

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NOKIA OF AMERICA CORPORATION *et al.*,
Petitioners

v.

IANARCH TECHNOLOGIES, LIMITED.,
Patent Owner

Case No. IPR2024-00899

U.S. Patent No. 9,806,892

DECLARATION OF DR. ALEXANDER V. SERGIENKO

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Exhibit	Short Name	Description
Ex. 1001	'892 Patent	U.S. Patent No. 9,806,892
Ex. 1002	'892 File History	File History of U.S. Patent No. 9,806,892
Ex. 1003	Declaration	Declaration of Dr. Alexander V. Sergienko
Ex. 1004	CV	<i>Curriculum Vitae</i> of Dr. Alexander V. Sergienko
Ex. 1005	'892 Contentions*	Iarnach's Infringement Contentions for the '892 Patent in <i>Iarnach Techs. v. AT&T Corp., et al.</i> , Case No. 2:23-cv-0231-JRG (E.D. Tex.)
Ex. 1006	Röger*	M. Röger <i>et al.</i> , "Optically Powered Fiber Networks" Optics Express, Vol. 16, No. 26 (December 22, 2008)
Ex. 1007	G.987.3*	ITU-T Standard G.987.3 (2010)
Ex. 1008	G.988*	ITU-T Standard G.988 (2010)
Ex. 1009	Ghazisaidi	International Publication No. WO2013014483 to Ghazisaidi
Ex. 1010	G.9807.1*	ITU-T Standard G.9807.1 (2023)
Ex. 1011	Wong*	Shing-Wa Wong <i>et al.</i> , "Sleep Mode for Energy Saving PONs: Advantages and Drawbacks" 2009 IEEE Globecom Workshops

* Citations throughout are made to the exhibit page number rather than the document page number.

Exhibit	Short Name	Description
Ex. 1012	Dixit*	Abhishek Dixit <i>et al.</i> , “ONU power saving modes in next generation optical access networks: progress, efficiency and challenges” Optics Express, Vol. 20, No. 26 (December 10, 2012)
Ex. 1013	Amitai	U.S. Patent No. 9,209,897
Ex. 1014	Hood ’969	U.S. Patent No. 8,873,969
Ex. 1015	Hood ’813	European Patent Specification EP 2 710 813 B1
Ex. 1016	Hood ’080	European Patent Specification EP 2 692 080 B1
Ex. 1017	Schmuck	European Patent Specification EP 2 333 989 B1
Ex. 1018	Hall-Ellis Declaration	Declaration of Dr. Sylvia D. Hall-Ellis
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Ex. 1020	Attachment 1A	Hall-Ellis Declaration Attachment 1A
Ex. 1021	Attachment 2A	Hall-Ellis Declaration Attachment 2A
Ex. 1022	Attachment 2B	Hall-Ellis Declaration Attachment 2B
Ex. 1023	Attachment 2C	Hall-Ellis Declaration Attachment 2C
Ex. 1024	Attachment 2D	Hall-Ellis Declaration Attachment 2D
Ex. 1025	Attachment 3A	Hall-Ellis Declaration Attachment 3A
Ex. 1026	Attachment 3B	Hall-Ellis Declaration Attachment 3B
Ex. 1027	Attachment 3C	Hall-Ellis Declaration Attachment 3C
Ex. 1028	Attachment 3D	Hall-Ellis Declaration Attachment 3D

Exhibit	Short Name	Description
Ex. 1029	AT&T Case— DCO	Doc. No. 50, Docket Control Order, <i>Iarnach Technologies Ltd. v. AT&T Corp. et al.</i> , No. 2:23-cv-00231 (E.D. Tex.)
Ex. 1030	AT&T Case— Intervenor	Doc. No. 31, Order Granting Nokia’s Motion to Intervene, <i>Iarnach Technologies Ltd. v. AT&T Corp. et al.</i> , No. 2:23-cv-00231 (E.D. Tex.)
Ex. 1031	Caseload	U.S. District Courts – Judicial Caseload Profile (Dec. 2023)
Ex. 1032	Verizon Case— DCO	Doc. No. 45, Agreed Docket Control Order, <i>Iarnach Technologies Ltd. v. Verizon Communications, Inc. et al.</i> , No. 2:23-cv-00631 (E.D. Tex)
Ex. 1033	AT&T Complaint	Doc. No. 1, Complaint, <i>Iarnach Technologies Ltd. v. AT&T Corp. et al.</i> , No. 2:23-cv-00231 (E.D. Tex.)
Ex. 1034	Verizon Complaint	Doc. No. 1, Complaint, <i>Iarnach Technologies Ltd. v. Verizon Communications, Inc. et al.</i> , No. 2:23-cv-00631 (E.D. Tex)

DECLARATION OF DR. ALEXANDER V. SERGIENKO

I, Dr. Alexander V. Sergienko, do hereby declare and say as follows:

I. INTRODUCTION

1. My name is Dr. Alexander V. Sergienko, and I have been retained as a technical expert by counsel for Petitioners to address certain issues regarding U.S. Patent No. 9,806,892 (“the ’892 Patent”).

2. I have personal knowledge of the facts contained in this Declaration, am of legal age, and am otherwise competent to testify.

3. Unless otherwise stated, the matters contained in this Declaration are of my own personal knowledge and, if called as a witness, I could and would testify completely and truthfully with regard to the matters set forth herein.

4. My opinions are based on my years of education, research, and experience, as well as my study of the relevant materials. A list of materials I considered is included at the beginning of this Declaration.

5. I reserve all available rights to supplement this Declaration if further information becomes available, or if I am asked to consider additional information. This Declaration represents only those opinions I have formed to date.

6. Further, I reserve all available rights to consider and comment on any additional expert statements or testimony of Patent Owner’s expert(s) in this matter.

7. I am being compensated at my usual consulting rate of \$500 per hour for my time spent working on issues in this matter. My compensation does not depend on the outcome of this matter or the opinions I express.

II. QUALIFICATIONS

8. A true and correct copy of my curriculum vitae is attached as Ex. 1004 to this Declaration.

9. I received my Ph.D. in Quantum Radiophysics and Optics from Moscow State University in 1987 and my Master of Science Degree in Physics and Optics from Moscow State University in 1981.

10. I am currently a tenured full professor at Boston University where I hold joint appointments in the Photonics Center, the Department of Electrical and Computer Engineering, and the Department of Physics. My expertise and research interests include optics, photonics, secure communication, quantum physics, laser physics, nonlinear optics, and precise optical measurement in telecommunication and optical engineering.

11. I have experience and familiarity with the technical areas involved in this case. With over 30 years of research experience in the field of optics, I have studied and worked with optical networks such as those at issue in this case. For example, during my tenure as a Director of the Quantum Communication and Measurement Laboratory at the Boston University Photonics Center, I developed

quantum optical technologies for high-resolution characterization of optical device parameters (e.g., fibers, WDM switches, ROADM routers, and amplifiers) in telecommunication networks as well as technologies for secure communication (quantum cryptography).

12. My research areas of interest include, but are not limited to, lasers, optics, photonics devices, microscopy, nonlinear spectroscopy, and spectroscopic imaging; precise characterization of telecommunication networks and its elements including all-optical wavelength selective switches (WSS); liquid crystal spatial light modulators, MEMS-based optical switches, and DLP projecting displays; ultra-precise optical measurement in science and technology (quantum metrology), quantum sensors with attosecond (in time) and nanometer (in space) sensitivity based on quantum interferometry; OTDR with a mm spatial resolution; and secure quantum communication.

13. I have published 150 technical papers in major refereed research journals in the area of photonics, physics, and optical technology. Several of these research journals include: Nature Communications; Journal of the Optical Society of America; Physical Review Letters; and Physical Review A. These technical papers including a paper titled “Evaluation of Polarization Mode Dispersion in a Telecommunication Wavelength Selective Switch Using Quantum Interferometry” published in Optics Express; a paper titled “Precise evaluation of polarization mode

dispersion by separation of even- and odd-order effects in quantum interferometry” published in Optics Express; a paper titled “Odd- and Even-Order Dispersion Cancellation in Quantum Interferometry” published in Physical Review Letters; a paper titled “Dispersion and Fidelity in Quantum Interferometry” published in a Physical Review A; a paper titled “Photon-Counting Optical Coherence-Domain Reflectometry Using Superconducting Single-photon Detectors” published in Optics Express; a paper titled “Submicron axial resolution in an ultrabroadband two-photon interferometer using superconducting single-photon detectors” published in Optics Express; a paper titled “Simultaneous Measurement of Group and Phase Delay Between Two Photons” published in Physical Review A; a paper titled “Dispersion-Independent High-Visibility Quantum Interference in Ultrafast Parametric Down-Conversion” published in Physical Review Letters; a paper titled “Quantum Cryptography Using Femtosecond-Pulsed Parametric Down-Conversion” published in Physical Review A; a paper titled “Tests of a Two-photon Technique for Measuring Polarization Mode Dispersion with Subfemtosecond Precision” published in the Journal of Research of the National Institute of Standards and Technology; a paper titled “High Capacity Fibonacci Protocol for Quantum Communication” published in CLEO-Europe/QELS; a paper titled “High Capacity Fibonacci Protocol for Quantum Communication - Engineering Entangled States in High-Dimensional Hilbert Space” published in the First International Workshop for

Quantum Repeaters and Networks, Monterey, California; a paper titled “Development of Entangled-Coherent-State Quantum Key Distribution with Single-Photon Nonlinear Cross-Phase Modulation” published in QCrypt 2014, 4th international conference on quantum cryptography; a paper titled “High-resolution quantum measurement in modern telecommunication using broadband entanglement and fast single-photon detectors” published in the 2nd International Conference on Quantum Technology, Russian Quantum Center; a paper titled “High resolution optical time-domain reflectometry using superconducting single-photon detectors” published in ICONO/LAT: 2013; and a paper titled “Adaptive Optics Control of the Propagation of Biphoton Wavepacket” published in OSA Optics and Photonics Congress Imaging and Applied Optics.

14. I have presented more than 330 research papers at major international research conferences including multiple invited and plenary talks. I have contributed 7 book chapters on precise optical measurement and quantum optics. I have served as the sole editor of a book titled Quantum Communications and Cryptography and a co-author of a book “Quantum metrology, Imaging, and Communication” with two of my former postdocs.

15. I am an inventor on eight patents, including U.S. Patent No. 6,646,727, titled “Polarization Mode Dispersion Characterization Apparatus and Method,” and

U.S.S.R. Patent No. 51533534, titled “A Method for the Measurement of Time Parameters of Optical Processes and Photoelectric Devices.”

16. I have taught courses in optical measurement, quantum optics, photonics, electrical circuit theory, and analog electronics. I have also been an advisor to graduate students researching various subjects in physics, electrical engineering, and photonics.

17. I am a Fellow of the Optical Society of America (“OSA”) (<10% of total OSA members) and have been a lead of Quantum Computing and Communication Technical Group at OSA for several years. I am a member of the American Physical Society and a member of IEEE. I currently serve as an associate editor for two major physics and optics international research journals: Physical Review Letters and Journal of Optics.

18. From 1990 to 1996, I worked for the University of Maryland and the National Institute of Standards and Technology (“NIST”). While at NIST, I developed several novel optical measurement technologies that outperformed existing conventional approaches both in resolution and in accuracy. In 1996, I joined the Photonics Center and the Department of Electrical and Computer Engineering at Boston University. I since have been a member of the Boston University faculty.

19. While at NIST and Boston University I developed several new technologies allowing to evaluate several critical parameters of telecommunication networks and their elements, such as fibers, WDM switches, and ROADM routers. This involved the characterization of the fiber network quality based on single-photon optical time-domain reflectometry (OTDR) and measurement of polarization mode dispersion (PMD) and polarization-dependent loss (PDL) with superior resolution based on the use of quantum interferometry.

III. SCOPE OF THE ENGAGEMENT

20. I have been retained by Alston & Bird LLP on behalf of Petitioners to provide various analyses and opinions. Among other tasks, I have been asked to address the technology claimed in the '892 Patent and to evaluate whether certain claims of the '892 Patent would have been obvious to a person of ordinary skill in the art.

21. All of the opinions I express in this Declaration have been made from the standpoint of a person of ordinary skill in the relevant art at the time of the invention of the '892 Patent, which I am informed is, for purposes of this matter, the earliest claimed priority date of July 13, 2012.

22. I have been asked to identify the level of skill in the art pertinent to the '892 Patent. It is my opinion that a person of ordinary skill in the art pertinent to the '892 Patent would have had at least a bachelor's degree in electrical engineering,

computer engineering, or similar discipline and had at least two years of experience with optical communications and networks. A person with a different degree but with additional relevant experience could still qualify if the additional experience compensates for the different educational background.

23. I consider myself a person of ordinary skill in the art as of no later than the earliest claimed priority date (July 13, 2012).

24. My opinions are based on my experience and knowledge and the information I have reviewed as of the date of this Declaration. In connection with my analysis, I have reviewed the exhibits listed in the above list of exhibits, as well as each of the items referenced herein. My opinions directed to the invalidity of the challenged claims are based, at least in part, on the following prior art publications:

25. **“G.987.3”** (Ex. 1007), which is ITU-T Recommendation G.987.3 titled “10-Gigabit-capable Passive Optical Networks (XG-PON): Transmission convergence (TC) layer specification” approved October 2010 and published October 2011.

26. **“Röger”** (Ex. 1006), which is an article titled “Optically powered fiber networks” published December 17, 2008.

27. **“G.988”** (Ex. 1008), which is ITU-T Recommendation G.988 titled “ONU management and control interface (OMCI) specification” approved October 2010 and published October 2011.

28. “**Ghazisaidi**” (Ex. 1009), which is International Publication No. WO2013014483, filed on July 27, 2011 designating the United States (among other states) and published on January 31, 2013.

IV. LEGAL STANDARDS

29. For purposes of this Declaration, counsel for Petitioners have instructed me to make the following assumptions:

30. Claims are construed from the perspective of a person of ordinary skill in the art (“POSITA”) as of the effective filing date of the patent application. Persons of ordinary skill in the art are deemed to read the claims in the context of the entire patent, including the specification and prosecution history. In other words, the terms are not considered in a vacuum.

31. It is my understanding that information that satisfies one of the categories of prior art set forth in 35 U.S.C. § 102 may be used in an invalidity analysis under §§ 102 or 103. If information is not properly classified as prior art under one of the subsections of § 102 of the Patent Act, then it may not form the basis of an anticipation or obviousness determination. It is also my understanding that, for inter partes review, applicable prior art is limited to patents and printed publications.

32. I am also informed and understand that a patent claim is invalid under 35 U.S.C. § 103 if the differences between the invention and the prior art are such

that the subject matter as a whole would have been obvious at the time of the invention to a POSITA to which the subject matter pertains. Obviousness, I am informed, is determined based on the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and secondary indications of non-obviousness to the extent they exist.

33. I understand that whether there are any relevant differences between the prior art and the claimed invention is to be analyzed from the view of a POSITA at the time of the invention. A POSITA is a hypothetical person who is presumed to be aware of all of the relevant art at the time of the invention. The POSITA is not an automaton and may be able to fit together the teachings of multiple patents (or other printed publications) by employing ordinary creativity and the common sense that familiar items may have obvious uses in another context or beyond their primary purposes.

34. In analyzing the relevance of the differences between the claimed invention and the prior art, I understand that I must consider the impact, if any, of such differences on the obviousness or non-obviousness of the invention as a whole, not merely some portion of it. The person of ordinary skill faced with a problem is able to apply his or her experience and ability to solve the problem and also look to any available prior art to help solve the problem.

35. I understand that an invention would have been obvious if a POSITA, facing the wide range of needs created by developments in the field, would have seen an obvious benefit to the solutions tried by the patent applicant. When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, it would have been obvious to a POSITA to try the known options. If a technique has been used to improve one device, and a POSITA would recognize that it would improve similar devices in the same way, using the technique would have been obvious.

36. I understand that I do not need to look for precise teachings in the prior art directed to the subject matter of the claimed invention. I understand that I may consider the inferences and creative steps that a POSITA would have employed in reviewing the prior art at the time of the invention. For example, if the claimed invention combines elements that were known in the prior art and if the combination yields results that were predictable to a POSITA at the time of the invention, then this would make it more likely that the claim was obvious. On the other hand, if the combination of known elements yields unexpected or unpredictable results, or if the prior art teaches away from combining the known elements, then this would make it more likely that the claim that successfully combined those elements was not obvious. I understand that hindsight must not be used when comparing the prior art to the invention during an obviousness analysis.

37. I understand that obviousness may be shown by demonstrating that it would have been obvious to modify what is taught in a single piece of prior art to create the patented invention. Obviousness may also be shown by demonstrating that it would have been obvious to combine the teachings of more than one item of prior art. I understand that a claimed invention may be obvious if some teaching, suggestion, or motivation exists that would have led a POSITA to combine the invalidating references. I also understand that this suggestion or motivation may come from sources such as explicit statements in the prior art, or from the knowledge of a person having ordinary skill in the art. Alternatively, any need or problem known in the field at the time and addressed by the patent may provide a reason for combining elements of the prior art. I also understand that when there is a design need or market pressure, and there are a finite number of predictable solutions, persons of ordinary skill may be motivated to apply both their skill and common sense in trying to combine the known options in order to solve the problem.

38. I understand that absent evidence of an invention date prior to the filing date of a patent, the invention date of the patent is presumed to be its filing date. A prior invention requires a complete conception of the invention and a reduction to practice of that invention. The patent owner has the burden of establishing by clear and convincing evidence a date of conception earlier than the filing date of the patent.

V. RELEVANT TECHNICAL BACKGROUND

39. In this technical background, I describe the pertinent technology as it existed as of July 13, 2012, the assumed priority date of the '892 Patent. As I will describe, all these ideas were well known to a POSITA at the time of the alleged invention.

A. Passive Optical Networks

40. A Passive Optical Network (PON) is a fiber-optic telecommunications network that provides Ethernet connectivity from a main data source to endpoints. A fiber-optic network transmits information, in the form of pulses of light, from one location to another. The pulses of light, called signals, represent bits of data. For example, the bits of data may represent video, speech, still picture, motion, smoke, temperature, and/or the like. Ex. 1006 (Röger), 5.

41. In contrast to active optical networks, a PON distributes a single signal to multiple branches, point-to-multipoint, through unpowered optical beam splitters. *See* Ex. 1006 (Röger), 4-5, 11; Ex. 1007 (G.987.3), 9, 84. Instead of active devices in these locations, PONs use small passive optical splitters. *See* Ex. 1006 (Röger), 4-5, 11; Ex. 1007 (G.987.3), 84.

