

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT TRIAL AND APPEAL BOARD

II-VI Incorporated,
Petitioner,

v.

Alexander Soto and Walter Soto,
Patent Owners.

CASE: IPR2021-01494
U.S. PATENT NO. 8,958,697

PETITION FOR *INTER PARTES* REVIEW

Mail Stop *Patent Board*
Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

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LIST OF EXHIBITS

Exhibit No.	Description
1001	U.S. Patent 8,958,697 B2
1002	Declaration of Keith W. Goossen, Ph.D.
1003	File History of U.S. Patent 8,958,697 B2
1004	Pub. 2002/0146026 A1 to Unitt et al. (“Unitt”)
1005	U.S. Patent 7,079,775 B2 to Aronson et al. (“Aronson”)
1006	U.S. Pub. No. 2009/0304384 A1 to Li (“Li”)
1007	U.S. Patent 8,238,754 B2
1008	U.S. Patent 9,337,948 B2
1009	U.S. Patent 7,242,868 B2
1010	File History Serial No. 60/485,072
1011	File History Serial No. 60/515,836
1012	File History Serial No. 60/477,845
1013	File History Serial No. 60/480,488
1014	File History Serial No. 10/886,514
1015	File History Serial No. 12/982,872
1016	File History Serial No. 10/865,547
1017	File History Serial No. 11/772,187
1018	File History Serial No. 12/512,968
1019	U.S. Patent 7,925,162 B2
1020	U.S. Patent 6,494,623 to Ahrens et al.

Exhibit No.	Description
1021	U.S. Patent No. 5,039,194 to Block et al. (“Block”)
1022	U.S. Patent Publication No. 2004/0208601 A1 to Tan et al. (“Tan”)
1023	802.3u- 1995 - IEEE Standards for Local and Metropolitan Area Networks: Supplement - Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units, and Repeater for 100Mb/s Operation, Type 100BASE-T (Clauses 21-30)
1024	Cooperation Agreement for Small Form-Factor Pluggable Transceivers (available at schelto.org/SFP/SFP%20MSA%20091400.htm) (last accessed August 19, 2021)
1025	U.S. Patent 6,533,470 to Ahrens

Mandatory Notices (37 C.F.R. § 42.8(b))

A. Real Parties-In-Interest

The following are real parties-in-interest (“RPIs”), pursuant to 37 C.F.R. §42.8(b)(1)¹:

- II-VI Incorporated;
- Finisar Corporation.

B. Related Matters

Patent Owners Alexander Soto and Walter Soto have, through their exclusive licensee, asserted U.S. Patent No. 8,958,697 in the following litigation:

¹ Petitioner has listed every defendant who has been involved in, has directed, or has any control over, this Petition as RPIs; as such, the instant Petition correctly names all RPIs. *Applications in Internet Time, LLC v. RPX Corp.*, 897 F.3d 1336 (Fed. Cir. 2018). No defendant in any case involving the ’723 Patent is subject to a 1-year bar under 35 U.S.C. § 315(b). Even if the Board finds that other unnamed parties are, in fact, RPIs, Petitioner should be allowed to amend its Mandatory Notices to reflect any other party the Board deems an RPI as the addition of any other party would not trigger a time bar or estoppel issue. *Sharkninja Operating LLC, et al. v. iRobot Corp.*, IPR2020-00734, Paper 11 (October 6, 2020) (precedential).

- *NextGen Innovations, LLC v. II-VI, Inc., et al.*, Case No. 4:20-cv-00854 (E.D. Tex.).

In this litigation, the following related patents are also asserted:

- U.S. Patent No. 8,238,754;
- U.S. Patent No. 9,887,795;
- U.S. Patent No. 10,263,723;
- U.S. Patent No. 10,763,958; and
- U.S. Patent No. 10,771,181.

The E.D. Tex. case has been transferred to California, however no case number has been assigned to-date. Updated mandatory notices will be provided as soon as a case number in the California action is assigned.

Petitions for *Inter Partes* Review have been filed for the above-referenced patents in the following matters:

- IPR2021-01358
- IPR2021-01359
- IPR2021-01361

The following related patent applications are currently pending before the United States Patent and Trademark Office (“USPTO”): Ser. No. 17/013,635; Ser. No. 17/138,794; and Ser. No. 17/146,407.

Petitioner is also concurrently filing an IPR Petition in IPR2021-01495 challenging certain claims of related U.S. Patent No. 8,238,754.

C. Lead and Backup Counsel and Service

Lead Counsel	Backup Counsel
<p>Jason A. Engel Reg. No. 51,654 K&L Gates LLP 70 W. Madison Street, Suite 3100 Chicago, IL 60602 Jason.Engel.PTAB@klgates.com T: (312) 807-4236 F: (312) 827-8145</p>	<p>Erik J. Halverson Reg. No. 73,552 K&L GATES LLP 70 W. Madison St., Suite 3100 Chicago, IL 60602 erik.halverson@klgates.com T: (312) 807-4240 F: (312) 345-8529</p> <p>Mark G. Knedeisen Reg. No. 42,747 K&L GATES LLP 210 Sixth Ave. Pittsburgh, PA 15222 mark.knedeisen@klgates.com T: (412) 355-6342 F: (412) 355-6501</p> <p>Katherine L. Allor Reg. No. 72,691 K&L GATES LLP 70 W. Madison Street, Suite 3100 Chicago, IL 60602 Katy.allor@klgates.com T: (312) 807-4325 F: (312) 345-9987</p>

Petitioner consents to electronic service by email at the above addresses.

I. INTRODUCTION

Petitioner requests institution of *Inter Partes* Review (“IPR”) of claims 1-3, 9-10, 13, 15-17, 20, 21, 24 and 25 (“Challenged Claims”) of U.S. Patent 8,958,697 (“’697 Patent,” Ex.1001) and cancelation of the Challenged Claims in view of the grounds described below. A declaration by Dr. Keith W. Goossen, an expert in the field of the ’697 Patent and the prior art, supports this Petition. (Ex. 1002).

II. TECHNICAL BACKGROUND

A. ’697 Patent

Claim 1 of ’697 Patent claims an “integrated pluggable Passive Optical Network (PON) optical transceiver module adapted to process and perform PON data link layer communications and functions” (Ex. 1001, 19:12-14). Figure 6 (shown below) is a schematic of a PON. It includes a head-end optical module 600 in communication with transceiver modules 604A-C via a passive optical distribution network 602. (*Id.*, 7:12-21).

