[14] “The network device of claim 11, wherein a transmission time of a transmitted packet is measured at 90% of peak amplitude of a transmission signal, 90% of peak power of a transmission signal, 90% of total power of a transmission signal, or a mean delay of a transmission signal.”

454. I have reviewed claims 4, 14, 24, and 34, and I conclude that claims 4, 14, 24, and 34 recite similar claim limitations.

455. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei-Smith discloses these claims for the same reasons that IEEE802.ah-Frei-Smith discloses claim 4. *See also* §VII(G)(1)-(2) (providing overview of Smith and explaining motivation to combine IEEE802.3ah-Shvodian-Frei with Smith).

2. Dependent Claims 15, 25, and 35

[15] “The network device of claim 11, wherein an arrival time of a received packet is measured at 90% of peak amplitude of a received signal, 90% of peak power of a received signal, 90% of total power of a received signal, or a mean delay of a received signal.”

456. I have reviewed claims 5, 15, 25, and 35, and I conclude that claims 5, 15, 25 and 35 recite similar claim limitations.

457. As such, it is my opinion that IEEE802.3ah-Shvodian-Frei-Smith discloses these claims for the same reasons that IEEE802.ah-Frei-Smith discloses claim 5. *See also* §VII(G)(1)-(2) (providing overview of Smith and explaining motivation to combine IEEE802.3ah-Shvodian-Frei with Smith).

VIII. ADDITIONAL REMARKS/CONCLUSION

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

459. I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false

statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code. I declare under penalty of perjury that the foregoing is true and correct.

Dated 2/8/2024



SCOTT ACTON