42. PONs consist of a network-side interface at the main source, or head-end, and a client-side interface at the endpoints. Optical Line Termination (OLT) (used interchangeably with Optical Line Terminal) provides the network-side

interface of the network while Optical Network Terminations (ONTs), or Optical Network Units (ONUs), provide the client-side or user-side interface. ONTs and ONUs are virtually identical from a functionality point of view and will be referred to in unison throughout.

43. PONs garnered popularity in the late 1990s and early 2000s because of their numerous benefits, such as their ability to convey significantly more information than conventional electrical cables. For example, an optical fiber operating at 10 Gb/s can carry data equivalent to over 128,000 voice calls. Dozens of fibers may be included in a single cable, thereby multiplying the amount of data that can be transmitted. Because optical cables convey considerably more data than conventional electrical cables, fiber-optic networks are used to transmit large amounts of data across cities, states, and continents.

44. Further, PONs allowed for long reach between central offices and customer premises, minimized fiber deployment, provided higher bandwidth, and eliminated the necessity to install active multiplexers at splitting locations, thus relieving operators of the gruesome task of maintaining active curbside units and providing power to them.

45. To standardize communication networks and allow interoperability for equipment in PON networks, the ITU-T issued a series of recommendations. One such recommendation was G.987.3, which describes “the transmission convergence

layer for 10-gigabit-capable passive optical network systems – a family of flexible access network systems that operate over a point-to-multipoint optical access infrastructure at nominal data rates in the order of 10.0 Gbit/s in at least one direction, while providing a wide range of broadband and narrow-band services to end users.” Ex. 1007 (G.987.3), 3, 9. G.987.3 further discloses components of the PON including an optical line termination (OLT) and optical network units (ONUs). Ex. 1007 (G.987.3), 10, 97-106. The OLT provides the network-side interface of the network while ONUs provide the client-side or user-side interface.

VI. OVERVIEW OF THE '892 PATENT

46. The claims of the '892 Patent that are being challenged, and that I have been asked to evaluate, are claims 1-5 and 10-15. I have reproduced the challenged claims below:

Claim	Recitation
1[A]	A method of optical communication in a passive optical network, comprising:
1[B]	operating an optical network unit (ONU) in a first state in which a transmitter of the ONU is turned off and a receiver of the ONU is turned on;
1[C]	operating the ONU in a second state in which both the transmitter and the receiver are turned off;
1[D]	transitioning the ONU directly from the first state to the second state and transitioning the ONU directly from the second state to the first state, based on a power management rule;
1[E]	ensuring the ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first state or the second state; and

1[G]	receiving, by the receiver, a power management message from an optical line terminal (OLT); and
1[E]	changing the power management rule based on the received power management message.
2	The method of claim 1, further comprising: operating the ONU in a third state in which both the transmitter and the receiver are turned on.
3	The method of claim 1, wherein the power management rule specifies a first time period for operation in the first state and a second time period for operation in the second state and wherein the transitioning is performed upon expiration of at least one of the first time period and the second time period.
4	The method of claim 1, further comprising: transmitting, to an optical line terminal, a message indicative of the transitioning between the first state and the second state.
5	The method of claim 1, further comprising: performing the transitioning responsive to the received power management message and a local decision to change an operational state.
10[A]	An optical communication apparatus, comprising:
10[B]	a memory that stores processor-executable instructions; and
10[C]	a processor that uses the stored instructions to implement a method, comprising operating an optical network unit (ONU) in a first state in which a transmitter of the ONU is turned off and a receiver of the ONU is turned on; and operating the ONU in a second state in which both the transmitter and the receiver are turned off; and
10[D]	wherein the processor includes means for transitioning the ONU directly from the first state to the second state and means for transitioning the ONU directly from the second state to the first state, based on a power management rule;
10[E]	wherein the processor uses stored instructions to ensure the ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first state or the second state; and
10[F]	wherein the processor further uses the stored instructions to implement the method by receiving, by the receiver, a power management message from an optical line terminal (OLT) and changing the power management rule based on the received power management message.

11	The apparatus as in claim 10, wherein the power management rule specifies a first time period for operation in the first state and a second time period for operation in the second state and wherein the transitioning is performed upon expiration of at least one of the first time period and the second time period.
12[A]	An optical line terminal (OLT) for operation in a passive optical network (PON), the optical line terminal comprising:
12[B]	a processor configured to generate messages for controlling a transition of an optical network unit from a first low power state in which a receiver of the optical network unit is turned on but a transmitter of the optical network unit is turned off to a second low power state in which both the receiver and the transmitter of the optical network unit are turned off;
12[C]	a transmitter configured to transmit the generated messages to the optical network unit;
12[D]	wherein the generated messages comprises a periodic consent message to allow the optical network unit to remain in either the first low power state or the second low power state.
13	The optical line terminal as in claim 12, wherein the processor includes means for specifying a first time period for operation in the first low power state and a second time period for operation in the second low power state and wherein the transition of the optical network unit from the first low power state to the second low power state is controlled to occur upon expiration of at least one of the first time period and the second time period.
14[A]	A passive optical network (PON) communications system, comprising:
14[B]	an optical network unit (ONU) operable in a first low power mode in which the ONU is able to receive but not transmit and a second low power mode in which the ONU is not able to either receive or transmit, wherein the ONU is configured to transition from the first low power mode to the second low power mode and to transition from the second low power mode to the first low power mode based on a power management rule, and wherein the ONU changes a power management rule based on a received power management message;
14[C]	an optical line terminal (OLT) communicably coupled to the ONU, the OLT configured to transmit a control message to the ONU to control at least one aspect of transition of the ONU between the first low power mode and the second low power mode; and

14[D]	the ONU configured to ensure that the ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first low power mode or the second low power mode.
15	The system as in claim 14, wherein: the OLT is configured to transmit the control message that includes the power management rule that specifies a first time period for operation in the first low power state and a second time period for operation in the second low power state and to control the ONU to transition from the first low power state to the second low power state upon expiration of at least one of the first time period and the second time period.

A. Prosecution History

47. In the first Office Action, the Examiner rejected Claims 1-17 under pre-AIA 35 § U.S.C. 103(a) as being unpatentable over Skubic in view of Pfeiffer. Ex. 1002 ('892 File History), 130-135. In response, the Applicant amended independent claim 1 to recite “ensuring the ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first state or the second state,” and Applicant amended several other independent claims in similar fashion. Ex. 1002 ('892 File History), 95-104. The Applicant amended independent claim 14 to recite “wherein the generated messages comprises a periodic consent message to allow the optical network unit to remain in either the first low power state or the second low power state.” Ex. 1002 ('892 File History), 99. Applicant also argued that Pfeiffer relates to “wireless networks designed for use in industrial environments” and was not reasonably pertinent to the problem faced by the inventor. Ex. 1002 ('892 File History), 102. Specifically, the Applicant argued that Pfeiffer was not relevant to the problem that the “traditional standards of compliance in optical equipment required that the ONU could not go from one low power state directly to another low power state.” Ex. 1002 ('892 File History), 102.

48. In the second Office Action, the Examiner rejected Claims 1-17 under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over Skubic in view of Pfeiffer and further in view of G.987.3. Ex. 1002 ('892 File History), 80-87. In response, the

Applicant amended independent claim 1 to recite “receiving, by the receiver, a power management message from an optical line terminal (OLT)” and “changing the power management rule based on the received power management message,” and amended several other independent claims in similar fashion. Ex. 1002 (’892 File History), 63-74. The Applicant argued that Skubic fails to teach that a power management rule is changed based on the received power message because “the signalling from the OTL [sic] to the ONU only commands the ONU to transition between states and may not change the underlying rule,” Ex. 1002 (’892 File History), 71. The Applicant further argued that Skubic didn’t teach that updating the ONU state machine was related to the claimed power management rule. Ex. 1002 (’892 File History), 71. Regarding independent claim 14, the Applicant argued that the G.987 did not disclose periodic consent messages to allow an optical network unit to remain in a low power state. Ex. 1002 (’892 File History), 71-73.

49. In the third Office Action, the Examiner rejected Applicant’s arguments regarding Skubic. Ex. 1002 (’892 File History), 35-44. The Examiner rejected claims 1-2, 4-8, 10-13, and 16-17 under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over Skubic in view of Pfeiffer and further in view of ITU-T G.987.3. Ex. 1002 (’892 File History), 38. The Examiner rejected claims 14-15 under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over Skubic in view of Ma. Ex. 1002 (’892 File History), 42. In response, the Applicant amended independent claim 1 to recite

“transitioning the ONU directly from the first state to the second state and transitioning the ONU directly from the second state to the first state, based on a power management rule,” and the Applicant amended several other independent claims in similar fashion. Ex. 1002 (’892 File History), 22-34. Regarding independent claim 14, the Applicant argued that Skubic in view of Ma does not teach that periodic consent messages allow the ONU to remain in “either the first low power state or the second low power state.” Ex. 1002 (’892 File History), 28. A Notice of Allowance was then mailed. Ex. 1002 (’892 File History), 9-13.

B. Priority Date

50. I understand that the ’892 Patent issued from U.S. Patent Application No. 14/414,698 (“the ’698 Application”) filed January 13, 2015. I understand that the ’698 Application is a national stage entry of PCT application no. PCT/US2013/05033, filed July 15, 2013. I understand that the application claims foreign priority to PCT application PCT/CN2012/78649, filed July 13, 2012. For purposes of this declaration, I have assumed that the earliest alleged priority date of the ’892 Patent is not earlier than July 13, 2012.

C. Claim Construction

51. Based on my review of the ’892 Patent and its file history, a POSITA would have understood the claims in light of the specification, and interpreted them

by using their plain and ordinary meaning in accordance with the then current state of the art.

52. Certain elements of claims 10 and 13 should be construed under 35. U.S.C. § 112(f). Specifically, the following material claim terms should be construed under 35. U.S.C. § 112(f).

- “wherein the processor includes *means for transitioning the ONU directly from the first state to the second state and means for transitioning the ONU directly from the second state to the first state, based on a power management rule*” (10[D]).
- “wherein the processor includes *means for specifying a first time period for operation in the first low power state and a second time period for operation in the second low power state*” (Claim 13).

53. The '892 Patent generally discloses a flow chart, Figure 8, that describes a method 800 that operates on an ONU. Ex. 1001 ('892 Patent), FIG. 8. Further, the '892 Patent states that “[t]he processes and logic flows described in this document can be performed by one or more programmable processors executing one or more computer programs to perform functions by operating on input data and generating output.” Ex. 1001 ('892 Patent), 14:8-11. Further, the '892 Patent states that “[p]rocessors suitable for the execution of a computer program include, by way of example, both general purpose and special purpose microprocessors, and any one

or more processors of any kind of digital computer.” Ex. 1001 (’892 Patent), 14:17-20. As such, the structure for the means enumerated above in Claim 10 and Claim 13 are each designed to be implemented on a processor that can execute computer program instructions. Ex. 1001 (’892 Patent), 14:8-39.

D. The ’892 Patent’s Specification

54. The ’892 Patent discloses a “passive optical network” including an “optical line terminal” in connection with one or more “optical network unit[s]” (ONUs). Ex. 1001 (’892 Patent), 1:19-41. The specification of the ’892 Patent also cites to G.987.3 as disclosing a passive optical network. Ex. 1001 (’892 Patent), 4:25-29. The ONUs of the ’892 Patent can operate in an “ONU Dozing mode,” in which the ONU transmitter is powered off and the ONU receiver is powered on. Ex. 1001 (’892 Patent), 4:17-24. A parameter may be configured to the ONU specifying a maximum time interval in which the ONU is allowed to remain in the ONU Dozing mode. Ex. 1001 (’892 Patent), 4:52-61. The ONUs of the ’892 Patent further discloses an “ONU Cyclic sleep mode” in which the ONU transmitter and ONU receiver are powered off. Ex. 1001 (’892 Patent), 4:17-24. A parameter may be configured to the ONU specifying a maximum time interval in which the ONU can be allowed to remain in the ONU Cyclic sleep mode. Ex. 1001 (’892 Patent), 5:12-20. When in a power saving mode, “the ONU spends most of the time toggling between the Sleeping power level (with the lowest power consumption) and the

Dozing power level (with the next lowest power consumption), only occasionally returning to the full-power level operation.” Ex. 1001 (’892 Patent), 6:3-8. Transitions between these power states may be based on a power management rule. Ex. 1001 (’892 Patent), 12:31-45. The power management rule “may be based on the timing parameters that control how long the ONU can be in” the sleep or dozing mode. Other power management rules include transitioning based on user input, messages from the OLT, and the like. Ex. 1001 (’892 Patent), 12:31-45.

VII. SUMMARY OF THE PRIOR ART

A. Optically Powered Fiber Networks (Röger)

55. Röger was published on December 17, 2008. Ex. 1006 (Röger). Dr. Hall-Ellis has testified that the issue of the open access journal *Optics Express* that included Röger was “publicly available on December 17, 2008, because by that date it had been cataloged and indexed at the Library of Congress, made part of the OCLC bibliographic database, and received at the National Library of Medicine.” Ex. 1018 (Hall-Ellis Declaration), ¶67. The publication date is confirmed by Schmuck. The publication date is confirmed by Schmuck. Ex. 1019 (Hall-Ellis CV), pg. 1, [0005], pg. 15. Röger was not cited and was not considered during the prosecution.

56. Röger discloses an optical communication system including “optical line terminations” and “optical network units.” Ex. 1006 (Röger), 5. The system of Röger uses a “low-energy medium-access control (LE-MAC) protocol, which

enables efficient use of the optically provided energy that is transmitted to each subscriber.” Ex. 1006 (Röger), 3. In this low-energy protocol, optical network units may operate in a low-power “sleep” mode with a receiver and transmitter off, while “nearly periodically” turning on their receiver circuitry to listen for polling from an optical line termination. Ex. 1006 (Röger), 5, 7, 11-12. Polling indicating a rendezvous time may be received, in which case an optical network unit transitions to a low-power snooze mode with receiver and transmitter off until a rendezvous time when the optical network unit communicates with the optical line terminal. Ex. 1006 (Röger), 5, 6-8, 11-12.

B. ITU-T Standard G.987.3 (2010)

57. G.987.3 is an ITU-T standard approved on October 7, 2010 and published on October 3, 2011. Ex. 1007 (G.987.3), 1, 3. G.987.3 was identified in the specification of the ’892 Patent and was cited in prosecution. Ex. 1002 (’892 File History), 25, 38, 40-41, 69-73, 82-88, 144, 162. Thus, there can be no dispute that G.987.3 was publicly available prior to the priority date of the ’892 Patent. G.987.3 and its citation during the prosecution history is addressed in further detail above in Section VI.A. *See supra* §VI.A. Dr. Hall-Ellis has testified that G.987.3 was “publicly available on October 3, 2011, because by that date it had been approved by the ITU-T Study Group 15 and posted on the ITU website.” Ex. 1018 (Hall-Ellis Declaration), ¶57. The public availability prior to the priority date of the ’892 Patent

is further confirmed by numerous other patents and printed publications. See, e.g., Ex. 1015 (Hood '813), pg. 2, col. 2: 9-49, 5:36-53, col. 7:1-5; Ex. 1016 (Hood '080), pg. 2, col. 1:19-27; Ex. 1017 (Schmuck), [0002], [0038], pg. 24; Ex. 1018 (Hall-Ellis Declaration), pg. 1, [0010], [0019], [0026]-[0027], pg. 20.

58. G.987.3 discloses a passive optical communication network including an optical line terminal and optical network units. Ex. 1007 (G.987.3), 10, 97-106. An optical network unit in the network may operate in low power states including an “Asleep” state with its receiver and transmitter off, a “Listen” state with its receiver on and transmitter off, or in higher power states with both receiver and transmitter on. Ex. 1007 (G.987.3), 100. When transitioning from low power states, the optical network unit ensures that it is “fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control.” Ex. 1007 (G.987.3), 100. The optical network units and optical line terminal exchange “Sleep_Allow” and “Sleep_Request” messages that affect which state the optical network units operate in. Ex. 1007 (G.987.3), 57, 59, 99-105.

C. ITU-T Standard G.988 (2010)

59. G.988 is an ITU-T standard approved on October 7, 2010 and published on September 22, 2011. Ex. 1008 (G.988), 1, 3. Dr. Hall-Ellis has testified that G.988 was “publicly available on September 22, 2011, because by that date it had been approved by the ITU-T Study Group 15 and posted on the IUT website.” Ex. 1018

(Hall-Ellis Declaration), 60. The publication date is confirmed by Amitai. See Ex. 1013 (Amitai), pg. 2, col. 5:31-40. G.988 was not cited and was not considered during prosecution.

60. G.988 “specifies the optical network unit (ONU) management and control interface (OMCI) for optical access networks as defined in” ITUT-T G.987.3. Ex. 1008 (G.988), 7. G.988 addresses “ONU configuration, fault management and performance management for optical access system operation” and “defines a protocol necessary to support the capabilities identified for these ONUs.” Ex. 1008 (G.988), 7.

D. International Publication No. WO2013014483 (Ghazisaidi)

61. Ghazisaidi is an international application filed on July 27, 2011, designating the United States (among other states) and published in English. Ex. 1009 (Ghazisaidi), Cover. Ghazisaidi was not cited and was not considered during prosecution.

62. Ghazisaidi describes “energy efficient dynamic bandwidth allocation in optical networks.” Ex. 1009 (Ghazisaidi), [0001]. Ghazisaidi discloses an optical line terminal and optical network units communicating in a passive optical network. Ex. 1009 (Ghazisaidi), [0003]. Ghazisaidi further discloses a control device that may be implemented in the optical line terminal and/or the optical network units

including a processor and a memory used to store various instructions for the processor. Ex. 1009 (Ghazisaidi), [0052].

VIII. THE PRIOR ART RENDERS OBVIOUS THE CLAIMS OF THE '892 PATENT

A. Ground 1: G.987.3 in View of Röger and Further in View of G.988 Renders Obvious Claims 1-5 and 14-15 of the '892 Patent.

63. Passive optical networks were first developed in the mid-1990s, years before the '892 Patent. The ITU-T documents, including G.987.3, define and coordinate standards for telecommunications technologies around the world including passive optical networks. The ITU-T recommendations are essential for ensuring that all passive optical networks can function efficiently. The standards defined in these recommendations allow passive optical networks from around the world to interconnect. While individual optical network units, optical line terminals, and passive optical networks may differ, all must be within the boundaries defined by the ITU-T recommendations in order to operate with other components.