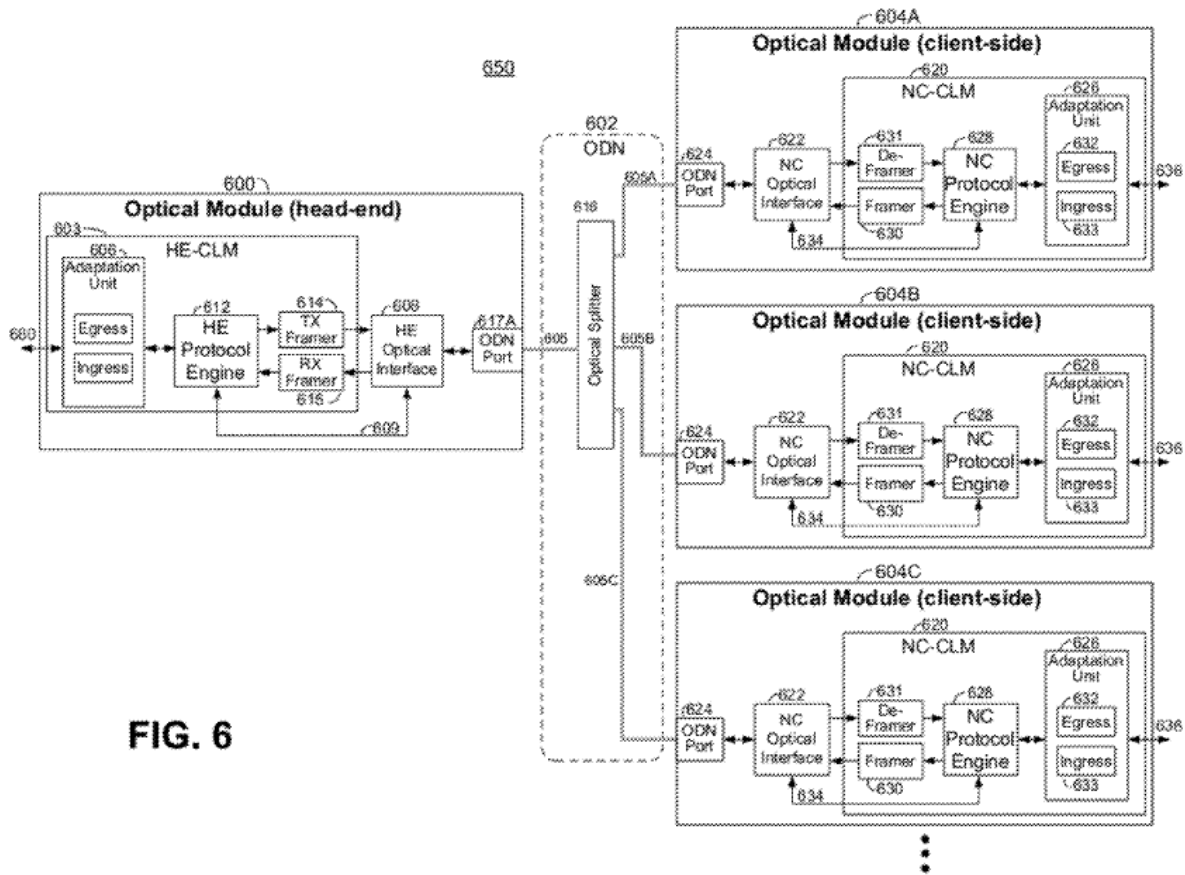


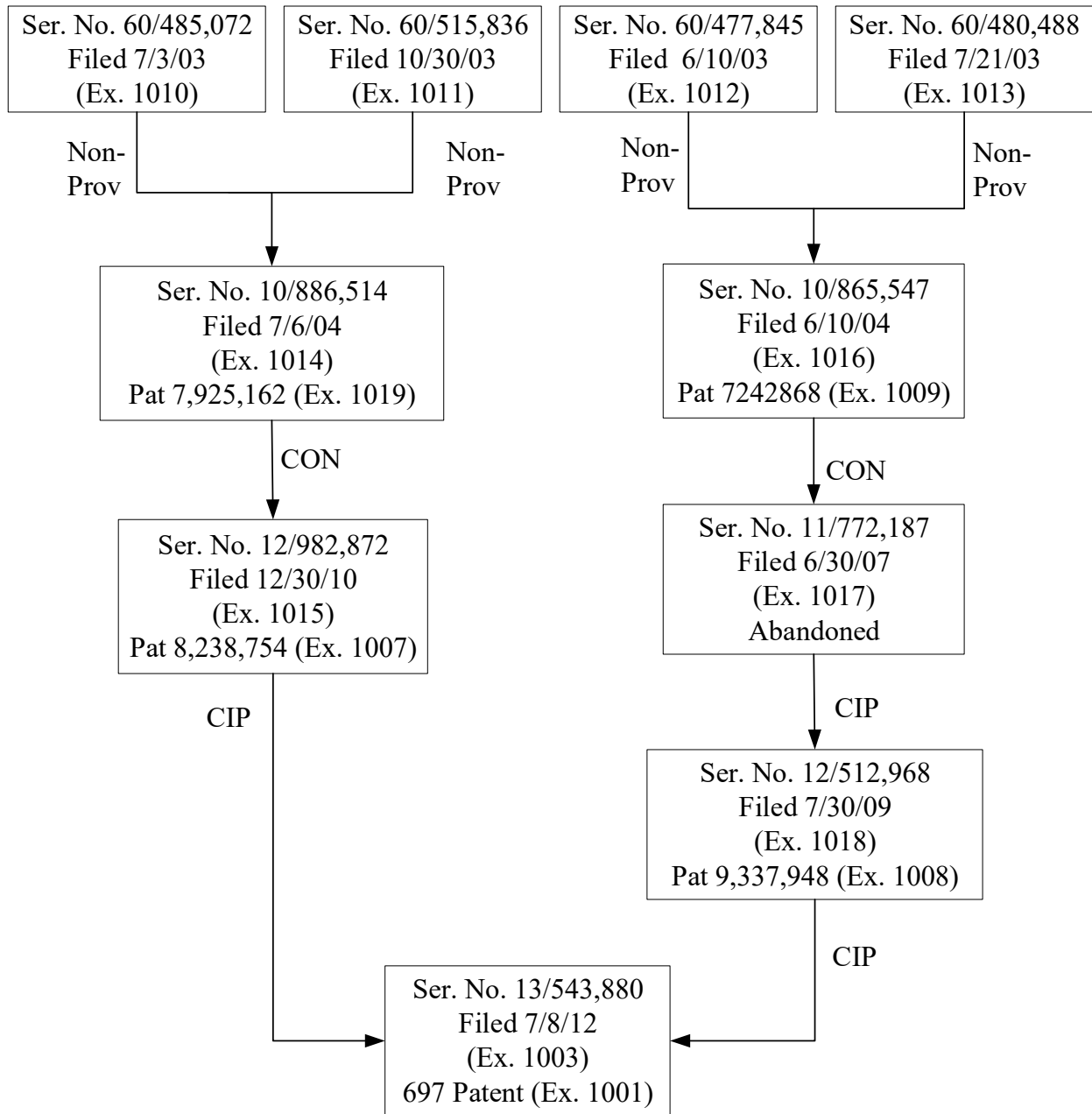
FIG. 6

The PON optical transceiver module comprises a PON protocol processor and an Ethernet media access control (MAC) device. (*Id.*, 2:62-64). With reference to the transceiver modules 604A-C shown in Figure 6, the NC protocol engine 628, framer 630 and deframer 631 “can be combined into a single IC” as the PON protocol processor. (*Id.*, 9:19-23). The PON protocol processor “perform[s] the functions of a data link layer protocol or layer-2 protocol according to the OSI model.” (*Id.*, 9:23-25). The adaption unit 626 is an embodiment of the Ethernet MAC. (*Id.*, 17:64-67).

For downstream communications from the head-end, the PON protocol processor “de-encapsulate[s] user data received from PON data link layer communications to the Ethernet MAC.” The Ethernet MAC then “encapsulate[s] the user data received from the PON protocol processor and provide[s] the user data to a switch, router or media converter using Ethernet communications.” For upstream communications, the Ethernet MAC “de-encapsulate[s] user data received from the switch, outer or media converter and provide[s] the user data to the PON protocol processor.” The PON protocol processor then “encapsulate[s] user data received from the Ethernet MAC and encapsulate[s] the user data for communication across the PON.” (Ex. 1001, 2:65-3:12).

B. Prosecution History

The '697 Patent was filed July 8, 2012, as a continuation-in-part (CIP) of two prior applications (now both patents): Serial No. 12/982,872, now U.S. Patent 8,238,754; and Serial No. 12/512,968, now U.S. Patent 9,337,948. Each application claims priority to earlier filed applications, including provisional applications filed in 2003. The chart below shows the '697 Patent family. Copies of the patents and file histories of the applications in the '697 Patent family are provided as Exhibits 1008-1019 as shown in the chart below.



The examiner made no prior art rejections in the examination of the '697 Patent. Ex. 1003, 38-46 (sole Office Action with only § 112(b) rejections).

C. Priority for Challenged Claims

In a CIP, like the '697 Patent, priority is assessed on a claim-by-claim basis.

Transco Prods., Inc. v. Performance Contracting, Inc., 38 F.3d 551, 557 n.6 (Fed. Cir. 1994). A claim in a CIP is entitled to an earlier effective filing date only if the claim finds support in an earlier-filed nonprovisional application. *Id.* To be “supported” by an earlier-filed application, the earlier-filed application must “convey with reasonable clarity to those skilled in the art that, as of the filing date sought, [the inventor] was in possession of the invention.” *Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1563–64 (Fed. Cir. 1991). “Obviousness simply is not enough; the subject matter must be disclosed to establish possession.” *PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1310 (Fed. Cir. 2008) (citing *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1571–72 (Fed. Cir. 1997)). When there is not *in haec verba* support, “the missing descriptive matter must necessarily be present in the [earlier] application’s specification such that one skilled in the art would recognize such a disclosure.” *Tronzo v. Biomet, Inc.*, 156 F.3d 1154, 1159 (Fed. Cir. 1998). Claims reciting new matter, however, are entitled to only the filing date of the CIP application and not to the filing date of the earlier-filed application. *Transco*, 38 F.3d at 557 n.6.

The challenged apparatus-type claims (i.e., claims 1-3, 9-10 and 13) of the ’697 Patent are entitled only to a priority date of July 8, 2012, the filing date of the ’697 Patent application, because these claims are not supported by an earlier application.

Independent claim 1 recites that the PON protocol processor performs “one or more” of several listed functions. (Ex. 1001, 19:19-26). The “one or more” claim language means that the claim covers a PON processor that performs any of the listed functions individually, as well as combinations of the listed functions. *See e.g., Nikon Corp. v. ASM Lithography B.V.*, 308 F.Supp.2d 1039 (N.D. Cal. 2004) (claim reciting “measuring the displacement along at least one of said X and Y axis ...” in context of patent for use of laser interferometer positioning in photolithographic process meaning determining and quantifying movement along either the X or Y axis or both). To support the full scope of claim 1, the disclosure must disclose a PON processor capable of supporting all of the listed functions. Otherwise, the disclosure would not convey to a person skilled in the art (“POSITA,” described further below) that the inventors were in possession of a PON processor that could perform all of the listed functions. *See Vas-Cath*, 935 F.2d at 1563–64; *In re Gosteli*, 872 F.2d 1008 (Fed. Cir. 1989) (claim with disjunctive limitations not entitled to foreign priority date because foreign application to which priority was claimed did not disclose one of options).

Among the listed function options for the PON processor in claim 1 is “operation administration and maintenance (OAM) message processing.” This function for the PON processor is first disclosed in the ‘697 Patent specification filed in July 2012. (Ex. 1001, 8:19-20, 9:39-40). Neither this disclosure, nor

anything similar, is disclosed in any of the prior applications in the '697 Patent family. (Ex. 1007 to 1019; Ex. 1002, ¶¶49-52). Thus, claim 1 and its dependent claims (e.g., Challenged Claims 2-3, 9-10 and 13) are entitled only to a priority date of July 2012.

For purposes of this Petition only, Petitioner assumes that the challenged method claims 15-17, 20, 21, 24 and 25 are entitled to a priority date of July 3, 2003.

In the original prosecution, the examiner did not assess explicitly the priority date of any claim of the '697 Patent. (Ex. 1003, 38-46).

Regardless of the priority date, the pre-America Invents Act (AIA) versions of 35 U.S.C. §§ 102-103 apply for all Challenged Claims. All references to §§ 102-103 herein refer to the pre-AIA versions thereof.

D. Person of Ordinary Skill in the Art

A person of ordinary skill in the art (“POSITA”) is a hypothetical person who is presumed to know the relevant prior art and has ordinary creativity when interpreting and combining prior art. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 420–21 (2007).

A POSITA for the '697 Patent, as of either July 2003 or July 2012, would have a Bachelor’s Degree in electrical engineering, computer engineering, or

similar discipline, and approximately two years of experience with optical networks, including PONs. Ex. 1002, ¶46. Such a POSITA would have had knowledge of design considerations known in the industry and would have been familiar with then-existing products and solutions. *Id.* A POSITA would have been familiar with MSA optical modules, including SFP, XFP and XENPAK, and would have been familiar with both communications networking technology as well as optoelectronic devices and packaging techniques. *Id.*

III. GROUNDS FOR STANDING

Petitioner certifies that (1) the '697 Patent is available for IPR; (2) Petitioner is not barred or estopped from requesting an IPR on the Grounds identified herein; and (3) Petitioner has not filed a complaint relating to the '697 Patent.

IV. PAYMENT OF FEES

Petitioner authorizes the USPTO to charge any required fees to Deposit Account 02-1818.

V. CLAIM CONSTRUCTION

The Board should construe the claim terms according to their ordinary meaning to a POSITA and the patent's prosecution history. 37 C.F.R. § 42.100(b). Because the prior art plainly discloses the claim elements, construction of technical claim terms is unnecessary. *Nidec Motor v. Zhongshan Broad Ocean Motor*, 868

F.3d 1013, 1017 (Fed. Cir. 2017).