64. There can be no dispute that the majority of the elements of the independent claims of the '892 Patent are disclosed by ITU-T standard G.987.3. In its related infringement contentions, Patent Owner has mapped the majority of claim elements to the later ITU-T standard G.9807.1. Ex. 1005 ('892 Contentions), 1-25. However, many of the cited sections in the infringement contentions are the same or substantially similar to sections present in G.987.3. Ex. 1005 ('892 Contentions), 1-

11, 15-25; Ex. 1007 (G.987.3), 97-106. In fact, every claim element from the infringement contentions except for 1[D] is mapped to a section of G.9807.1 that is the same or substantially similar to G.987.3. Ex. 1005 ('892 Contentions), 1-11, 15-25; Ex. 1007 (G.987.3), 97-106.

65. To the extent that Patent Owner can argue that there is any claim recitation that was not disclosed by or obvious in view of the ITU-T standard G.987.3, it is 1[D] – “transitioning the ONU directly from the first state to the second state and transitioning the ONU directly from the second state to the first state, based on a power management rule.” As is disclosed below and to the extent that it is argued that 1[D] is not taught or suggested by the state diagram of ITU-T standard G.987.3 and the POSITA’s understanding of the market pressure to reduce power consumption, the POSITA would have understood that direct transitions were well known in the art. For at least these reasons and for the reasons outlined below in Ground 1, the claims at issue are unpatentable.

Motivation to Combine

66. A POSITA would have been motivated to combine G.987.3 with G.988 and Röger for at least the following reasons. First, G.987.3 and G.988 are both ITU-T standards that are intended to operate together and inform the implementation of optical networks. Ex. 1007 (G.987.3), 1; Ex. 1008 (G.988), 1. In fact, G.987.3 and G.988 each explicitly reference one another. Ex. 1007 (G.987.3), 9-10, 97-98; Ex.

1008 (G.988), 7-8. Moreover, each of G.987.3 and G.988 are standards directed towards optical systems including optical network units. Ex. 1007 (G.987.3), 10, 97-106; Ex. 1008 (G.988), 7, 12, 18. Thus, there can be no dispute that a person of ordinary skill in the art would have been motivated to combine and, in fact, routinely did combine G.987.3 and G.988 when implementing optical networks. For example, a POSITA would have relied on G.988 to inform architecture for exchanging OMCI signals between an OLT and an ONU. Ex. 1008 (G.988), 18.

67. Like G.987.3 and G.988, the disclosures in Röger are directed towards optical communications in a passive optical network. Ex. 1006 (Röger), 2; Ex. 1007 (G.987.3), 1, 3; Ex. 1008 (G.988), 12. In particular, all of G.987.3, G.988 and Röger are directed to communications between optical line terminals and optical network units. Ex. 1006 (Röger), 5; Ex. 1007 (G.987.3), 10, 97-106; Ex. 1008 (G.988), 3.

68. Additionally, G.987.3, G.988, and Röger disclose optical network units operating in a first low power mode where a receiver is on and a transmitter is off and a second low power mode where both the receiver and transmitter are off. Ex. 1006 (Röger), 5-8, 11-12; Ex. 1007 (G.987.3), 100-102; Ex. 1008 (G.988), 81. G.987.3 and Röger specifically suggest that these modes allow the optical network units to save power. Ex. 1006 (Röger), 6-8, 10-13; Ex. 1007 (G.987.3), 97-106. Both G.987.3 and Röger address transitions between power states. Ex. 1006 (Röger), 6-8, 10-13; Ex. 1007 (G.987.3), 97-106. Röger would have been developed in view of an

earlier version of the ITU-T recommendations for passive optical networks. G.987.3, however, does not explicitly allow direct transitions between a Doze mode (which includes the first low power state) and Cyclic sleep mode (which includes the second low power state). Ex. 1007 (G.987.3), 101.

69. It should be noted that note 2 of the OLT state transition and output table in G.987.3 states that “[d]irect transitions between Doze mode and Cyclic Sleep mode are disallowed.” Ex. 1007 (G.987.3), 105. This note is only applicable to the OLT, and there is no similar restriction or note in the ONU state transition and output table. In fact, the same note is present in the OLT state transition and output table of G.9807.1, while direct transitions between the ONU’s Asleep and Listen states are incorporated into a single LowPower state (watchful sleep state). Ex. 1010 (G.9807.1), 235-238. G.9807.3 allows a LowPowerWatch state for the OLT to support ONUs in the LowPower state (watchful sleep state) but continues to disallow direct transitions between Doze and Cyclic sleep mode, indicating that these transitions are a responsibility of internal ONU management. Furthermore, G.987.3 further states that the OLT is responsible for dealing with the possibility that the ONU does not receive downstream traffic from the ONU and allow for extra response delays if the ONU is incapable of responding in a normal time. Ex. 1007 (G.987.3), 106. Thus, it is the responsibility of the OLT to prepare for an ONU performing direct transitions.

70. It would have been obvious to the POSITA to allow for direct transitions between a first power state (e.g., Listen mode) and a second low power mode (e.g., Asleep mode). This is driven by a well-known problem in the field, reducing power consumption. As stated in G.987.3, “it is desirable to reduce the power consumed by an ONU as much as possible.” Ex. 1007 (G.987.3), 97. As was well known, it was desirable to reduce power to realize “more efficient realizations of given functions” as technology achieves higher levels of functionality and speed. Ex. 1007 (G.987.3), 97. Greater power consumption leads to greater cost, and in a passive optical network with multiple ONUs, saving power consumed by each ONU can lead to a significant reduction in total cost. Moreover, there are a finite number of solutions to reduce power consumption in optical networks. Moreover, the possible transitions between different low power states is even more limited given the limited number of power states and the limited number of scenarios for an ONU to transition between them. Therefore it would have been obvious to a POSITA to try the finite number of transitions and find that direct transition between the Listen mode and the Asleep sleep mode would reduce power consumption compared to transitioning to a full power state in between the Listen mode and the Asleep sleep mode.

71. Regardless, it was well known as of the effective filing date of the ’892 Patent for an ONU to directly transition between two low power states. Specifically,

Röger teaches that ONUs may transition directly back and forth between the first low power state and the second low power state as part of a “low-energy” protocol which allows efficient use of the optically provided energy transmitted to optical network units. Ex. 1006 (Röger), 6-8, 10-13. This “low-energy” protocol allows an optical network unit to nearly periodically listen for signals from an optical line terminal without wasting power by turning on their transmitters. Ex. 1006 (Röger), 6-8, 10-13. If the optical network unit receives a signal indicating a rendezvous time at which to communicate with the optical line terminal, the optical network unit continues to save the most power possible by snoozing until the rendezvous time. Ex. 1006 (Röger), 6-8, 12.

72. A POSITA would have been motivated to apply these direct transitions to the optical network units of G.987.3 in view of the known advancements in technology at the time.¹ Advancements in chip speed that occurred prior to the priority date of the '892 Patent made it more practical to periodically turn on and off a receiver while a transmitter remained off in an ONU. In particular, a POSITA would have been motivated to apply the direct transitions of Röger in light of advancements in how fast a receiver could be switched on from a sleep mode.

¹ Röger would have been developed in view of an earlier version of the ITU-T recommendations for PONs.

Periodically turning on a receiver was previously less efficient due to a slower continuous mode (CM) clock and data recovery (CDR) time of 2-5 milliseconds for each RxOn event for earlier electronic circuits. Ex. 1011 (Wong), 3-4. However, prior to the priority date of the '892 Patent, it was known that a modern Burst mode (BM) CDR technology which utilized a local oscillator unit at each ONU reduced the CDR time down to 1-10 nanoseconds. Ex. 1011 (Wong), 3-4. This reduced time for an RxON event made it much more practical to periodically switch the receiver on and off while keeping the transmitter off, since delays in CDR and additional power consumption were reduced.² This improvement to electronic chip and circuits technology also reduced the attractiveness of leaving an ONU in a receive-only state since additional power could be saved by periodically switching the receiver off without causing significant delay during transition.

73. Given this improvement to electronic chip and circuits technology, a POSITA would have been motivated to apply the direct transitions between sleep and receive states from Röger to G.987.3. The POSITA would have been motivated to apply these transitions because Röger specifically states that its protocol

² Indeed, other authors around the time of the priority date acknowledged that remaining in a receive mode only made sense for ONUs that are equipped with CM-CDR rather than BM-CDR. Ex. 1012 (Dixit), 4-5.

(including direct transitions) allows optical network units to operate with “the least possible power consumption.” Ex. 1006 (Röger), 6. A POSTIA would further have been motivated to “save both energy and communication bandwidth” by applying the direct transitions found in Röger. Ex. 1006 (Röger), 7. A POSITA would have known that saving energy and communication bandwidth would allow the passive optical network systems of G.987, G.988, and Röger to perform their functionality with more efficiency. For example, saving energy allows each individual optical network unit to operate more efficiently and saving communication bandwidth allows a greater number of optical network units to be in communication with an optical line terminal.

74. A POSITA would have had a reasonable expectation of success when applying the direct transitions of Röger to the passive optical network of G.987.3. Both the system of G.987.3 and Röger include optical network units in communication with an optical line terminal. Ex. 1006 (Röger), 5; Ex. 1007 (G.987.3), 10, 97-106. G.987.3 states that when an optical network unit receives a Sleep_Allow(ON) PLOAM event, the optical network unit has discretion to exercise any power management mode including doze or sleep mode. Ex. 1006 (Röger), 5; Ex. 1007 (G.987.3), 10, 97-106. This would not preclude the ONU from alternating between a doze mode and a sleep mode as described in Röger. Ex. 1006 (Röger), 6-8, 10-13. An ONU of G.987.3 would be operable to directly transition back and forth

as shown in Röger because the ONU of Röger would be standardized based on ITU-T recommendations. The ONU would alternate between sleep and doze modes, occasionally waking up to an Aware state that would be identical to DozeAware or SleepAware. The DozeAware state and the SleepAware states are interchangeable (i.e., both have a transmitter and receiver turned on) and are used to forward downstream traffic and respond to grant allocations, allowing the optical network unit to transition between the Asleep state and the Listen state would not impact these functions of the optical network unit. Ex. 1007 (G.987.3), 100-102.

Claim 1[A]: A method of optical communication in a passive optical network, comprising:

75. To the extent the preamble is limiting, G.987.3 teaches Claim 1[A]. G.987.3 teaches “10-Gigabit-capable passive optical network systems.” Ex. 1007 (G.987.3), 3. The passive optical network systems of G.987.3 include both optical network units (ONUs) and optical line terminals (OLTs), which are in communication with each other. Ex. 1007 (G.987.3), 10, 97-106. Thus, a POSITA would have understood that G.987.3 teaches a method of optical communication in a passive optical network. *See* Ex. 1005 (’892 Contentions), 2-8.

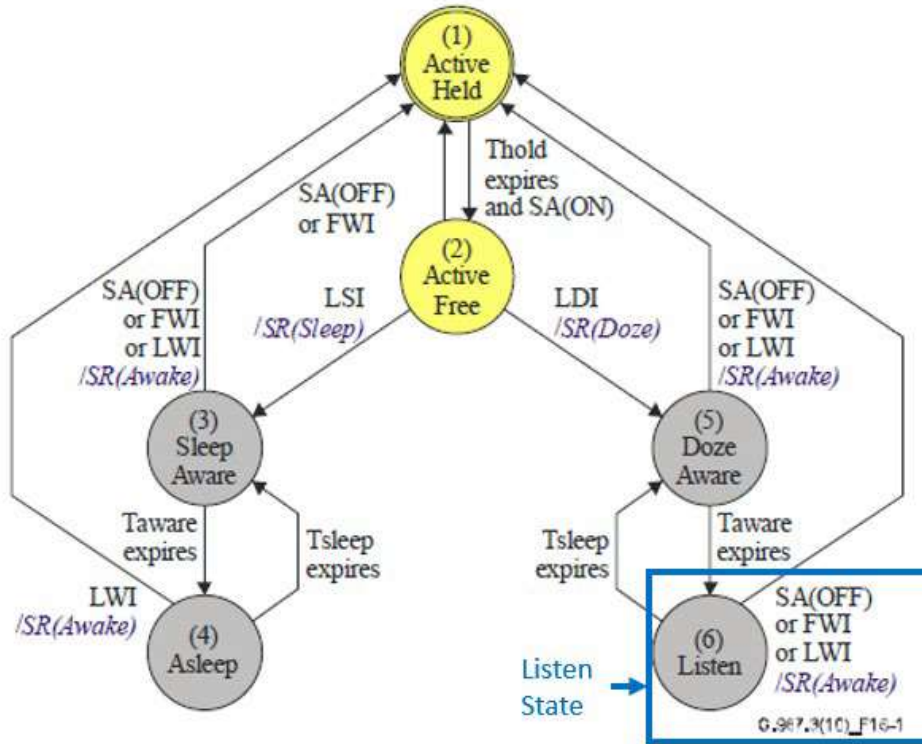
76. Similarly, a POSITA would have understood that Röger, which was understood to operate with prior ITU-T networks, envisages optical powering of “short-range passive optical networks (PON).” Ex. 1006 (Röger), 2. For example, Röger teaches an OLT in communication with ONUs sharing a common fiber using

remotely located “passive power splitters.” Ex. 1006 (Röger), 5. Thus, a POSITA would have understood that Röger likewise teaches a method of optical communication in a passive optical network. *See* Ex. 1005 (’892 Contentions), 2-8.

1[B]: operating an optical network unit (ONU) in a first state in which a transmitter of the ONU is turned off and a receiver of the ONU is turned on;

77. As discussed above with respect to 1[A], the passive optical system of G.987.3 includes ONUs. *See supra*, §VIII.A, 1[A]. G.987.3 teaches that an ONU may operate in a “Listen” state in which “The ONU receiver is on” and “the transmitter is off.” Ex. 1007 (G.987.3), 100. As such, the “Listen” state of G.987.3 is the claimed first state. Annotated Figure 16-1 (reproduced below) of G.987.3 illustrates a state diagram for the ONU including the “Listen” state. Ex. 1007 (G.987.3), 101. Thus, a POSITA would have understood that G.987.3 teaches operating an optical network unit (ONU) in a first state in which a transmitter of the ONU is turned off and a receiver of the ONU is turned on. *See* Ex. 1005 (’892 Contentions), 8-9.

Ex. 1007 (G.987.3), Fig. 16-1 (annotated)



78. Similar to G.987.3, Röger teaches 1[B]. Röger teaches that subscribers (ONUs) in a sleep mode (i.e., with receiver and transmitter circuitry powered off) “**activate their basic receiver circuitry**” during wake-up intervals to “listen for the [OLT’s] polling.” Ex. 1006 (Röger), 8. Thus, the ONU of Röger transitions to a “receive” subscriber mode (“first state”) with its receiver circuitry turned on and its transmitter circuitry turned off. Additionally, the blue boxes in annotated table 2 (reproduced below) shows the receive subscriber mode with a receiver (but no transmitter) powered on. Ex. 1006 (Röger), 11. Thus, a POSITA would have understood that Röger likewise teaches operating an optical network unit (ONU) in

a first state in which a transmitter of the ONU is turned off and a receiver of the ONU is turned on. *See* Ex. 1005 ('892 Contentions), 8-9.

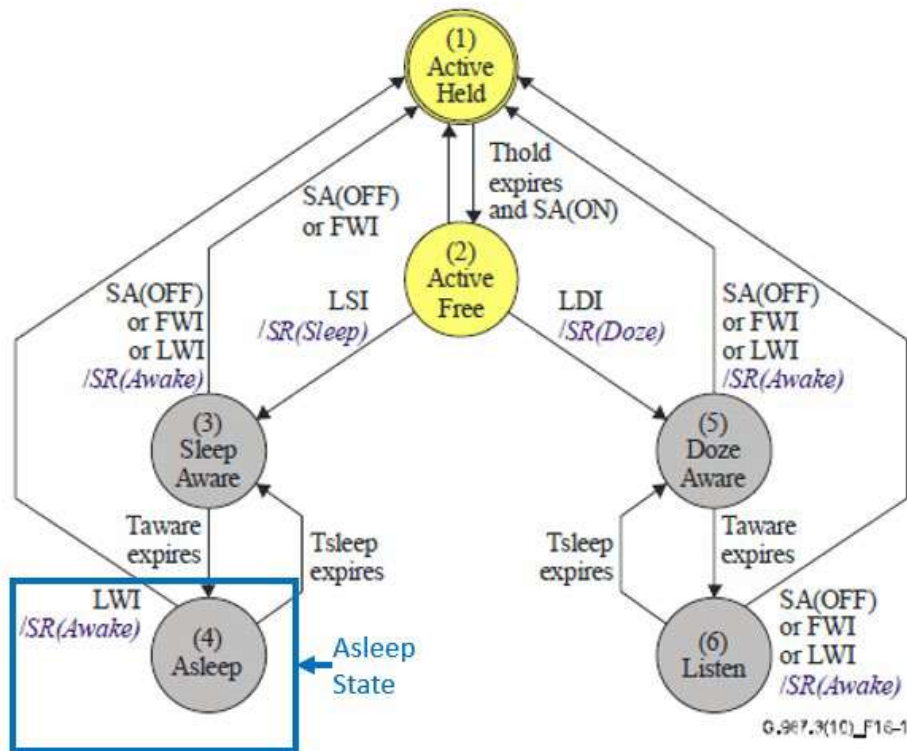
Ex. 1006 (Röger), Table 2

Table 2. Subscriber operating modes and total DC supply currents I_b for a supply voltage $V_b = 3.6$ V.

Subscriber modes		Attributes	μ C current $I_{\mu C}$	Supply current I_b	Total I_b
Sleep	μ C low-power modes	Low-Q clock	0.5 μ A	I_{Sleep}	0.5 μ A
Snooze		High-Q clock	1 μ A	I_{Snooze}	1 μ A
Receive	μ C active mode	Receiver on	3.5 mA	I_{Rx}	6 mA
Transceive		Transceiver on		I_{RxTx}	11 mA

1[C]: operating the ONU in a second state in which both the transmitter and the receiver are turned off;

79. G.987.3 teaches that an ONU may operate in an “Asleep” state. Ex. 1007 (G.987.3), 100. G.987.3 states that while in the Asleep state, “The ONU shuts down both its receiver and transmitter.” Ex. 1007 (G.987.3), 100. As such, the “Asleep” state of G.987.3 is the claimed second state. Annotated Figure 16-1 (reproduced below) of G.987.3 illustrates a state diagram for the ONU including the “Asleep” state. Ex. 1007 (G.987.3), 101. Thus, a POSITA would have understood that G.987.3 teaches operating the ONU in a second state in which both the transmitter and the receiver are turned off. *See* Ex. 1005 ('892 Contentions), 10-11.