Regarding non-technical claim terms, independent claim 1 recites that the PON protocol processor performs “one or more the following functions comprising...” and then lists several functions. Similarly, several challenged dependent claims recite an item “selected from the group consisting essentially of ...” several alternatives. *See* claims 2 and 16 (optical module form factors); claims 3 and 17 (network protocols); claims 9 and 21 (fiber connectors); and claims 10 and 24 (Ethernet MACs). The listed items in these claims should be viewed as alternatives like *Markush* claims. *See Abbott Labs v. Baxter Pharmaceutical Products, Inc.*, 334 F.3d 1274, 1280-81 (Fed. Cir. 2003). As alternatives, the prior art needs only to show one of the alternatives to show that the claims are invalid. *See Brown v. 3M*, 265 F.3d 1349, 1351 (Fed. Cir. 2001) (“When a claim covers several structures or compositions, either generically or as alternatives, the claim is deemed anticipated if any of the structures or compositions within the scope of the claim is known in the prior art.”).

VI. STATEMENT OF PRECISE RELIEF REQUEST AND REASONS THEREFORE

Petitioner requests the institution of IPR and the cancellation of the Challenged Claims on the following Grounds:

Ground	Basis	Relied-On References	Claim(s)
1A	§ 103	Unitt (Ex. 1004) and Aronson (Ex. 1005)	1-3, 9-10, 13, 15-17, 20, 21, 24-25
1B	§ 103	Unitt, Aronson and Block (Ex. 1021)	9, 21
2A	§ 103	Unitt and Tan (Ex. 1022)	1-3, 9-10, 15-17, 21, 24
2B	§ 103	Unitt, Tan, Aronson	13, 20, 25
3	§ 103	Li (Ex. 1006)	1-3, 9-10, 13

A. The Petition Should Not Be Discretionarily Denied

1. *Becton, Dickinson*

The claims of the '697 Patent have not been considered in view of any of the prior art relied upon in the asserted grounds of this Petition.² Accordingly, the present Petition should not be discretionarily denied under 35 U.S.C. § 325(d). *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 (PTAB Feb. 13, 2020) (precedential).

² Other patent documents by Unitt et al. (Patent No. 6,970,461) and Aronson (Patent No. 7,486,894 and Pub. No. 2007/0031153) were considered in the original file history, but they are substantively different from Exs. 1004-1005.

2. *Fintiv*

The Board should not deny this Petition in view of 35 U.S.C. § 314(a). *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) sets forth six factors to consider in a discretionary denial under 35 U.S.C. § 314(a). When assessed holistically, these six factor do not warrant discretionary denial.

First, no stay has been sought by any party as the related district court case is currently in its infancy. This favors not exercising discretionary denial.

Second, presently, there is no trial date set for any litigation involving the '697 Patent. This favors not exercising discretionary denial.

Third, Petitioner's parallel proceedings are in their infancy, with a scheduling order not yet entered, minimal discovery has occurred, and no claim construction schedule, let alone a trial schedule, exists.

Fourth, Petitioner's parallel proceedings are anticipated to present additional and distinct issues from this proceeding. Petitioner has not yet presented any invalidity contentions in the district court, but expects the district court case to focus heavily, if not exclusively, on product prior art, which cannot be raised here. In this regard, there will be little to no overlap of issues should this proceeding be instituted, which also favors institution. Indeed, after Petitioner's venue motion has been decided and the appropriate jurisdiction for the district court case has been determined, Petitioner plans to submit a *Sands Revolution*-type stipulation

and will update the Board accordingly after such stipulation has been provided.

Fifth, plaintiff in the parallel proceeding is not the patent owner. This favors not exercising discretion to deny institution.

Sixth, the merits of the arguments presented to the Board here strongly warrant consideration, also weighing in favor of institution.

Balancing these factors holistically, the Board should not exercise its discretion to deny this Petition.

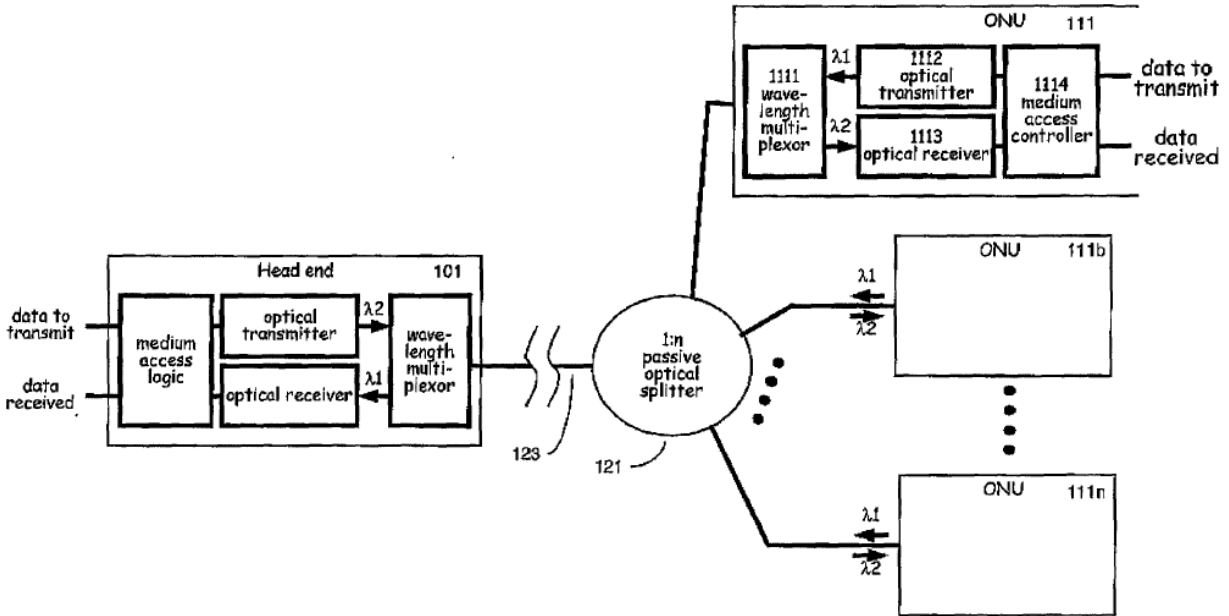
B. Overview of Prior Art

1. Unitt

Unitt is a published patent application that was filed March 27, 2002 and published October 10, 2002. (Ex. 1004, cover). To the extent a Challenged Claim is entitled to a July 3, 2003 priority date, Unitt qualifies as prior art under both § 102(a) because it was published before July 3, 2003 and § 102(e) because it was filed before July 3, 2003. To the extent a Challenged Claim is entitled to a July 8, 2012 priority date, Unitt qualifies as prior art under § 102(b).

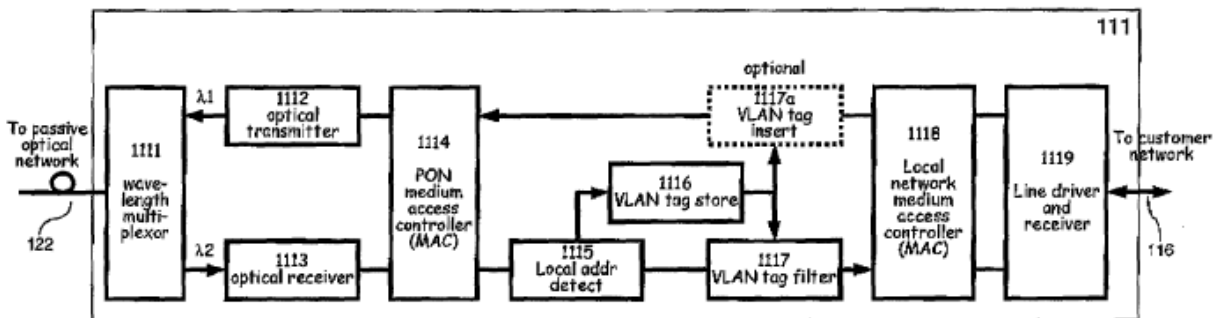
Like the '697 Patent, Unitt discloses a PON with a headend 101 connected to a number of optical network units (ONUs), as shown in reproduced Figure 2 of Unitt below. (Ex. 1004, ¶[0052], Figs. 1-2). “Each ONU converts ... the optical signal to an electrical signal and decodes the information.” (Ex. 1004, ¶[0055]).

Fig. 2



Unitt's Figure 4 discloses more details of the ONU 111. The ONU is an optical transceiver because it both transmits and receives optical data. It includes both a transmitter 1112 and a receiver 1113 for transmitting and receiving data, respectively, via the passive optical network 122. (Ex. 1002, ¶56).

Fig. 4



2. Aronson

Aronson is a patent that issued on July 17, 2006 from an application filed Feb. 5 2001. (Ex. 1005, cover). To the extent a Challenged Claim is entitled to a July 3, 2003 priority date, Aronson qualifies as prior art under § 102(e). To the extent a Challenged Claim is entitled to a July 8, 2012 priority date, Aronson qualifies as prior art under § 102(b).

Aronson discloses an optoelectronic transceiver that, with reference to Aronson's Figure 2, reproduced below, "contains a Receiver Optical Subassembly (ROSA) 102 and Transmitter Optical Subassembly (TOSA) 103 along with associated postamplifier 104 and laser driver 105 integrated circuits that communicate the high speed electrical signals to the outside world." (*Id.*, 4:37-42).

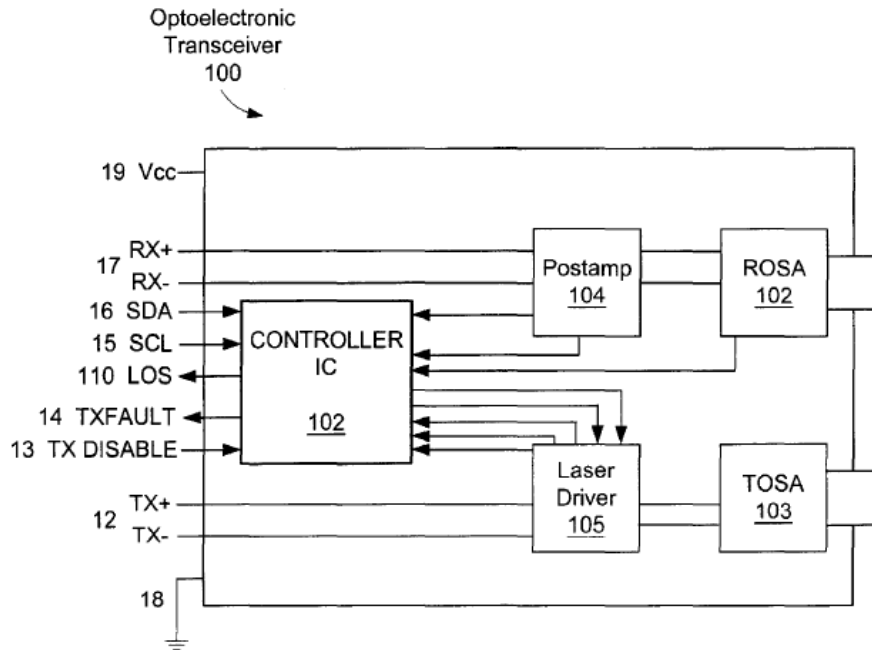


Fig. 2

Referring to Aronson’s Figure 3, the transceiver has an “interface 121 [that] is coupled to host device interface input/output lines, typically clock (SCL) and data (SDA) lines, 15 and 16. In the preferred embodiment, the serial interface 121 operates in accordance with the two wire serial interface standard that is also used in the GBIC and SFP standards” (*Id.*, 4:61-66). In this context, “GBIC” refers to gigabit interface converter and “SFP” refers to small form-factor pluggable. (Ex. 1002, ¶¶59-60).

3. Li

Li is a U.S. application that published in December 2009. (Ex. 1006, cover). It qualifies as prior art under § 102(b) for Challenged Claims entitled only to a priority date of July 2012.

Li discloses an optical network system that includes a “pluggable optical transceiver 100 that is plugged into a host device 200 at a first site, and network equipment 500 at a second site.” (Ex. 1006, ¶[0017]). The pluggable optical transceiver “is an integrated device, which can have a form factor as defined by standards for optical transceivers, such as GBIC, SFF, small form-factor pluggable (SFP), XFP, X2, XENPAK, and SFP+.” (*Id.*). The transceiver provides physical layer functions, as well as “functions beyond physical layer,” such as “media access control (MAC), Ethernet/ATM switching, operation administration management (OAM) message process, forward error correction (FEC), etc.” (*Id.*, ¶[0018]).

An example of Li’s transceiver is shown in Figure 2 thereof, reproduced below. As shown, the transceiver includes a PON processing unit, which “can perform system-layer functions that include media access control (MAC), Ethernet/ATM switching, forward error correction, or OAM message processing.” (*Id.*, ¶[0044]).