80. Similar to G.987.3, Röger teaches 1[C]. Röger teaches a sleep mode (“second state”) for ONTs which requires “[a]ll communication circuitry switched off.” Ex, 1006, 6. Röger further teaches a “snooze mode” in which “all dispensable circuitry” (including the receiver and transmitter) is off. Ex. 1006, 9. The blue boxes in annotated table 2 (reproduced below) shows the sleep and snooze subscriber modes with both receiver and transmitter powered off. Ex. 1006 (Röger), 11. Thus, a POSITA would have understood that Röger likewise teaches operating the ONU in a second state in which both the transmitter and the receiver are turned off. *See* Ex. 1005 (’892 Contentions), 10-11.

Ex. 1006 (Röger), Table 2

Table 2. Subscriber operating modes and total DC supply currents I_b for a supply voltage $V_b = 3.6$ V.

Subscriber modes		Attributes	μ C current $I_{\mu C}$	Supply current I_b	Total I_b
Sleep	μ C low-power modes	Low-Q clock	0.5 μ A	I_{Sleep}	0.5 μ A
Snooze		High-Q clock	1 μ A	I_{Snooze}	1 μ A
Receive	μ C active mode	Receiver on	3.5 mA	I_{Rx}	6 mA
Transceive		Transceiver on		I_{RxTx}	11 mA

1[D]: transitioning the ONU directly from the first state to the second state and transitioning the ONU directly from the second state to the first state, based on a power management rule;

81. G.987.3 teaches indirect transitions between the “Listen” state (“the first state”) and the “Asleep” state (“the second state”). Ex. 1007 (G.987.3), 100-102. As discussed above, a POSITA would have been motivated to apply direct transitions between these states to G.987.3. *See supra*, §VIII.A, Motivation to Combine. A POSITA would have known that it would be advantageous to save energy by not powering on the transmitter when transitioning between the “Listen” and “Asleep” states. *See supra*, §VIII.A, Motivation to Combine. This is also consistent with Patent Owner’s position in its related infringement contentions, which contend that 1[D] is met by a “maximum sleep interval” ($I_{\text{sleep}}/I_{\text{lowpower}}$) in a later version of G.988, which specifies “the maximum time the ONU spends in its asleep, listen, or low-power states.” Ex. 1005 (’892 Contentions), 12. Similarly, G.987.3 and G.988 each disclose the “maximum sleep interval” as I_{sleep} , specifying

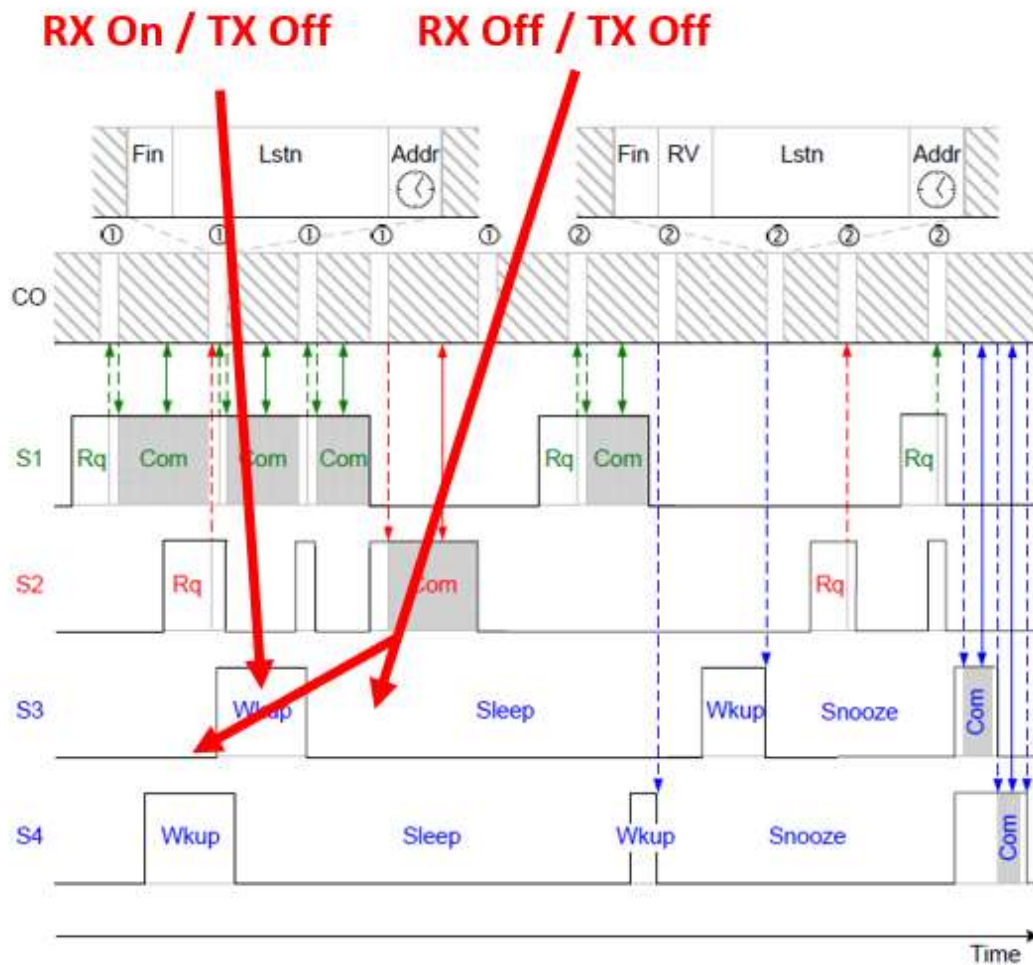
“the maximum time the ONU spends in its asleep or listen states.” Ex. 1008 (G.988), 82; Ex. 1007 (G.987.3), 98.

82. In addition to G.987.3 rendering 1[D] unpatentable, the combination of G.987.3 and Röger render 1[D] unpatentable. Röger teaches an “efficient protocol” that saves “both energy and communication bandwidth” by using a rendezvous sequence to inform sleep mode subscribers of future communications. Ex. 1006 (Röger), 6-8. Subscriber stations (ONUs) are in a sleep mode where “all communication circuitry is switched off.” Ex. 1006 (Röger), 6. The subscriber stations then “activate their basic receiver circuitry” for a wake-up period and “listen for the [OLT’s] polling.” Ex. 1006 (Röger), 6-8. Thus, the subscriber stations (ONUs) directly transition from the sleep mode (“first state”) to a receive state (“second state”) where the receiver is turned on and the transmitter remains off. Ex. 1006 (Röger), 6-8. 10-13.

83. If a rendezvous signal is not received by the subscriber station during the wake-up period, “the subscribers go back to sleep.” Ex. 1006 (Röger), 8. Thus, the subscriber stations (ONUs) directly transition from a receive mode (“first state”) where the receiver is turned on and the transmitter is turned off to a sleep mode (“second state”) where both the receiver and transmitter are turned off. Ex. 1006 (Röger), 6-8, 10-13. Therefore, as illustrated further by annotated Figure 2 (reproduced below), the subscriber station S3 (among other examples) first operates

in a sleep mode (“second state”) in which its transmitter and receiver are turned off, illustrated by the first low portion of the line representing subscriber station S3. Ex. 1006 (Röger), 7. Subscriber station S3 then transitions directly into a receive mode (“first state”) in which its transmitter is off and its receiver is on, illustrated by the first high portion of the line representing subscriber station S3. Ex. 1006 (Röger), 7. Finally, subscriber station S3 then transitions directly back into the sleep mode (“second state”) in which its transmitter and receiver are both turned off, illustrated by the second low portion of the line representing subscriber station S3. Ex. 1006 (Röger), 7.

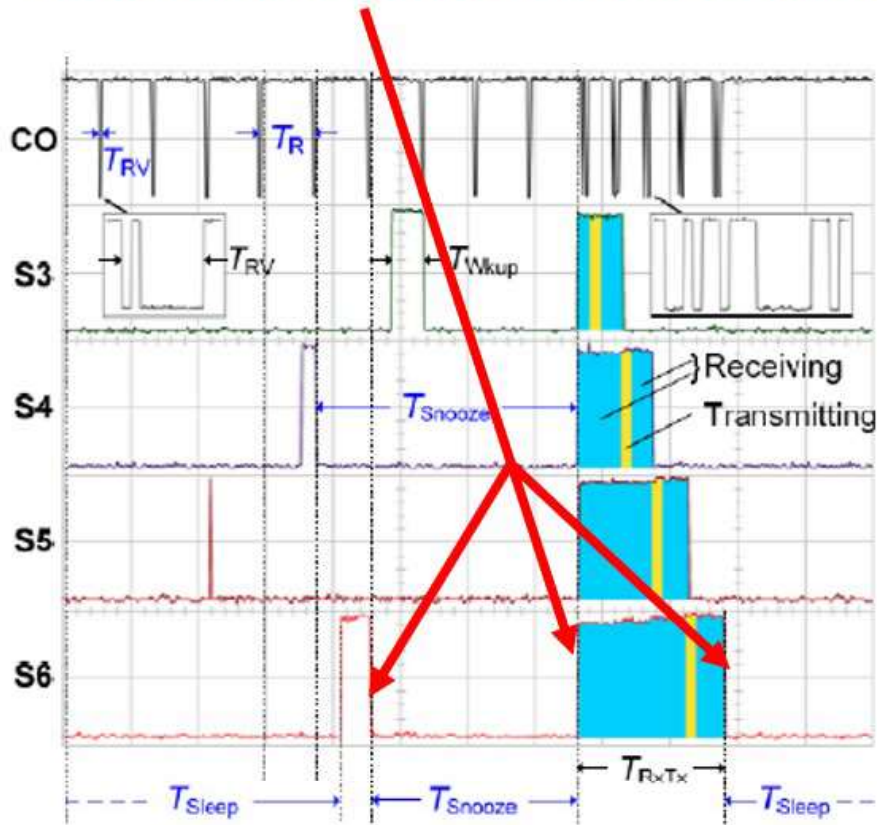
Ex. 1006 (Röger), Fig. 2 (annotated)



84. If the subscriber station receives a rendezvous signal during the wake-up period, the subscriber station transitions directly from the receive mode (“first state”) directly an “energy saving *snooze mode*,” which, as explained above, is also a “second state” because all dispensable circuitry” (including the receiver and transmitter) is off. Ex. 1006, 8-9. The subscriber station “sets a high precision clock to the rendezvous time.” Ex. 1006, 8. Furthermore, “[a]t the rendezvous time *all subscribers switch to receive mode*,” and later activate the transmitter to respond to

polling. Ex. 1006, 12-13. Thus, the ONUs of Röger transition directly from a receive mode (“first state”) to a snooze mode (“second state”) and directly back to the receive mode (“first state”) at the rendezvous time. Indeed, Figure 6 also illustrates yet another direct transition from snooze mode (“second state”) to receive mode (transition to dark blue) (“first state”) at the rendezvous time and a transition out of dark blue receive mode (“first state”) in response to an End command, which puts the listening subscribers to sleep (“second state”). *Id.* (confirming that dark blue is the receive mode). As such, a POSITA would have understood that the combination of G.987.3 and Röger demonstrate that the direct transitions claimed 1[D] are unpatentable.

Direct Transitions between First and Second State



85. With respect to the claimed recitation related to the “power management rule” recited in 1[D], the ’892 Patent generally describes that a power management rule “may be based on the timing parameters that control how long the ONU can be in the first or the second mode,” “transitioning based on user input,” “responding incoming control messages from the OLT that specify entering or exiting the first and the second states, and so on.” Ex. 1001 (’892 Patent), 12:31-45. The example power management rules described in the ’892 Patent generally include local and external causes of state transitions. Ex. 1001 (’892 Patent), 12:31-45.

86. Like the rules in the '892 Patent that cause state transitions, the direct transition of Röger from the sleep mode ("second state") to the receive mode ("first state") are made based on a "power management rule" that subscriber stations should alternate back and forth between the sleep mode ("second state") and receive mode ("first state") until receiving a message to do otherwise. Röger describes the intervals in which the subscriber stations enter the receive mode as "nearly periodically appearing wake-up intervals." Ex. 1006 (Röger), 7. The "power management rule" further causes the ONUs of Röger to transition directly from the receive mode ("first state") to the sleep mode ("second state") at the end of a time TWkup. Ex. 1006 (Röger), 12-13. Thus, a POSITA would have understood that Röger teaches transitioning the ONU directly from the first state to the second state and transitioning the ONU directly from the second state to the first state, based on a power management rule. See Ex. 1005 ('892 Contentions), 11-15.

1[E]: ensuring the ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first state or the second state;

87. Regarding the "Asleep" state ("second state"), G.987.3 teaches that "before exiting this state, the ONU ensures that it is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control." Ex. 1007 (G.987.3), 100. Thus, a POSITA would have understood that G.987.3 teaches ensuring the ONU is fully powered up, synchronized, and capable of

responding to both upstream and downstream traffic and control before exiting the second state.

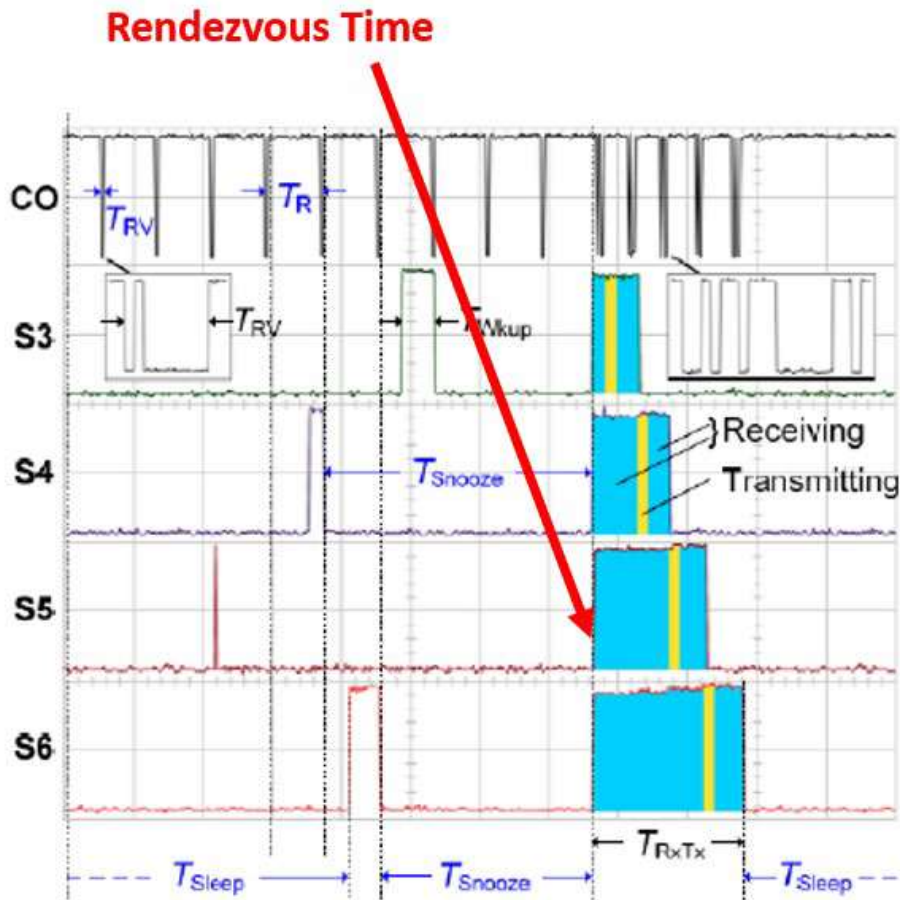
88. Claim 1[E] requires the “ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting” either the first state or the second state. Regardless, the POSITA would understand that G.987.3 teaches both. Regarding the “Listen” state (“first state”), G.987.3 teaches that “before exiting this state, the ONU ensures that it is fully powered up and capable of responding to both upstream and downstream traffic and control.” Ex. 1007 (G.987.3), 100. A POSITA would have understood that the ONU would have needed to be synchronized before exiting the listen state in order to be capable of responding to upstream and downstream traffic and control. *See* Ex. 1005 (’892 Contentions), 15-16.

89. This is also consistent with Patent Owner’s position in its related infringement contentions, which contend that [1E] is met by G.9807.1, which identically states that before exiting a low power state, “the ONU ensures that it is fully powered up and capable of responding to both upstream and downstream traffic and control.” Ex. 1005 (’892 Contentions), 16. Patent Owner further states in its related infringement contentions that “[i]n order to respond to upstream and downstream traffic and control, *the ONU is necessarily synchronized.*” Ex. 1005 (’892 Contentions), 16. Thus, a POSITA would have understood that G.987.3

teaches ensuring the ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first state or the second state. *See* Ex. 1005 ('892 Contentions), 15-16.

90. Likewise, Röger teaches that ONUs “maintain time synchronism with the [OLT]” in a snooze mode (“second state”). Ex. 1006, 6. The ONUs are configured to use a “precise quartz clock” to wake-up from the snooze mode (“second state”) “exactly at a rendezvous time” and communicate with an OLT, as illustrated in annotated Figure 6 (reproduced below). Ex. 1006, 8, 12. Röger states that “[f]our randomly self-activating subscribers (S3 ... 6) *synchronize* and communicate with the [OLT]” at the rendezvous time. Ex. 1006, 12. A POSITA would have known that the ONUs would have had to be fully powered up and capable of responding to upstream and downstream traffic (i.e., capable of receiving and transmitting messages between the ONU and OLT) before exiting the snooze mode (“second state”) or receive mode (“first state”), in order to communicate with the OLT. Thus, Röger likewise discloses ensuring the ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first state or the second state.