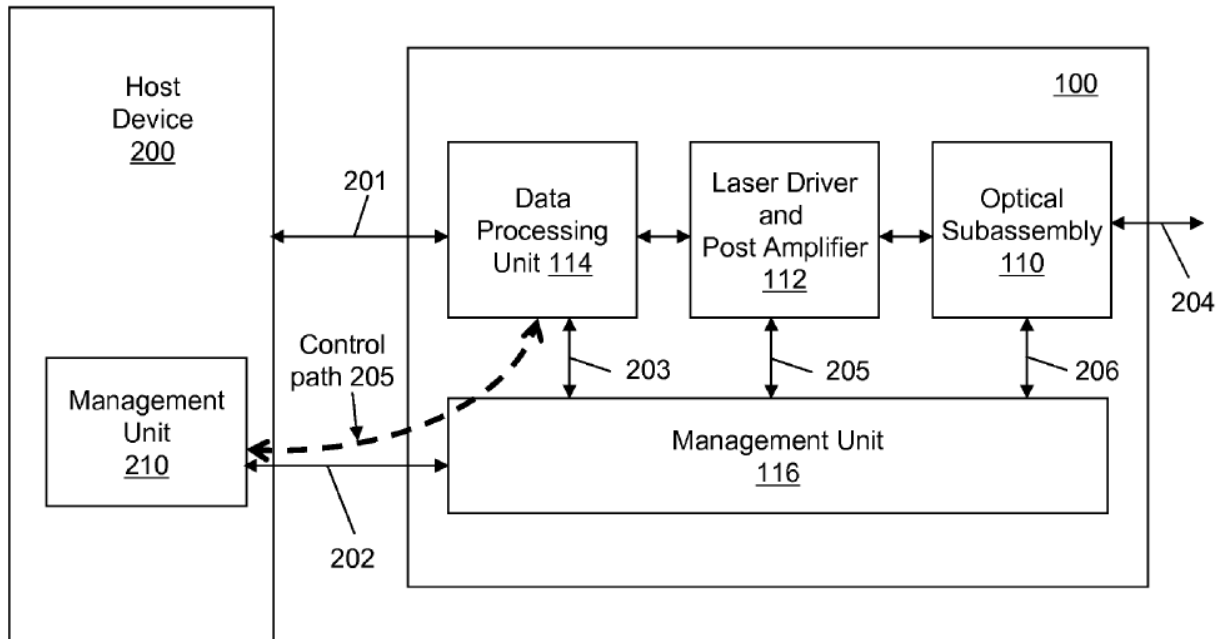


Figure 2

4. Block

Block is a patent that issued in 1991. (Ex. 1021, cover). It qualifies as prior art under § 102(b).

Block discloses an optical fiber link card communication module with receptacles. (Ex. 1021, 5:41-60). Some of the receptacles can be “an FC type optical fiber connector.” (*Id.*, 5:64-66).

5. Tan

Tan is a U.S. application that published in 2004. Tan's application was filed June 6, 2002. (Ex. 1022, cover). It discloses bi-directional, pluggable optical transceivers. (Ex. 1022, Abstract, Figs. 6A-6F; Ex. 1002, ¶¶64-65).

C. Ground 1A

1. Motivation to Combine

The scope and content of the prior art includes Unitt and Aronson, which collectively disclose all of the elements of Challenged Claims 1-3, 9-10, 13, 15-17, 20-21 and 24-25. There are no differences between the subject matter of these Challenged Claims and the combination of Unitt and Aronson.

A POSITA would have been motivated to combine Unitt and Aronson; that is, to make Unitt's ONU pluggable as taught in Aronson. First, Unitt states that by embodying the ONU (i.e., transceiver) as a single application specific integrated circuit (ASIC), the change would reduce size, complexity, and cost, and would provide higher reliability. (Ex. 1004, ¶¶[0054], [0084]). Thus, Unitt guides a POSITA to miniaturize the ONU, including integration of the ONU functions onto an ASIC. (Ex. 1002, ¶¶67-70).

Second, Unitt also describes that "[i]n a practical network, it is highly desirable that the system should be 'plug and play', that is, no re-configuration of the ONU should be needed when attaching a new ONU to an existing system."

(Ex. 1004, ¶[0063]). Thus, the text of Unitt itself guides a POSITA to make the ONU pluggable in the form taught by, for example, Aronson. (Ex. 1002, ¶71).

Third, a POSITA, guided by Unitt to seek miniaturization and pluggability of the ONU (which is an optical transceiver) for at least the reasons above, would have known that Small Form Factor Pluggable (SFP) optical transceiver technology exists, such as disclosed in Aronson. (Ex. 1002, ¶71). Aronson's SFP optical transceiver technology satisfies the teachings of Unitt for a miniature, pluggable ONU. Thus, a POSITA would have been motivated to meet Unitt's need for a miniature, pluggable ONU with SFP technology, such as taught by Aronson. (Ex. 1002, ¶¶72-73).

With this combination, Unitt's ONU (i.e., an optical transceiver) would be embodied in a miniature, pluggable SFP form factor as taught in Aronson. (Ex. 1002, ¶¶64-73).

2. Claim 1

[Ipre] An integrated pluggable Passive Optical Network (PON) optical transceiver module adapted to process and perform PON data link layer communications and functions and configured to removably couple to an optical module port of a switch, router or media adapter and adapted to communicate with the switch, router or media adapter using an Ethernet protocol, the PON optical transceiver module comprising:

Unitt's ONU is an optical transceiver that is adapted to process and perform PON data link layer communications and functions. (Ex. 1004, ¶[0069]; Ex. 1002,

¶75). Because a POSITA would have been motivated to embody Unitt's ONU with a SFP module as taught in Aronson (as set forth above), an optical transceiver that is a pluggable module and configured to removably couple to an optical port of another device, such as a switch, router or media adapter, would have been obvious to a POSITA in view of Unitt and Aronson. (Ex. 1002, ¶¶77-78).

Unitt also teaches using an Ethernet protocol for communications, data link layer communications. (Ex. 1004, ¶[0053]). Unitt also teaches that the ONU is in communication with, at least, a router of the customer network to which the ONU is connected. (Ex. 1004, Fig. 1 (ONU 111 connected to router 112); ¶¶[0053], [0081]).

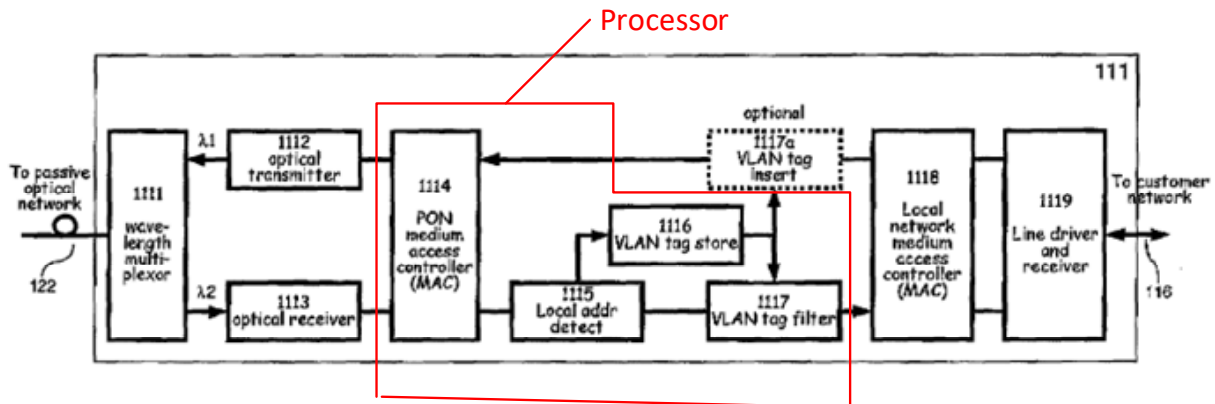
Thus, this element would have been obvious to a POSITA. (Ex. 1002, ¶¶67-79).