Ex. 1006, Fig. 6 (annotated)



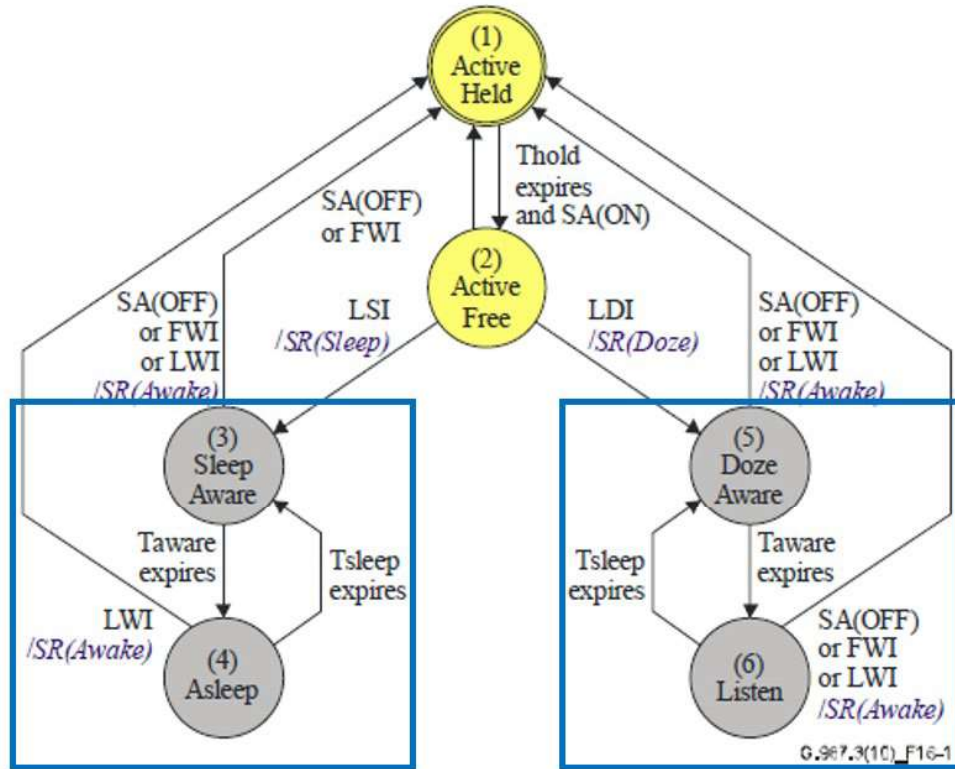
1[F]: receiving, by the receiver, a power management message from an optical line terminal (OLT); and

91. The term “power management message” appears nowhere in the ’892 Patent outside of the claims. *See* Ex. 1001 (’892 Patent). As such, and in view of the claims, the POSITA would have understood a “power management message” to be a message that is usable to change a power management rule. Ex. 1001 (’892 Patent), claims 1, 5-6, 9-10, 14. The ’892 Patent also doesn’t define a power management

rule but generally describes that the power management rule “may be based on the timing parameters that control how long the ONU can be in the first or the second mode,” “transitioning based on user input,” “responding incoming control messages from the OLT that specify entering or exiting the first and the second states, and so on.” Ex. 1001 (’892 Patent), 12:31-45. The example power management rules described in the ’892 Patent generally include local and external causes of state transitions. Ex. 1001 (’892 Patent), 12:31-45.

92. G.987.3 teaches a power management message as used in the claims (i.e., a message used to change a power management rule). For example, an ONU of G.987.3 may be operating with a “power management rule” that uses timing parameters to control how long the ONU is in a low power state (i.e., Asleep state or a Listen state) and an aware state (i.e., SleepAware state or DozeAware state), transitioning between the low power state and the aware state at the expiration of timers. Ex. 1007 (G.987.3). 98, 101-102. Annotated Figure 16-1 (reproduced below) illustrate options for this power management rule boxed in blue. Ex. 1007 (G.987.3), 101

Ex. 1007 (G.987.3), Figure 16-1 (annotated)



93. G.987 teaches that PLOAM messages (“power management message[s]”) are used to coordinate ONU and OLT state machines so as to change a power management rule. Ex. 1007 (G.987.3), 98, 100, 103, 106. For example, when operating with the power management rule above, an ONU may receive a PLOAM event Sleep_Allow(OFF) with which “[t]he OLT withholds consent to exercise a power management mode.” Ex. 1007 (G.987.3), 100. Thus, the PLOAM event Sleep_Allow(OFF) (“power management message”) is changing the power management rule from timing parameters that control how long the ONU can be in a low power state or aware state to a power management rule that, based on receiving

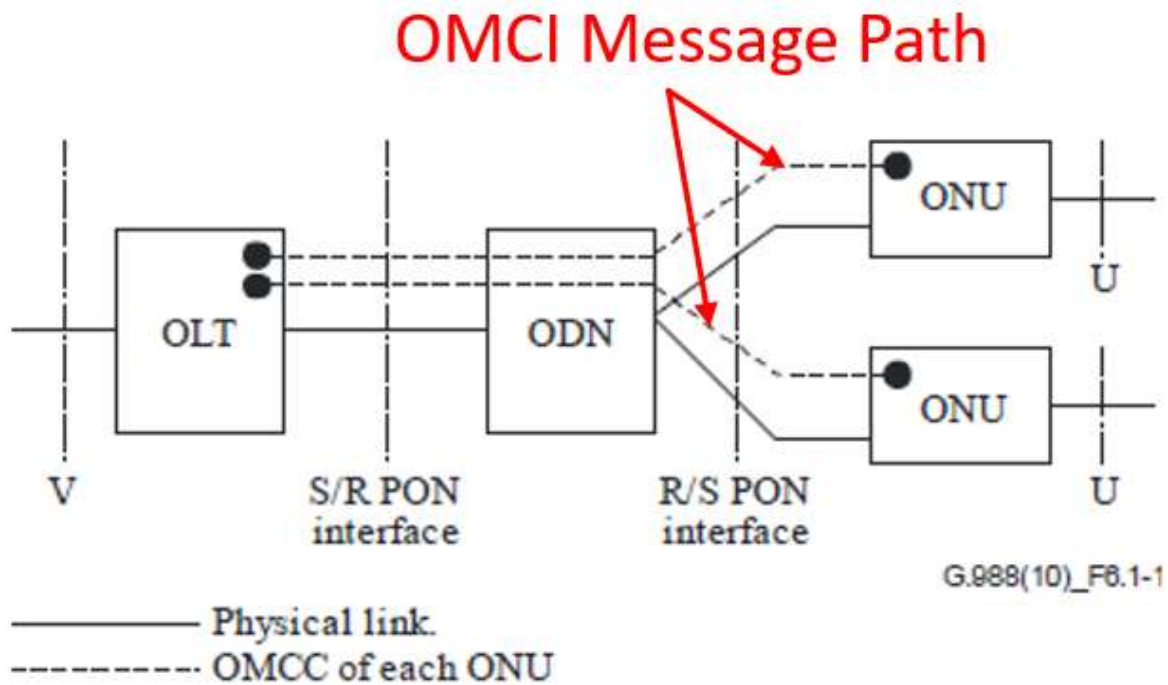
the power management message from the OLT, the ONU may not exercise a low power mode. The power management rule may then be changed back to the timing parameters associated with the low power states and the aware states using another power management message: the PLOAM event Sleep_Allow(ON), “[t]he OLT grants permission to the ONU to exercise any power management mode and leaves the selection of doze [(which includes the Listen “first state”)] or cyclic sleep mode [(which includes the Asleep “second state”)] to the ONU’s discretion.” Ex. 1007 (G.987.3), 100.

94. Additionally, the “power management message[s]” are taught by forced wake-up indication transmitted by the OLT. Ex. 1007 (G.987.3), 30, 98, 100-105. Using a forced wake-up indication, the OLT requires the ONU to require “immediate wake-up and transition to a full power state.” Ex. 1007 (G.987.3), 100. Like the PLOAM event Sleep_Allow(ON), the forced wake-up indication changes the power management rule from timing parameters that control how long the ONU can be in a low power state or aware state to a power management rule that, based on receiving the power management message from the OLT, the ONU must transition to a full power state.

95. OMCI messages taught by G.987.3 likewise teach the “power management message[s].” Ex. 1007 (G.987.3), 98-99. Specifically, G.987.3 states that “[t]he OLT uses OMCI to discover the ONU’s power management capabilities

and to configure its power management attributes and modes.” Ex. 1007 (G.987.3), 98. Such power management attributes and modes include timing parameters such as Isleep, which controls how long the ONU may remain in an Asleep state or a Listen state. When the ONU receives an OMCI message configuring these parameters, this changes the power management rule by changing the amount of time the ONU remains in a low power state before transitioning to an aware state.

96. G.988 likewise teaches the OMCI messages (“power management messages”). The dotted line of annotated Figure 6.1-1 of G.988 (reproduced below) shows a path for OMCI signals between an OLT and ONU. Ex. 1008 (G.988), 18. The OMCI messages may configure power management parameters including the maximum time an ONU may remain in a low power state and a minimum time an ONU may remain in an aware state. Altering these parameters changes the “power management rule” by altering the “timing parameters that control how long the ONU can be in the first or the second mode.” Ex. 1001 (’892 Patent), 12:31-45.



97. All of the above messages in G.987.3 are transmitted from the OLT to the ONU and thus would be received by the receiver of the ONU. Ex. 1007 (G.987.3), 98-105.

98. This is also consistent with Patent Owner's position in its related infringement contentions, which identify PLOAM messages as power management messages, which are used to coordinate ONU and OLT state machines. Ex. 1005 ('892 Contentions), 17-18. For example, the infringement contentions identify PLOAM event Sleep_Allow(ON), stating "[t]he OLT grants permission to the ONU to exercise watchful sleep management mode." Ex. 1005 ('892 Contentions), 18. As another example, the infringement contentions identify the PLOAM event

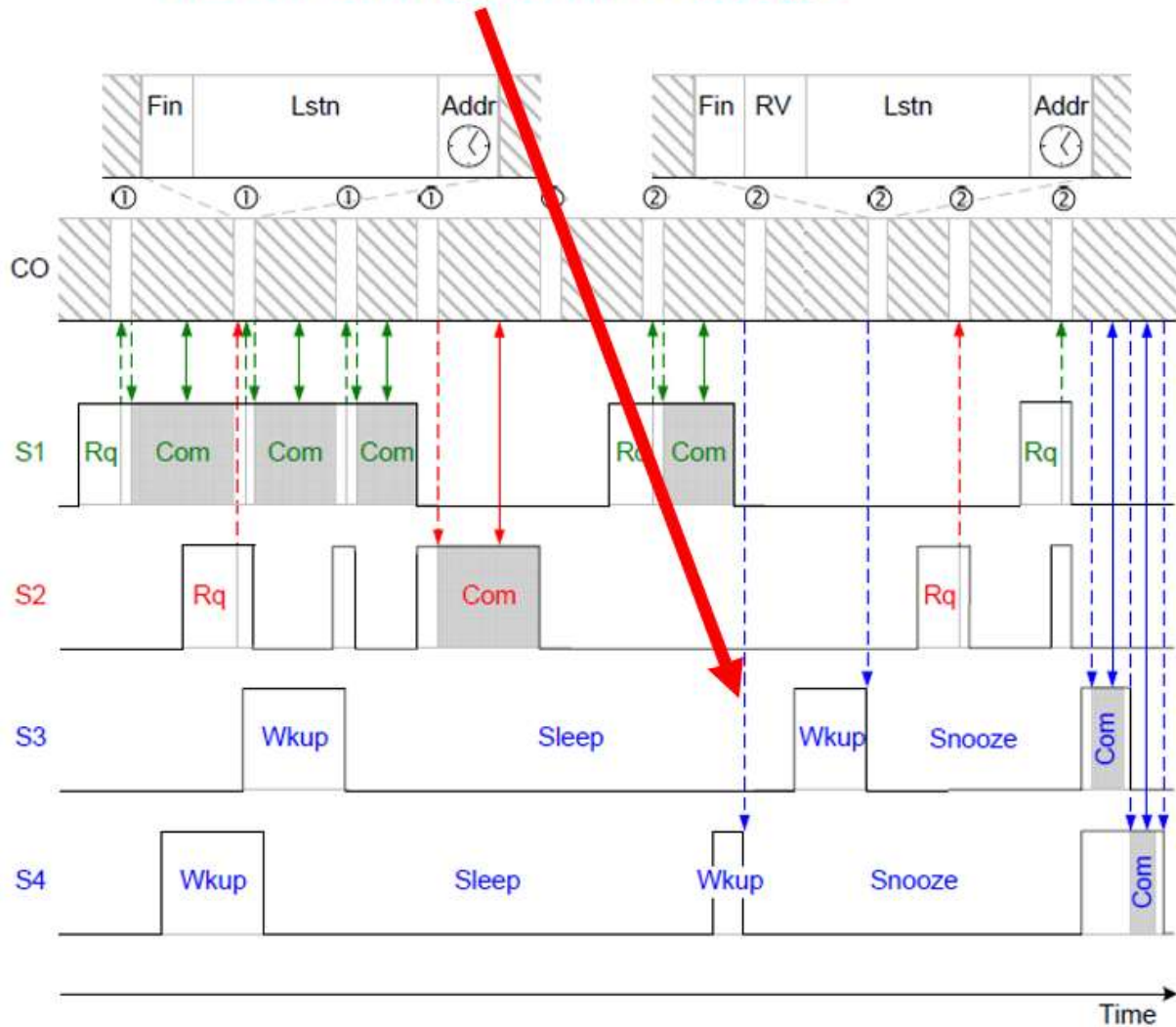
Sleep_Allow(OFF), stating “[t]he OLT withholds consent to exercise a power management mode.” Ex. 1005 (’892 Contentions), 18. The infringement contentions further identify OMCI messages as power management messages, stating “[t]he OLT uses OMCI to discover the ONU’s power management capabilities and to configure its power management attributes and modes.” Ex. 1005 (’892 Contentions), 18. As Patent Owner’s infringement contentions state, “[a]ny OMCI message from the OLT updating a parameter for the ONU dynamic power management control ME ... constitutes a power management message form an OLT ... includ[ing] OMCI messages updating the Power reduction management mode, Maximum sleep interval, ... Minimum aware interval, [and] Minimum active held interval ... parameters,” all parameters that were identified in G.988 before the priority date of the ’892 Patent. Ex. 1005 (’892 Contentions), 17-18; Ex. 1008 (G.988), 82. In addition, the infringement contentions identify a forced wake-up indication as a power management message, stating that the OLT transmits the forced wake-up indication to the ONU in order to require “immediate wake-up and transition to the ActiveHeld state.” Ex. 1005 (’892 Contentions), 18. Thus, a POSITA would have understood that G.987.3 teaches receiving, by the receiver, a power management message from an optical line terminal (OLT). *See* Ex. 1005 (’892 Contentions), 17-18.

99. Röger likewise teaches 1[F]. For example, as illustrated by the dashed blue line in annotated Figure 2 (reproduced below), subscriber stations (ONUs) receive broadcast polling signals from a central office (OLT). Ex. 1006 (Röger), 7. The broadcast polling signal is a “power management message” because it causes the ONUs to immediately transition power states and indicates a rendezvous time at which the ONUs should wake up and communicate with the OLT. Ex. 1006 (Röger), 6-8.

100. Likewise, the power management message is taught by an “ending signal” received by the ONUs from the OLT after the rendezvous time because the “ending signal” causes the ONUs to transition states back to sleep mode (“second state”). Ex. 1006 (Röger), 12. Thus, a POSITA would have understood that Röger likewise teaches receiving, by the receiver, a power management message from an optical line terminal (OLT). *See*, Ex. 1005 (’892 Contentions), 17-18.

Ex. 1006 (Röger), Fig. 2 (annotated)

Power Management Message



1[G]: changing the power management rule based on the received power management message.

101. G.987.3 teaches that PLOAM messages (“power management messages”) change a “power management rule” by effecting when an ONU can transition states. Ex. 1007 (G.987.3), 98-102. For example, when operating with a power management rule that the ONU alternates between a low power state (i.e.,

Asleep state or Listen state) and an aware state (i.e., SleepAware state or DozeAware state), transitioning between the low power state and the aware state at the expiration of timers, an ONU may receive a PLOAM event Sleep_Allow(OFF) (“power management message”) with which “[t]he OLT withholds consent to exercise a power management mode.” Ex. 1007 (G.987.3), 100-101. Thus, the PLOAM event Sleep_Allow(OFF) (“power management message”) is changing the power management rule from timing parameters that control how long the ONU can be in a low power mode or aware state to a power management rule that, based on receiving the power management message from the OLT, the ONU may not exercise a low power mode. Ex. 1007 (G.987.3), 100-101. The power management rule may be changed back to timing parameters associated with the low power states and the aware states by another power management message: the PLOAM event Sleep_Allow(ON), “[t]he OLT grants permission to the ONU to exercise any power management mode and leaves the selection of doze [(which includes the Listen “first state”)] or cyclic sleep mode [(which includes the Asleep “second state”)] to the ONU’s discretion.” Ex. 1007 (G.987.3), 100-101. Thus, Sleep_Allow(ON) changes a power management rule back to alternating between a low power state and an aware state based on timing parameters. Ex. 1007 (G.987.3), 100-101.

102. Additionally, the forced wake-up indication transmitted to the ONU requires “immediate wake-up and transition to a full power state” for the ONU. Ex.

1007 (G.987.3), 100. This changes the power management rule from timing parameters that control how long the ONU can be in a low power mode or aware state to a power management rule that, based on receiving the power management message from the OLT, the ONU must transition to a full power state. Ex. 1007 (G.987.3), 100-102. In addition, the OLT of G.987.3 uses OMCI messages to configure the ONUs with minimum or maximum times to spend in different power states. Ex. 1007 (G.987.3), 98. Thus, the OMCI messages change the power management rule by changing “timing parameters that control how long the ONU can be in the first or the second mode.” Ex. 1001 (’892 Patent), 12:31-45. These timing parameters may include Isleep, which controls how long an ONU may remain in an Asleep state or a Listen state. Ex. 1007 (G.987.3), 98. When the ONU receives an OMCI message configuring these parameters, this changes the power management rule by changing the amount of time the ONU remains in a low power state before transitioning to an aware state. Ex. 1007 (G.987.3), 98-101.

103. This is also consistent with Patent Owner’s position in its related infringement contentions, which identify PLOAM events in G.9807.1 as “effect[ing] a change in the power management rule at the ONU.” Ex. 1005 (’892 Contentions), 19. For example, the infringement contentions identify the PLOAM event Sleep_Allow(ON), with which “[t]he OLT grants permission to the ONU to exercise watchful sleep management mode.” Ex. 1005 (’892 Contentions), 19. The

infringement contentions further identify the PLOAM event Sleep_Allow(OFF), with which “[t]he OLT withholds consent to exercise a power management mode.” Ex. 1005 (’892 Contentions), 19. The infringement contentions further identify the OLT’s forced wake-up indication to the ONU in order to require “immediate wake-up and transition to the ActiveHeld state.” Ex. 1005 (’892 Contentions), 19. The infringement contentions further map to OMCI messages that alter parameters such as the “Maximum sleep interval”, saying that these messages “*effect a change in the power management rule implemented at the ONU.*” Ex. 1005 (’892 Contentions), 19. As taught by G.988, the maximum sleep interval is Isleep. Ex. 1008 (G.988), 82. Thus, a POSITA would have understood that G.987.3 teaches receiving, by the receiver, a power management message from an optical line terminal (OLT). *See* Ex. 1005 (’892 Contentions), 19.

104. Patent Owner may argue that during prosecution of the ’892 Patent, the Applicant alleged that reference Skubic did not teach changing the power management rule by commanding a transition between states. Ex. 1002 (’892 File History), 70-71. However, not only did the Examiner rejected the Applicant’s argument, but the argument contradicts what Patent Owner alleges in its related infringement contentions by mapping to the FWI, which causes “immediate ONU wake-up and its transition to the ActiveHeld state.” Ex. 1002 (’892 File History), 37-39; Ex. 1005 (’892 Contentions), 19. Thus, G.987.3 teaches changing the power

management rule based on the received power management message. *See* Ex. 1005 ('892 Contentions), 19. As such, any argument from Patent Owner regarding its statements regarding Skubic should be disregarded.

105. Regardless, Röger teaches 1[G]. For example, in response to receiving broadcast polling signals from a central office (OLT), a subscriber station (ONU) of Röger “extracts the time stamp for the next rendezvous with CO, sets a high precision clock to the rendezvous time, and then goes to an energy-saving snooze mode.” Ex. 1006 (Röger), 8. The polling signals (“power management message[s]”) cause a change in the power management rule by causing the ONU to transition to a snooze mode (“second state”) until the rendezvous time rather than nearly periodically alternating between a sleep mode (“second state”) and a receive mode (“first state”). Ex. 1006 (Röger), 7. Additionally or alternatively, the “ending signal” changes the power management rule. Röger states that “at rendezvous time all [ONUs] awake, wait for being addressed and exchange data with [OLT]. Ex. 1006 (Röger), 8. An ending signal issued by [OLT] sends the [ONUs] back sleeping.” Ex. 1006 (Röger), 12. Thus, the ending signal (“power management message”) causes a change in the “power management rule” by returning the ONU to nearly periodically alternating between a sleep mode (“second state”) and a receive mode (“first state”). Ex. 1006 (Röger), 6-8, 12. Thus, a POSITA would have understood that Röger

likewise teaches changing the power management rule based on the received power management message. *See* Ex. 1005 ('892 Contentions), 19.

Claim 2: The method of claim 1, further comprising: operating the ONU in a third state in which both the transmitter and the receiver are turned on.

106. G.987.3 teaches that in the ActiveHeld state (claimed “third state”), “[t]he ONU is fully responsive, forwarding downstream traffic and responding to all bandwidth allocations.” Ex. 1007 (G.987.3), 100. Both the transmitter and receiver of the ONU are turned on in the ActiveHeld state in order to be fully responsive, forward downstream traffic, and respond to bandwidth allocations. Ex. 1007 (G.987.3), 100. Thus, a POSITA would have understood that G.987.3 teaches operating the ONU in a third state in which both the transmitter and receiver are turned on.

107. The claimed “third” state is also taught by the ActiveFree state of G.987.3, where “[t]he ONU is fully responsive, forwarding downstream traffic and responding to all bandwidth allocations.” Ex. 1007 (G.987.3), 100. Likewise, the “third state” is taught by the DozeAware and SleepAware states of G.987.3 because “[b]oth ONU receiver and transmitter remain on.” Ex. 1007 (G.987.3), 100.

108. This is also consistent with Patent Owner’s position in its related infringement contentions, which identify the ActiveHeld state in G.9807.1 as the “third state”, where “[t]he ONU is fully responsive, forwarding downstream traffic

and responding to all bandwidth allocations.” Ex. 1005 (’892 Contentions), 21. The infringement contentions further identify the ActiveFree state of G.9807.1 as the “third state,” where “[t]he ONU is fully responsive, forwarding downstream traffic and responding to all bandwidth allocations.” Ex. 1005 (’892 Contentions), 21. Thus, a POSITA would have understood that G.987.3 teaches operating the ONU in a third state in which both the transmitter and the receiver are turned on. *See* Ex. 1005 (’892 Contentions), 21.

109. Likewise, Röger teaches claim 2. For example, the blue boxes in annotated Table 2 (reproduced below) show that the Subscribers (ONUs) can operate in a transceiving mode with a transceiver on. Ex. 1006 (Röger), 11. Röger further states that “the transceiving mode comprises both an activated receiver and transmitter,” thus teaching the “third state.” Ex. 1006 (Röger), 11. Thus, a POSITA would have understood that Röger likewise teaches operating the ONU in a third state in which both the transmitter and the receiver are turned on. *See* Ex. 1005 (’892 Contentions), 21.

Ex. 1006 (Röger), Table 2

Table 2. Subscriber operating modes and total DC supply currents I_b for a supply voltage $V_b = 3.6 \text{ V}$.

Subscriber modes		Attributes	μC current $I_{\mu\text{C}}$	Supply current I_b	Total I_b
Sleep	μC low-power modes	Low-Q clock	$0.5 \mu\text{A}$	I_{Sleep}	$0.5 \mu\text{A}$
Snooze		High-Q clock	$1 \mu\text{A}$	I_{Snooze}	$1 \mu\text{A}$
Receive	μC active mode	Receiver on	3.5 mA	I_{Rx}	6 mA
Transceiver		Transceiver on		I_{RxTx}	11 mA

Claim 3: The method of claim 1, wherein the power management rule specifies a first time period for operation in the first state and a second time period for operation in the second state and wherein the transitioning is performed upon expiration of at least one of the first time period and the second time period.

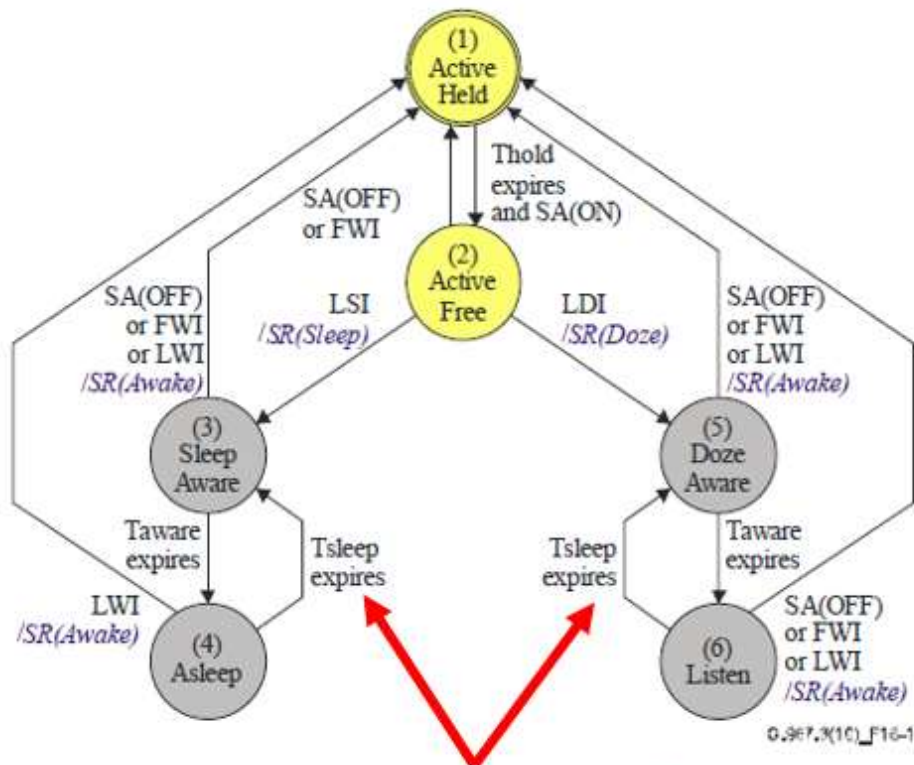
110. G.987.3 teaches the parameter “Isleep” defined as “the maximum time the ONU spends in its Asleep or Listen states,” which are the second state and the first states, respectively. Ex. 1007 (G.987.3), 98. Likewise, G.988 teaches a “Maximum sleep interval” which is also identified as the same “Isleep attribute.” Ex. 1008 (G.988), 82. G.988 teaches that “[t]he Isleep attribute specifies the maximum time the ONU spends in its asleep or listen states.” Ex. 1008 (G.988), 82. Isleep teaches the “first time period” by specifying the maximum time the ONU may spend in its Listen state (“first state”). Ex. 1007 (G.987.3), 99. The local timer at the ONU must be less than or equal to Isleep, so when the local timer is set to its maximum value, the ONU transitions from the Listen state (“first state”) at the expiration of Isleep. Ex. 1007 (G.987.3), 98. Isleep teaches the “second time period”

by specifying the maximum time the ONU may spend in its Asleep state (“second state”). Ex. 1007 (G.987.3), 98. The local timer at the ONU must be less than or equal to Isleep, so when the local timer is set to its maximum value, the ONU transitions from the Asleep state (“second state”) at the expiration of Isleep. Ex. 1007 (G.987.3), 98. Thus, a POSITA would have understood that Isleep teaches both the first time period and the second time period.

111. G.987.3 further teaches “Tsleep” which is a local timer with “a value equal to or less than Isleep.” Ex. 1007 (G.987.3), 98. The ONU may exit Asleep (“second state”) or Listen (“first state”) upon expiration of Tsleep, as illustrated in annotated Figure 16-1 (reproduced below). Ex. 1007 (G.987.3), 101. Tsleep teaches the “first time period” by specifying the time period the ONU spends in its Listen state (“first state”). Ex. 1007 (G.987.3), 98, 101-102. The ONU transitions from the Listen state (“first state”) at the expiration of Tsleep. Ex. 1007 (G.987.3), 98, 101-102. Tsleep teaches the “second time period” by specifying the time the ONU spends in its Asleep state (“second state”). Ex. 1007 (G.987.3), 98, 101-102. The ONU transitions from the Asleep state (“second state”) at the expiration of Tsleep. Ex. 1007 (G.987.3), 98, 101-102. Thus, a POSITA would have understood that since Isleep or Tsleep may control the time period which the ONU spends in the Asleep or Listen states, both timers teach the claimed “first time period” and “second time period.” Ex. 1007 (G.987.3)

112. Furthermore, the Isleep parameter and the Tsleep parameter are each specified by the “power management rule.” As described in the ’892 Patent, the power management rule “may be based on the timing parameters that control how long the ONU can be in the first or the second mode.” Ex. 1001 (’892 Patent), 12:31-45. As discussed above with respect to 1[F]-1[G], the power management rule of G.987.3 is that the ONU alternates between a low power state and an aware state based on timing parameters. *See supra*, §VIII.A, 1[F]-1[G]. Specifically, the Isleep and Tsleep parameters “control how long the ONU can be in the first or the second mode” before transitioning to the aware state, and thus are specified by the power management rule. Ex. 1007 (G.987.3), 98.

Ex. 1007 (G.987.3), Fig. 16-1 (annotated)



ONU transitions from first/second state upon expiration of Tsleap

113. This is also consistent with Patent Owner's position in its related infringement contentions, which identifies a maximum sleep interval in a later version of G.988, as "the maximum time the ONU spends in its asleep, listen, or low-power states." Ex. 1005 ('892 Contentions), 22-24. G.988 identified this maximum sleep interval prior to the priority date of the '892 Patent as the Isleep parameter discussed above. Ex. 1008 (G.988), 82. Thus, a POSITA would have understood that G.987.3 in view of Röger and further in view of G.988 renders obvious the power management rule specifying a first time period for operation in

the first state and a second time period for operation in the second state, wherein the transitioning is performed upon expiration of at least one of the first time period and the second time period. *See* Ex. 1005 ('892 Contentions), 22-24.

114. Likewise, and as discussed further above with respect to 1[D], a POSITA would have understood that Röger teaches a power management rule that ONUs remain in sleep mode (“second state”) until nearly periodic wake-up intervals in which they activate receiver circuitry (transitioning to the “first state”). Ex. 1006 (Röger), 6-8, 10-13; *see supra*, §VIII.A, 1[D]. The time which the ONU remains in sleep mode until the wake-up interval teaches the “second time period.” Ex. 1006 (Röger), 7. The ONU then transitions directly into a receive mode (“first state”) “for a time $T_{\text{Wkup}} > T_R$ ” (“first time period” being greater than a time in which the OLT sends a rendezvous signal). Ex. 1006 (Röger), 12. If the ONU does not receive a rendezvous signal during the first time period, it “goes back to sleep” (“second state”). Ex. 1006 (Röger), 8. As such, the ONU transitions from the second state to the first state at the expiration of the second time period and from first state to the second state at the expiration of the first time period.

115. If the ONU receives polling from the OLT (“power management messages”), the power management rule is changed by altering the “second time period.” Röger discloses that the ONU enters a snooze mode (“second state”), the ONU maintains “a precise quartz clock,” and it awakes “exactly at a rendezvous

time” for communication with the OLT. Ex. 1006, 8. Thus, the “second time period” when changed by a “power management message” is maintained by the quartz clock and is the time until the rendezvous time at which the ONU transitions from the second state back to the receive mode (“first state”). Ex. 1006, 11-13. Thus, Röger discloses the power management rule specifying a first time period for operation in the first state and a second time period for operation in the second state, wherein the transitioning is performed upon expiration of at least one of the first time period and the second time period.

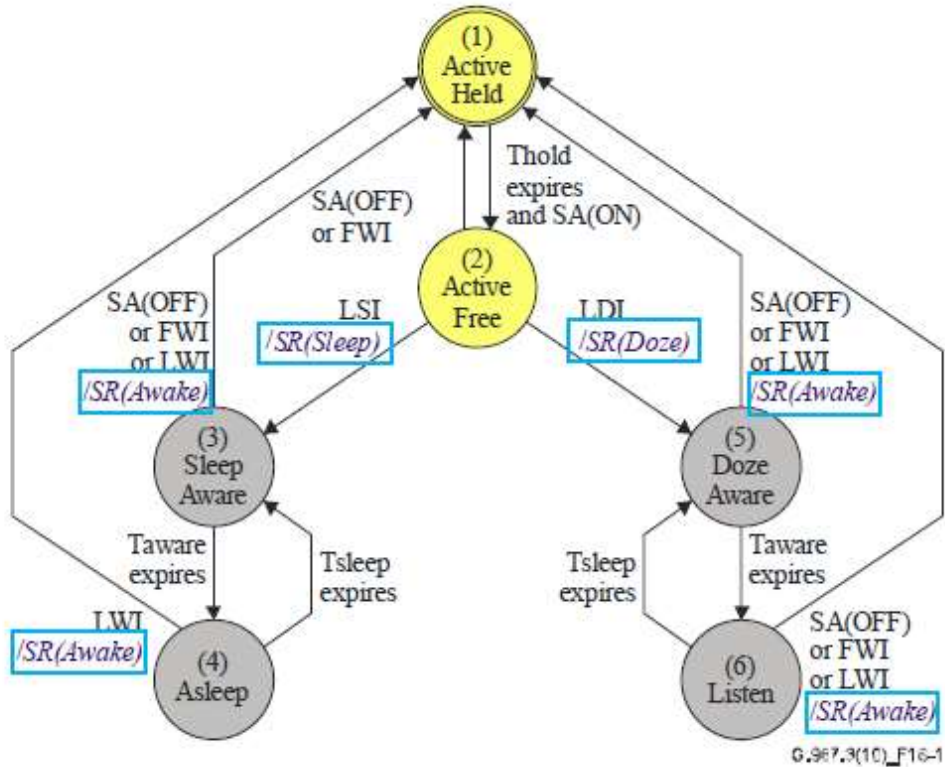
Claim 4: The method of claim 1, further comprising: transmitting, to an optical line terminal, a message indicative of the transitioning between the first state and the second state.

116. Claim 4 seems to contradict 1[D] since the transmitter would be turned on to transmit the message indicative of transitioning. Regardless, G.987.3 teaches Claim 4.

117. G.987.3 teaches that the ONU transmits “Sleep_Request” (used interchangeably with “SR” and “SleepRequest”) messages to “signal the ONU’s intention to change power saving modes.” Ex. 1007 (G.987.3), 52. For example, using a “SleepRequest(Doze)” message, “[t]he ONU informs the OLT of its intent to exercise the doze power management mode.” Ex. 1007 (G.987.3), 103. As another example, using a “SleepRequest(Sleep)” message, “[t]he ONU informs the OLT of its intent to exercise the cyclic sleep power management mode.” Ex. 1007 (G.987.3),

103. As yet another example, using a “SleepRequest(Awake)” message, “[t]he ONU informs the OLT of its intent to remain at full power.” Ex. 1007 (G.987.3), 103. Each of these messages are transmitted by the ONU upon entering and exiting the Asleep state (“second state”) and Listen state (“first state”), as boxed in blue in annotated Figure 16-1 (reproduced below). Ex. 1007 (G.987.3), 101.

118. As explained further with respect to 1[D], the ONU’s indirect transition performed when transmitting these messages would have been modified to the direct transition taught by Röger. *See supra* §VIII.A, 1[D]. Thus, a POSITA would have understood that G.987.3 in view of Röger renders obvious transmitting, to an optical line terminal, a message indicative of the transitioning between the first state and the second state.



Claim 5: The method of claim 1, further comprising: performing the transitioning responsive to the received power management message and a local decision to change an operational state.

119. G.987.3 in view of Röger renders obvious claim 5. As discussed above with respect to claim elements 1[F]-1[G], G.987.3 teaches that by using the PLOAM event Sleep_Allow(ON), “[t]he OLT grants permission to the ONU to exercise any power management mode and leaves the selection of doze or cyclic sleep mode to the ONU’s discretion.” Ex. 1007 (G.987.3), 100; *see supra* §VIII.A, 1[F]-1[G]. The ONU performs a transition responsive to the PLOAM message (“received power management message”) and due to a local decision to change an operational state, (since permission is granted to “exercise any power management mode” and the

“selection of doze or cyclic sleep mode” is left to the ONU’s local discretion). Ex. 1007 (G.987.3), 100.

120. Additionally, and as discussed further with respect to claim elements 1[F]-1[G], state transitions also may take place due to additional “power management message[s]” such as the PLOAM event Sleep_Allow(OFF) or a forced wake-up indication from the OLT. Ex. 1007 (G.987.3), 100; *see supra* §VIII.A, 1[F]-1[G]. Furthermore, as discussed with respect to claim 3, state transitions may take place at the end of a local timer which is based on a maximum allowed time in a power state configured by the OLT by OMCI message (“power management message”). Ex. 1007 (G.987.3), 98, 101-102; *see supra* §VIII.A, claim 3.

121. Further, the ONU of G.987.3 may transition due to other “local decisions to change operational states.” Ex. 1007 (G.987.3), 101. For example, a local sleep indication (LSI) occurs when “[t]he ONU has no local reason to remain at full power and is willing to exercise the cyclic sleep power management mode.” Ex. 1007 (G.987.3), 101. As another example, a local doze indication (LDI) occurs when “[t]he ONU has no local reason to remain at full power and is willing to exercise the doze power management mode.” Ex. 1007 (G.987.3), 101. As another example, a local wake-up indication (LWI) occurs when “[A] local stimulus prevents the ONU from exercising any power management mode” (i.e., transitioning from an Asleep or Listen mode to an ActiveHeld state). Ex. 1007 (G.987.3), 101. As

explained further with respect to 1[D], the ONU's indirect transition responsive to the received power management message and local decision to change an operational state would have been modified to the direct transition taught by Röger. *See supra* §VIII.A, 1[D].