[1a] a PON protocol processor for managing the transmission and reception of data link layer optical network communications including performing one or more of the following functions comprising: encapsulating user data into data link layer frames; frame synchronization; forward error correction; physical layer addressing; data packet queuing, and operation administration and maintenance (OAM) message processing;

Unitt discloses a data packet filter comprising an input port, an output port, and a processor. The processor is arranged "to receive, at the input port, a first data packet addressed, by means of the address field of the packet, to the data packet filter; to store the value of the filter tag field of the first data packet in the

store; to forward subsequent data packets received at the first port responsive to a comparison between values of their respective filter tag fields and the stored value of the filter tag field, regardless of the value of their respective address fields.” (Ex. 1004, ¶[0017]; see also ¶[0026]). Unitt further discloses that ONU performs data filtering. (*Id.*, ¶[0057]). Thus, the data packet filter referred to in ¶[0017] is part of the ONU. In particular, the processor of the ONU can be considered the components of the ONU shown below. (Ex. 1002, ¶80).

Fig. 4



The processor of the ONU performs at least the function of physical layer addressing. (Ex. 1004, ¶[0055]-[0071]).

[1b] an optical fiber interface port disposed to removably couple an optical fiber to the PON optical transceiver module;

Unitt’s ONU includes an optical fiber interface port. It is where the passive optical network connects to the ONU. (Ex. 1004, Fig. 4; Ex. 1002, ¶82). Modified

according to Aronson's pluggable SFP transceiver module, the optical fiber interface port would be "disposed to removably couple an optical fiber [i.e., the fiber 122 in Unitt's Figure 4] to the PON optical transceiver module" Therefore, this claim element would have been obvious. (Ex. 1002, ¶82).

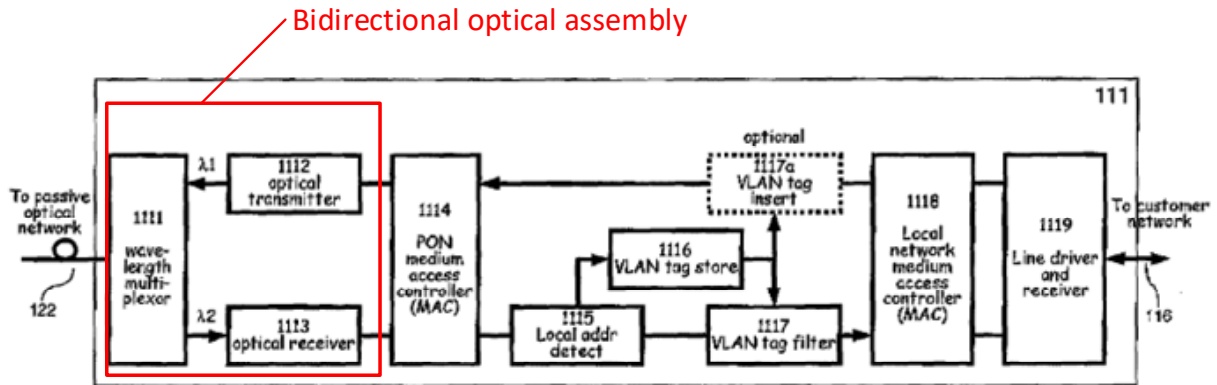
[1c] an electrical network interface port disposed for electrically coupling the PON optical transceiver module in a pluggable manner to a switch, router or media converter and for receiving and transmitting Ethernet electrical signals to the switch, router or media converter; and

Unitt's ONU includes an electrical network interface port, e.g., the line driver and receiver 1119 and the "customer port 116" that connect to the customer network. (Ex. 1004, Fig. 4). Modified according to Aronson's pluggable SFP transceiver module, the electrical network interface port would be "disposed for electrically coupling the PON optical transceiver module in a pluggable manner ..." to the customer network. Unitt's customer network includes at least a router. (Ex. 1004, Fig 1, ¶[0081]). Thus, it would have been obvious to a POSITA that Unitt's ONU is coupled electrically, via the customer network, to at least a router. (Ex. 1002, ¶83). This is especially so given that Aronson discloses an interface 121 that is "coupled to a host device interface" and that "operates in accordance with the two wire interface standard that is also used in the GBIC and SFP standards" (Ex. 1005, 4:61-66). Therefore, this claim element would have been obvious. (Ex. 1002, ¶83).

[1d] a bidirectional optical assembly optically coupled to the optical fiber interface port and electrically coupled to the PON protocol processor and disposed for transmitting optical signals through the optical fiber interface port responsive to electrical signals received from the PON protocol processor and disposed to conveying an electrical communication signal to the PON protocol processor responsive to receiving an optical communication signal through the optical fiber interface port;

Unitt's ONU includes a bidirectional optical assembly, e.g., the components of Unitt's ONU in the red box below. These components are coupled to both (1) the passive optical network 122 via the port therefor and (2) the processor, as described above. The bidirectional optical assembly of Unitt's ONU includes an optical transmitter 1112 that transmits optical signals to the optical network 122, where the transmitted optical signals are responsive to electrical signals from the processor. Unitt's bidirectional optical assembly also includes an optical receiver 1113 that receives optical signals from the optical network 122, which optical signals are conveyed to the processor. (Ex. 1002, ¶84). Unitt explicitly discloses that "[e]ach ONU converts 1113 the optical signal to an electrical signal" (Ex. 1004, ¶[0055]).

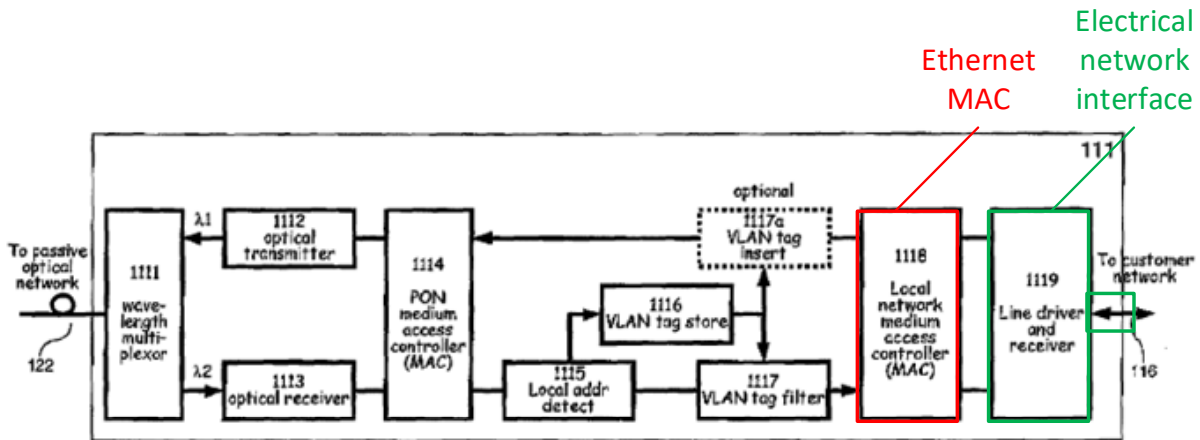
Fig. 4



[1e] an Ethernet MAC electrically coupled to the PON protocol processor and electrically coupled to the electrical network interface, the Ethernet MAC disposed to enable communications between the PON protocol processor and the switch, router or media converter using an Ethernet protocol, whereby

Unitt's ONU comprises both an Ethernet MAC and the electrical network interface as shown below. Unitt's Ethernet MAC is electrically coupled to the PON protocol processor and electrically coupled to the electrical network interface as shown in the diagram. The Ethernet MAC enables communications between the PON protocol processor and a device (e.g., switch, router or media converter) connected in the customer network, via "customer premises port 116," where the customer network "uses a readily available data networking standard, such as Ethernet 100baseT." (Ex. 1004, ¶[0053]). Therefore, the Ethernet MAC uses an Ethernet protocol. (Ex. 1002, ¶86).