122. This position is consistent with Patent Owner's position in its related infringement contentions, which identify in G.9807.1, in addition to the power management messages discussed with respect to 1[F]-1[G], a "[l]ocal sleep indication (LSI)" where "[t]he ONU has no local reason to remain at full power and is willing to exercise the watchful cyclic sleep power management mode." Ex. 1005 ('892 Contentions), 25. The infringement contentions further identify a "[l]ocal wake-up indication (LWI)" where "[a] local stimulus prevents the ONU from exercising any power management mode." Ex. 1005 ('892 Contentions), 25. The infringement contentions further point to the ONU receiving a "Sleep_Allow(ON) PLOAM message from the OLT allowing it to enter into the low power state" and using "internal local timers ... to govern the low power state to ensure the actual duration of the lower power state does not exceed" a maximum time configured by the OLT. Ex. 1005 ('892 Contentions), 25. Thus, a POSITA would have understood that G.987.3 in view of Röger renders obvious performing the transitioning responsive to the received power management message and a local decision to change an operational state. *See* Ex. 1005 ('892 Contentions), 25.

123. Röger likewise teaches ONUs in a minimum-energy sleep mode (“second state”) that periodically transition to a receive state (“first state”) during wake-up intervals “*which are initiated autonomously by the subscribers*” (ONUs) (i.e., responsive to a local decision to change the operational state). Ex. 1006 (Röger), 7. Furthermore, when the ONU receives, from the OLT, an ending signal (“power management message”), the subscribers are sent back into a sleep mode (“second state”), where they would “nearly periodically” transition back and forth with a receive state (“first state”). Ex. 1006 (Röger), 7, 12. Therefore, the direct transitions between the first state and second state are also performed responsive to receiving the ending signal (“power management message”). Thus, a POSITA would have understood that Röger likewise teaches performing the transitioning responsive to the received power message and a local decision to change an operational state. See Ex. 1005 (’892 Contentions), 25.

Claim 14[A]: A passive optical network (PON) communications system, comprising:

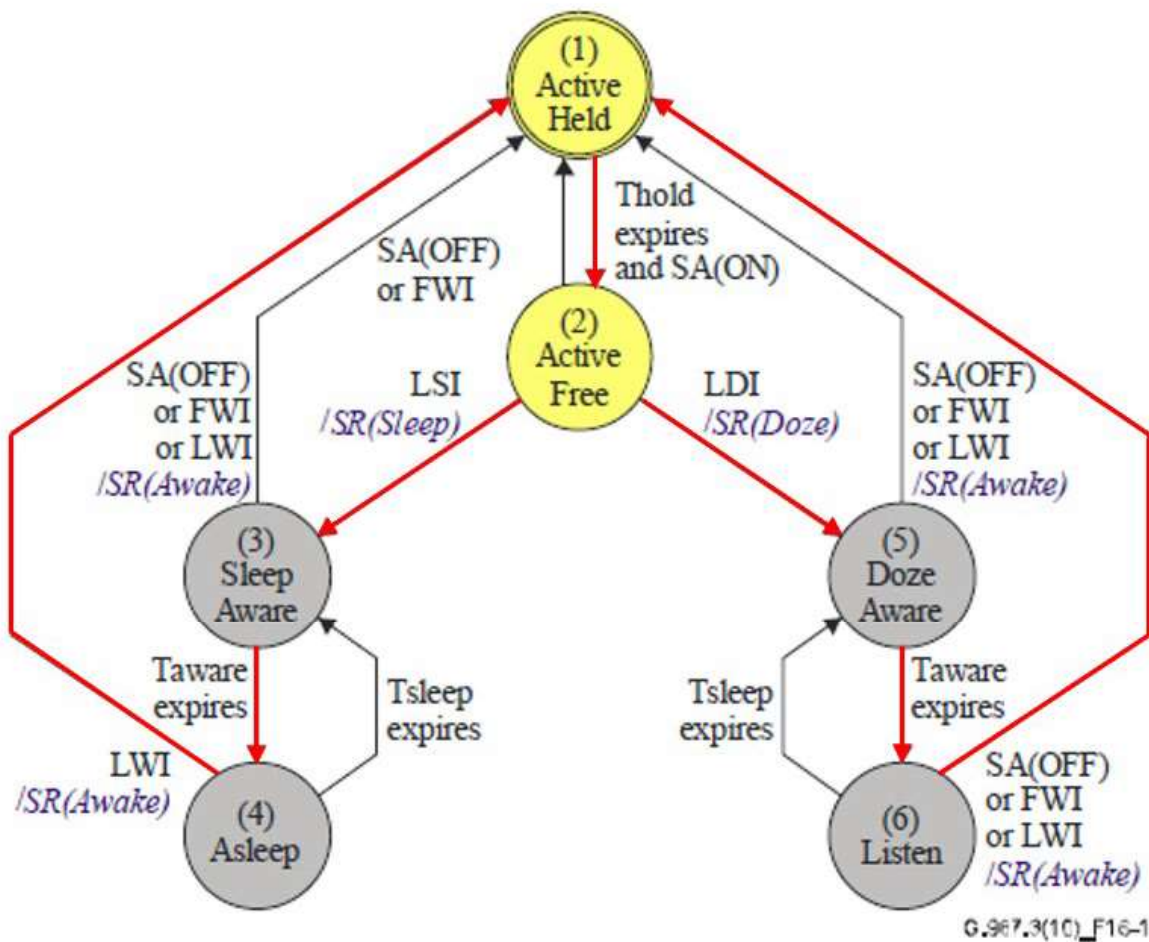
124. A POSITA would have understood that G.987.3 teaches claim 14[A] for at least the reasons described with respect to 1[A]. See *supra*, §VIII.A, 1[A].

125. A POSITA would have understood that Röger likewise teaches claim 14[A] for at least the reasons described with respect to 1[A]. See *supra*, §VIII.A, 1[A].

14[B]: an optical network unit (ONU) operable in a first low power mode in which the ONU is able to receive but not transmit and a second low power mode in which the ONU is not able to either receive or transmit, wherein the ONU is configured to transition from the first low power mode to the second low power mode and to transition from the second low power mode to the first low power mode based on a power management rule, and wherein the ONU changes a power management rule based on a received power management message;

126. a POSITA would have understood that G.987.3 teaches 14[B] for at least the reasons discussed with respect to claim elements 1[B]-1[C] and 1[F]-1[G].
See supra §VIII.A, 1[B]-1[C], 1[F]-1[G].

127. Additionally, and in view of the breadth of 14[B] and the lack of a requirement of a direct transition, a POSITA would have understood that G.987.3 teaches this limitation because the ONU is able to transition between the first low power mode and the second low power mode by going through the ActiveHeld, ActiveFree, and SleepAware or DozeAware states, as shown in red in annotated Figure 16-1 below. Ex. 1007 (G.987.3), 101.



128. Assuming *in arguendo* that Patent Owner argues that 14[B] requires a direct transition between the first low power state and the second low power state, a POSITA would have understood that G.987.3 in view of Röger renders obvious 14[B] for at least the reasons discussed with respect to claim elements 1[B]-1[D] and 1[F]-1[G]. See *supra* §VIII.A, 1[B]-1[D], 1[F]-1[G]. Indeed, Röger teaches direct transitions between the first low power state (receive mode) and the second low power state (sleep mode). Ex. 1006 (Röger), 6-8, 10-13.

14[C]: an optical line terminal (OLT) communicably coupled to the ONU, the OLT configured to transmit a control message to the ONU to control at least one aspect of transition of the ONU between the first low power mode and the second low power mode; and

129. A POSITA would have understood that G.987.3 teaches 14[C] for at least the reasons discussed with respect to claim elements 1[F]-1[G] and 14[B]. *See supra*, §VIII.A, 1[F]-1[G], 14[B].

130. A POSITA would have understood that the “control message” of the ’892 Patent includes the “power management message” described above. The term “power management message” is not used in the specification. *See* Ex. 1001 (’892 Patent). As such, and in view of the claims, the POSITA would have understood a “power management message” to be a message that is usable to change a power management rule. Ex. 1001 (’892 Patent), claims 1, 5-6, 9-10, 14. Regarding the “control message,” the specification of ’892 Patent states that a power management rule may include “responding incoming control messages from the OLT that specify entering or exiting the first and the second states.” Ex. 1001 (’892 Patent), 41-45. As such, a power management message changing the power management rule by causing an ONU to change states falls within the scope of a control message. Indeed, changing a power management rule (which generally include local and external causes of state transitions) would also “control at least one aspect of transition.” *See supra*, §VIII.A, 1[D].

131. Specifically, the PLOAM messages and transmitted by the OLT to the ONU teach the “control messages” because they allow or restrict the ONU from operating in a “first low power mode” or “second low power mode.” Ex. 1007 (G.987.3), 100. Allowing or restricting the ONU from operating in these states is “at least one aspect of the transition” because it causes the ONU to transition between states. Ex. 1007 (G.987.3), 100.

132. Further, FWIs transmitted by the OLT teach the “control messages” because they cause the ONU to transition to a full power state, which is “at least one aspect of the transition” because it is the first step of a transition between the “first low power state” and the “second low power state.” Ex. 1007 (G.987.3), 100-102.

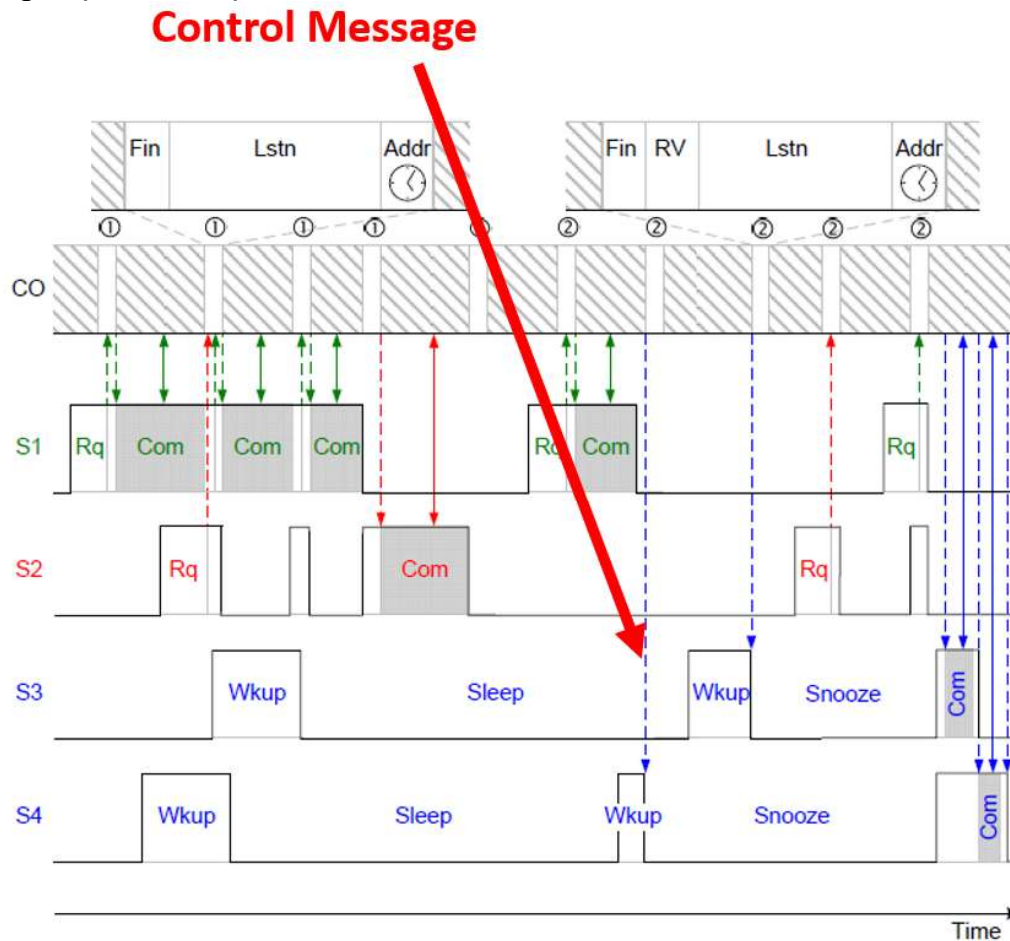
133. Finally, the “control messages” are taught by OMCI messages by which the OLT sends the ONU parameters including “Isleep” which is “the maximum time the ONU spends” in its first low power mode or second low power mode. Ex. 1007 (G.987.3), 98. The OLT controls “at least one aspect of a transition” from the first or second low power mode by using the OMCI message to specify the maximum time until the ONU must transition from these modes. Ex. 1007 (G.987.3), 98.

134. Assuming *in arguendo* that Patent Owner argues that Patent Owner argues that 14[C] requires a direct transition between the first low power mode and the second low power mode, a person having ordinary skill in the art would have

known that these control messages would be applicable to direct transitions between the first low power mode and the second low power mode in G.987.3 modified by Röger. Ex. 1006 (Röger), 6-8, 20-23.

135. Röger likewise teaches 14[C] for at least the reasons discussed with respect to claim elements 1[F]-1[G] and 5. *See supra* §VIII.A, 1[F]-1[G], claim 5. For example, when the ONU receives, from the OLT, an ending signal (“control message”), the subscribers are sent back into a sleep mode (“second state”), where they would “nearly periodically” transition back and forth with a receive state (“first state”). Ex. 1006 (Röger), 7, 12. Therefore, the direct transitions between the first state and second state are controlled at least in one aspect by the ending signal (“control message”) because the ending signal causes the ONU to nearly periodically transition between the sleep mode (“second state”) and the receive mode (“first state”). Ex. 1006 (Röger), 7, 12. Furthermore, as illustrated in annotated Figure 2 (reproduced below), the dashed blue line illustrates a polling signal (which also teaches the “control message”) transmitted by the OLT causes the ONU to transition from a receive mode (“first low power mode”) where a receiver is on and a transmitter is off to a snooze mode (which additionally discloses the “second low power mode”) in which both the receiver and transmitter are off. Ex. 1006, 7. Thus, Röger teaches 14[C].

Ex. 1006, Fig. 2 (annotated)



14[D]: the ONU configured to ensure that the ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first low power mode or the second low power mode.

136. A POSITA would have understood that G.987.3 teaches claim 14[D] for at least the reasons described with respect to claim 1[E]. *See supra* §VIII.A, 1[E].

Claim 15: The system as in claim 14, wherein: the OLT is configured to transmit the control message that includes the power management rule that specifies a first time period for operation in the first low power state and a second time period for operation in the second low power state and to control the ONU to transition from the first low power state to the second low power state upon expiration of at least one of the first time period and the second time period.

137. A POSITA would have understood that G.987.3 in view of Röger further in view of G.988 renders obvious claim 15 for at least the reasons discussed with respect to claims 1[F]-1[G], 3, and 14[C]. *See supra* §VIII.A, 1[F]-1[G], claim 3, 14[C].

138. The OMCI messages (which teach the “control message[s]”) transmitted from the OLT to the ONU define the parameter “Isleep” as “the maximum time the ONU spends in its Asleep or Listen states” and the parameter “Iaware” as “the minimum time the ONU spends in its Aware state.” Ex. 1007 (G.987.3), 100. Likewise, G.988 identifies the “Isleep” parameter as the “Maximum sleep interval.” Ex. 1008 (G.988), 82. The OMCI messages include the “power management rule” which, as stated in the ’892 Patent, “may be based on the timing parameters that control how long the ONU can be in the first or the second mode.” Ex. 1001 (’892 Patent), 12:31-45; Ex. 1007 (G.987.3), 98-99. As discussed further above with respect to 1[F]-1[G], the “power management rule” for the ONU is switching back and forth between a low power state and an aware state. *See supra*, §VIII.A, 1[F]-1[G]. Since Isleep and Iaware control how much time the ONU may

spend in these states, the OMCI message defines the “power management rule.” Ex. 1007 (G.987.3), 98. In addition, the maximum time the ONU spends in the Listen and Asleep states teaches the “second time period for operation in the second low power state” and the “first time period for operation in first low power state,” respectively. Ex. 1007 (G.987.3), 98. Therefore, “Isleep” teaches both the “first time period for operation in the first low power state” and the “second time period for operation in the second low power state.” The OLT controls the transition from the “first low power state” or the “second low power state” by defining the maximum time prior to the transition. Ex. 1007 (G.987.3), 98.

139. A POSITA would have known that timing parameters configured by the control messages would have also been applicable to direct transitions from the “first low power state” to the “second low power state” in G.987 modified by Röger, so that the ONU can save power while periodically listening for signals from the OLT. Ex. 1006 (Röger), 6-8, 10-13. Thus, a POSITA would have understood that G.987.3 in view of Röger renders obvious the OLT being configured to transmit the control message that includes the power management rule that specifies a first time period for operation in the first low power state and a second time period for operation in the second low power state and to control the ONU to transition from the first low power state to the second low power state upon expiration of at least one of the first time period and the second time period.

B. Ground 2: G.987.3 in View of Röger Further in View of G.988 Further in View of Ghazaisaidi Renders Obvious Claims 10-13 of the '892 Patent.

Motivation to Combine

140. A POSITA would have been motivated to combine G.987.3, G.988, and Röger with Ghazasaidi. All of G.987.3, G.988, Röger, and Ghazasaidi are directed towards passive optical network systems that include an optical line terminal in communication with a number of optical network units. Ex. 1006 (Röger), 2, 5; Ex. 1007 (G.987.3), 1, 3, 10, 97-106; Ex. 1008 (G.988), 3, 12; Ex. 1009 (Ghazisaidi), Abstract. Moreover, Ghazasaidi addresses a common problem with the other references- energy efficiency. Ex. 1009 (Ghazisaidi), [0001], [0005]. Ghazasaidi makes clear that “[m]any efforts have been devoted to reduce the energy consumption of wired and wireless access networks.” Ex. 1009 (Ghazisaidi), [0001]. Thus, a POSITA in possession of G.987.3, G.988, and Röger would have been motivated to look to the equivalent optical line terminal and optical network units of Ghazasaidi to inform ways to reduce energy consumption of a passive optical network system.

141. In addition, the POSITA would have been motivated to modify ONUs and OLTs in G.987.3, G.988, and Röger to include the processor and memory of Ghazasaidi’s ONUs and OLTs so that the ONUs and OLTs would be equipped to perform functionality useful in a passive optical network system. Ex. 1009

(Ghazisaidi), [0052]. Indeed, a person of ordinary skill in the art would have looked to disclosures like Ghazasaidi when implementing ONUs and OLTs for reducing power consumption. A POSITA would have had an expectation of success since the ONUs and OLTs of Ghazasaidi would have been standardized based on ITU-T recommendations. Thus, a POSITA would have known that a simple substitution of Ghazasaidi's processor and memory in the ONUs and OLTs of G.987.3, G.988, and Röger would have yielded predictable results and allowed such OLTs and ONUs to function in the passive optical network system.

Claim 10[A]: An optical communication apparatus, comprising:

142. A POSITA would have understood that G.987.3 teaches claim 10[A]. G.987.3 teaches an "ONU" (optical network unit) in communication with an "OLT" (optical line terminal). Ex. 1007 (G.987.3), 10, 97-106.

143. A POSITA would have understood that Röger teaches claim 10[A]. For example, Röger teaches "optical network units" (ONUs) in communication with "optical line terminations" (OLTs). Ex. 1006 (Röger), 5.

144. Ghazisaidi likewise teaches 10[A]. For example, Ghazisaidi teaches "a number of optical network units" (ONUs) in communication with an "optical line terminal" in a "passive optical network." Ex. 1009 (Ghazisaidi), [0003]. Thus, a POSITA would have understood that Ghazisaidi likewise teaches an optical communication apparatus.

10[B]: a memory that stores processor-executable instructions; and

145. A POSITA would have understood that ONUs of G.987.3, G.988, and Röger would have had memories to store instructions for communication in the passive optical network. Regardless, Ghazisaidi teaches 10[B]. Specifically, Ghazisaidi teaches that the ONU may include a memory “used to store various instructions for the processor.” Ex. 1009 (Ghazisaidi), [0052]. A POSITA would have known it to be obvious to use the memory of Ghazisaidi to store instructions for the ONU in G.987.3, as the Ghazisaidi’s memory stores instructions for an equivalent ONU. Thus, a POSITA would have understood that the combination teaches a memory that stores processor-executable instructions.

10[C]: a processor that uses the stored instructions to implement a method, comprising operating an optical network unit (ONU) in a first state in which a transmitter of the ONU is turned off and a receiver of the ONU is turned on; and operating the ONU in a second state in which both the transmitter and the receiver are turned off; and

146. G.987.3 in view of Ghazisaidi renders obvious claim 10[C]. A POSITA would have understood that ONUs of G.987.3, G.988, and Röger would have had processors to implement the functionality of the ONUs. Regardless, the ONU of Ghazisaidi includes “a processor” that uses instructions stored by a memory. Ex. 1009 (Ghazisaidi), [0052]. The processor of Ghazisaidi may be used for data communication via the passive optical network. Ex. 1009 (Ghazisaidi), [0052]. A POSITA would have known it to be obvious to use the processor of Ghazisaidi to

implement the functionality performed by the ONU in G.987.3, as the Ghazisaidi's processor controls the functionality of an equivalent ONU. Ex. 1009 (Ghazisaidi), [0052]. The processor would be operable to implement the method of claim 10[C] for the reasons discussed with respect to claim elements 1[B]-1[C]. *See supra* §VIII.A, 1[B]-1[C]. Thus, a POSITA would have understood that G.987.3 in view of Ghazisaidi renders obvious a processor that uses the stored instructions to implement a method, comprising operating an optical network unit (ONU) in a first state in which a transmitter of the ONU is turned off and a receiver of the ONU is turned on and operating the ONU in a second state in which both the transmitter and the receiver are turned off.

147. Röger in view of Ghazisaidi renders obvious 10[C] for at least the reasons discussed with respect to claim elements 1[B]-1[C]. *See supra* §VIII.A, 1[B]-1[C]. Thus, a POSITA would have understood that Röger in view of Ghazisaidi likewise renders obvious a processor that uses the stored instructions to implement a method, comprising operating an optical network unit (ONU) in a first state in which a transmitter of the ONU is turned off and a receiver of the ONU is turned on and operating the ONU in a second state in which both the transmitter and the receiver are turned off.

10[D]: wherein the processor includes means for transitioning the ONU directly from the first state to the second state and means for transitioning the ONU directly from the second state to the first state, based on a power management rule;

148. As described in 1[D], this recitation would have been obvious to the POSITA. *See supra*, §VIII.A, 1[D]. In addition, the processor of Ghazisaidi, as combined in this ground with G.987.3, G.988, and Röger, includes means for performing the functionality of Röger, including transitioning the ONU directly from the first state to the second and transitioning the ONU directly from the second state to the first state based on a power management rule, which was described above in 1[D]. Ex. 1009 (Ghazisaidi), [0052]; *see supra*, §VIII.A, 1[D]. Thus, a POSITA would have understood that the combination renders obvious that the processor includes means for transitioning the ONU directly from the first state to the second state and means for transitioning the ONU directly from the second state to the first state based on a power management rule.

10[E]: wherein the processor uses stored instructions to ensure the ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first state or the second state; and

149. As described in 1[E], this recitation would have been obvious to the POSITA. *See supra*, §VIII.A, 1[E]. In addition, the processor of Ghazisaidi, as combined in this ground with G.987.3, G.988, and Röger, includes means for using stored instructions to perform the functionality of G.987.3, including ensuring the

ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first state or the second state. Ex. 1009 (Ghazisaidi), [0052]; *see supra*, §VIII.A, 1[E]. Thus, a POSITA would have understood that the combination renders obvious that the processor uses stored instructions to ensure the ONU is fully powered up, synchronized, and capable of responding to both upstream and downstream traffic and control before exiting the first state or the second state.

10[F]: wherein the processor further uses the stored instructions to implement the method by receiving, by the receiver, a power management message from an optical line terminal (OLT) and changing the power management rule based on the received power management message.

150. As described in 1[F]-1[G], this recitation would have been obvious to the POSITA. *See supra*, §VIII.A, 1[F]-1[G]. In addition, the processor of Ghazisaidi, as combined in this ground with G.987.3, G.988, and Röger, includes means for using stored instructions to perform the functionality of G.987.3 and Röger, including receiving, by the receiver, a power management message from an optical line terminal (OLT) and changing the power management rule based on the received power management message. *See supra*, §VIII.A, 1[F]-1[G]; Ex. 1009 (Ghazisaidi), [0052]. Thus, a POSITA would have understood that the combination renders obvious that the processor uses stored instructions to receive, by the receiver,

a power management message from an optical line terminal (OLT) and changing the power management rule based on the received power management message.

Claim 11: The apparatus as in claim 10, wherein the power management rule specifies a first time period for operation in the first state and a second time period for operation in the second state and wherein the transitioning is performed upon expiration of at least one of the first time period and the second time period.

151. A POSITA would have understood that G.987.3 in view of Röger further in view of Ghazisaidi and further in view of G.988 renders obvious the power management rule specifying a first time period for operation in the first state and a second time period for operation in the second state and wherein the transitioning is performed upon expiration of at least one of the first time period and the second time period for at least the reasons discussed with respect to claim 3. *See supra* §VIII.A, claim 3.

152. A POSITA would have understood that Röger in view of Ghazisaidi renders obvious the power management rule specifying a first time period for operation in the first state and a second time period for operation in the second state and wherein the transitioning is performed upon expiration of at least one of the first time period and the second time period for at least the reasons discussed with respect to claim 3. *See supra* §VIII.A, claim 3.

Claim 12[A]: An optical line terminal (OLT) for operation in a passive optical network (PON), the optical line terminal comprising:

153. A POSITA would have understood that G.987.3 teaches an “OLT” (optical line terminal). The optical line terminal is part of a “10-Gigabit-capable passive optical network” system. Ex. 1007 (G.987.3), 1, 3, 10, 97-106.

154. A POSITA would have understood that Röger likewise teaches “optical line terminations” (OLTs). Ex. 1006 (Röger), 5. The optical line terminations are in communication with ONUs in a passive optical network. Ex. 1006 (Röger), 2, 5. Thus, Röger likewise teaches an optical line terminal (OLT) for operation in a passive optical network (PON). Ex. 1006 (Röger), 2, 5.

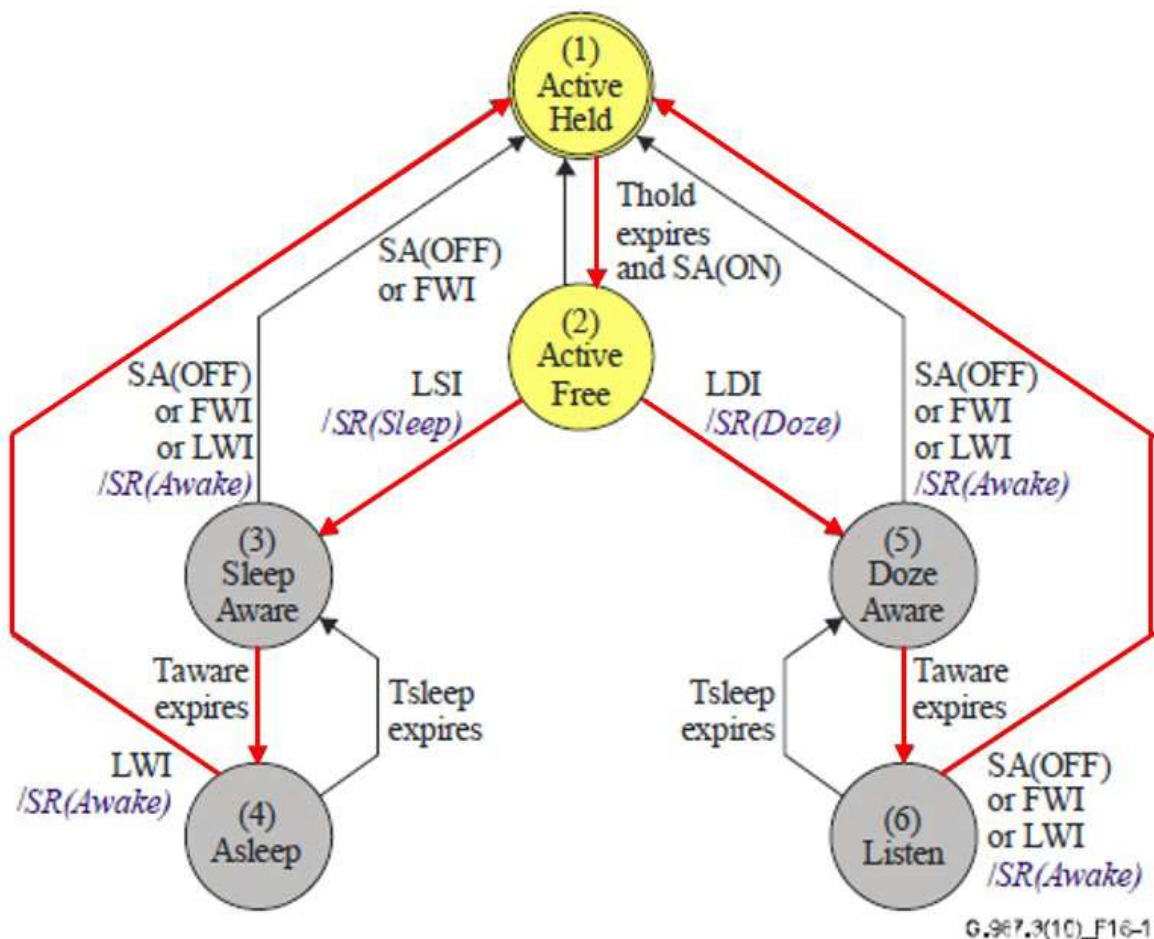
155. A POSITA would have understood that Ghazisaidi teaches 10[A]. For example, Ghazisaidi teaches an “optical line terminal” in communication with “a number of optical network units” (ONUs) in a “passive optical network.” Ex. 1009 (Ghazisaidi), [0003].

12[B]: a processor configured to generate messages for controlling a transition of an optical network unit from a first low power state in which a receiver of the optical network unit is turned on but a transmitter of the optical network unit is turned off to a second low power state in which both the receiver and the transmitter of the optical network unit are turned off;

156. A POSITA would have understood that 12[B] does not require the transition between the first low power mode and the second low power mode to be “direct.” As such, the ONU is able to transition between the first low power mode

and the second low power mode by going through the ActiveHeld and ActiveFree mode, as shown in Figure 16-1 below. Ex. 1007 (G.987.3), 101.

Ex. 1007 (G.987.3), Fig. 16-1



157. The OLT of Ghazisaidi includes “a processor” that uses instructions stored by a memory. Ex. 1009 (Ghazisaidi), [0052]. The processor of Ghazisaidi is used for data communication via the passive optical network. Ex. 1009 (Ghazisaidi), [0052]. A POSITA would have known it to be obvious to use the processor of Ghazisaidi to implement the functionality performed by the OLT in G.987.3 or Röger, as the Ghazisaidi’s processor controls the functionality of an equivalent OLT.

158. A POSITA would have understood that G.987.3 in view of Ghazisaidi renders obvious 12[B]. The OLT generates PLOAM events, bit-indication events, and OMCI messages (“messages”) which control transition of an optical network unit between states, as described with respect to claim elements 1[F]-1[G]. Ex. 1007 (G.987.3), 98-102; *see supra* §VIII.A, 1[F]-1[G].

159. Additionally, assuming *in arguendo* that Patent Owner argues that 12[B] requires a direct transition between the first low power state and the second low power state, G.987.3 in view of Röger further in view of Ghazisaidi renders obvious 12[B] as Röger teaches these direct transitions as described in 1[D]. Ex. 1006 (Röger), 6-8, 12-13; *see supra* VIII.A, 1[D]. Röger further teaches that the OLT generates polling signals (“messages”) that control the transition of an ONU from a receive state (“first low power state”) in which the ONU’s receiver is on and its transmitter is off to a snooze state (“second low power state”) in which the ONU’s receiver and transmitter are off, as described with respect to claim elements 1[F]-1[G]. Ex. 1006, 6-8, 12-13; *see supra*, §VIII.A, 1[F]-1[G].

12[C]: a transmitter configured to transmit the generated messages to the optical network unit;

160. G.987.3 in view of Ghazisaidi renders obvious 12[C]. The OLT of G.987.3 includes a transmitter to transmit the generated messages described with respect to claim element 1[F]. Ex. 1007 (G.987.3), 98-102; *see supra* VIII.A, 1[F]. Thus, a POSITA would have understood that G.987.3 in view of Ghazisaidi renders

obvious a transmitter configured to transmit the generated messages to the optical network unit.

161. Röger in view of Ghazisaidi renders obvious 12[C]. The OLT of Röger includes a “[o]ptical transmitters” which transmit data to the ONUs. Ex. 1006 (Röger), 4. The OLT transmits the generated message to the ONU as described with respect to claim element 1[F]. Ex. 1006 (Röger), 6-8, 12-13; *see supra*, VIII.A, 1[F]. Thus, a POSITA would have understood that Röger in view of Ghazisaidi renders obvious a transmitter configured to transmit the generated messages to the optical network unit.

12[D]: wherein the generated messages comprises a periodic consent message to allow the optical network unit to remain in either the first low power state or the second low power state.

162. G.987.3 in view of Ghazisaidi renders obvious 12[D]. For example, PLOAM messages are used to consent to the ONU operating in a doze mode which includes a Listen state (“first low power state”) or a cyclic sleep mode which includes an Asleep state (“second low power state”). Ex. 1007 (G.987.3), 100. Using the PLOAM event Sleep_Allow(ON), “[t]he OLT grants permission to the ONU to exercise any power management mode and leaves the selection of doze or cyclic sleep mode to the ONU’s discretion.” Ex. 1007 (G.987.3), 100. Similar to LPM-Allow in the ’892 Patent, Sleep_Allow(ON) shifts the responsibility to the ONU to

determine whether to remain in a low power state (i.e., gives consent). Ex. 1001 ('892 Patent), Table 1.

163. “Periodic consent message” is not found in the specification of the '892 Patent. *See* Ex. 1001 ('892 Patent). At best, “periodic consent message” refers to an LPM-Allow message, which, like Sleep_Allow(ON), is transmitted upon an OLT state transition and gives permission to the ONU to transition into a low power mode. Ex. 1001 ('892 Patent), Tables 1, 6; Ex. 1007 (G.987.3), 100, 103. To the extent Patent Owner argues that this message must be transmitted periodically, such functionality is the same in G.987.3 as the OLT may send Sleep_Allow PLOAM messages “*at any time*,” (e.g., periodically) even if a sleeping ONU would not receive the transmission. Ex. 1007 (G.987.3), 106. A POSITA would have known that periodically transmitting these messages would fall within “at any time” and would be beneficial by increasing communication between the OLT and ONU and regularly keeping the ONU informed of its permissions. A POSITA would have known that regularly keeping the ONU informed of its permissions would increase awareness as to whether the components of the PON are behaving correctly.

Claim 13: The optical line terminal as in claim 12, wherein the processor includes means for specifying a first time period for operation in the first low power state and a second time period for operation in the second low power state and wherein the transition of the optical network unit from the first low power state to the second low power state is controlled to occur upon expiration of at least one of the first time period and the second time period.

164. A POSITA would have understood that the combination renders obvious claim 13. First, the processor of Ghazisaidi would include the means for performing the functionality of G.987.3, including specifying the time period for operation in the first low power state and the second time period for operation in the second low power state is the processor of the OLT. Ex. 1009 (Ghazisaidi), [0052]; *See supra*, VIII.A, claim 3.

165. The OLT defines the parameter Isleep, which is “the maximum time the ONU spends in its Asleep or Listen states, as a count of 125 microsecond frames.” Ex. 1007 (G.987.3), 98. The Asleep state teaches the “second low power state” in which the receiver and transmitter are off, and the Listen state teaches the “first low power state” in which the receiver is on and the transmitter is off. Ex. 1007 (G.987.3), 100. Thus, Isleep teaches both the “first time period” for operation in the first low power state and the “second time period” for operation in the second low power state. Ex. 1007 (G.987.3), 98; *see supra*, VIII.A, claim 3. When a local timer is set to its maximum value, an ONU transitions out of the first low power state or second low power state at the expiration of the Isleep time period. Ex. 1007

(G.987.3), 98. A POSITA would have known to apply these time period to direct transitions between the first low power state and the second low power state in G.987 modified by Röger and described with respect to claim element 1[D]. Ex. 1006 (Röger), 6-8, 10-13; *see supra* §VIII.A, 1[D].

IX. REVISION OR SUPPLEMENTATION

166. In this declaration, I have presented my opinions regarding the invalidity of claims 1-5 and 10-15 of the '892 Patent based on the information available to me. My opinions are subject to change in view of opinions provided by the Patent Owner or its expert, or any additional information that I may receive. I reserve the right to supplement my opinions accordingly.

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

Executed May 27, 2024



Dr. Alexander V. Sergienko