Fig. 4



[1f] the PON optical transceiver module is disposed to manage the PON data link layer optical network data communications, and communicate with a switch, router or media converter using an Ethernet protocol.

The data link layer is conventionally considered Layer 2 of the OSI model. (Ex. 1002, ¶87; Ex. 1001, 7:36-37). A Layer 2 device decides how to forward data based on the MAC address. (Ex. 1002, ¶87; Ex. 1001, 2:64-3:1). Unitt’s ONU decides how to forward data based on MAC addresses. (Ex. 1004, ¶¶[0056]-[0059], [0069], [0079], [0092]). Unitt’s ONU also communicates with devices in the customer network via customer premises port 116. (*Id.*, ¶¶[0053], [0081]).

3. Claim 2

2. The PON optical transceiver module of claim 1, wherein the PON optical transceiver module conforms to a Multi-Source Agreement (MSA) optical module form factor selected from the group consisting essentially of: Small Form-factor Pluggable (SFP); SFP+; Compact small form-factor pluggable (C-SFP);

10 Gigabit Small Form-factor Pluggable (XFP); C Form-factor Pluggable (CFP); Quad Small Form Factor Pluggable (QSFP); QSFP+; XENPAK; X2; XPAK; and 300pin.

Aronson discloses optical modules that conform to the SFP standard. (Ex. 1005, 4:61-66). A POSITA would have been motivated to embody a transceiver like Unitt's ONU in a SFP standard module for the reasons described herein. Thus, this claim would have been obvious to a POSITA. (Ex. 1002, ¶89).

4. Claim 3

3. The PON optical transceiver module of claim 1, wherein the PON protocol processor performs functions conforming to a network protocol selected from the group consisting essentially of: ITU-T G.984 Gigabit PON (GPON); IEEE 802.3ah Ethernet PON (EPON); ITU-T G.987 10 Gigabit PON (XG-PON); IEEE 802.3av 10 Gigabit Ethernet PON (10G-EPON); ITU Next Generation PON (NG-PON); ITU NG-PON2; WDM-PON; ITU-T G.983 Broadband Passive Optical Network (BPON); Data over Cable Service Interface Specification (DOCSIS) PON (D-PON/DPON); and RFoG SCTE IPS910.

Unitt's ONU can use a gigabit Ethernet PON protocol. (Ex. 1004, ¶[0076]).

Therefore, claim 3 would have been obvious to a POSITA. (Ex. 1002, ¶91).

5. Claim 9

9. The PON optical transceiver module of claim 1, wherein the optical fiber interface port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of: Subscriber Connector (SC); Lucent Connector (LC); Fiber Channel (FC); Straight TP (ST); and Miniature Unit (MU).

Aronson refers to a “ROSA” and a “TOSA,” which a POSITA would understand to allude to the then-common use in small form factor optical transceivers of receiver and transmitter sub-assemblies, which contain an optical fiber connector. (Ex. 1002, ¶93). One form of then well-known fiber connectors for small form factor optical transceivers was the Lucent Connector (LC) type (*id.*), which is one of the connector types listed in claim 9. Therefore, claim 9 would have been obvious to a POSITA in view of Unitt and Aronson. (Ex. 1002, ¶¶94-95).

6. Claim 10

10. The PON optical transceiver module of claim 1, wherein the Ethernet MAC is selected from the group consisting essentially of: 10Mbit Ethernet MAC; 100Mbit Ethernet MAC; 1Gigabit Ethernet MAC; 10Gigabit Ethernet MAC; and 100Gigabit Ethernet MAC.

Unitt’s customer network can use the Ethernet 100baseT standard. (Ex. 1004, ¶[0053]). Ethernet 100baseT is a 100 Mbps standard. (Ex. 1002, ¶97). Thus, at least the “100 Mbit Ethernet MAC” option in this claim would have been obvious. *Id.*

7. Claim 13

13. The PON optical transceiver module of claim 1, wherein the PON optical transceiver module is configured to monitor alarms and diagnostics and reporting of the alarms or

diagnostics are performed in-band over the Ethernet communications between the PON optical transceiver module and the switch, router or media converter.

Aronson's optoelectrical transceiver monitors alarms and diagnostics, and reports the alarms or diagnostics. First, Aronson discloses that "FIG. 2 shows a number of connections from the laser driver 105 to the controller IC 110, as well as similar connections from the ROSA 106 and Postamp 104 to the controller IC 110. These are *analog monitoring connections* that the controller IC 110 uses to provide *diagnostic feedback to the host device*" (Ex. 1005, 6:41-47 (emphasis added)). The host device is connected to the transceiver via the interface 121. (*Id.*, 4:61). Second, Aronson discloses that "the limit flags are also sometimes call [*sic*] alarm and warning flags. The host device (or end user) can monitor these flags to determine whether conditions exist that are likely to have caused a transceiver link to fail (alarm flags) or whether conditions exist which predict that a failure is likely to occur soon." (*Id.*, 7:31-35). Thus, Aronson teaches reporting diagnostic information to a host device or end user.

Unitt further teaches deleting and inserting, by the transceiver/ONU, metadata into Ethernet communication frames passing through the transceiver/ONU. (Ex. 1004, ¶¶[0061], [0070]). This can be considered "in-band" communications. (Ex. 1002, ¶¶99-100). In light of Aronson's teaching of monitoring and transmitting alarms and diagnostics by an optoelectric transceiver,

and Unitt's teachings of a transceiver that deletes and inserts metadata into Ethernet communication frames passing through the transceiver (e.g., "in-band" communications), this claim would have been obvious. (Ex. 1002, ¶¶99-100).

8. Claim 15

[15pre] A Passive Optical Network (PON) optical transceiver module for a passive optical network, the PON optical transceiver module having a pluggable form factor and adapted to removably couple to an optical module port of a switch, router or media converter, and the PON optical transceiver module having an optical interface port for coupling to one or more optical fibers of the passive optical network, and the PON optical transceiver module having a bidirectional optical assembly optically coupled to the optical port and for converting electrical signals to optical signals and for converting optical signals to electrical signals, and the PON optical transceiver module having a PON protocol processor electrically coupled to the bidirectional optical assembly and for processing and performing optical data link layer network communications, and the PON optical transceiver module having an Ethernet media access controller (MAC) electrically coupled to the PON protocol processor and the PON optical transceiver module having an electrical network interface port electrically coupled to the Ethernet MAC and for electrically communicating to the switch or router, a method of communicating on a passive optical network from the PON optical transceiver module comprising the steps of:

This claim element described the components of the PON optical transceiver module. The features of the PON optical transceiver module, including the "pluggable" nature of the transceiver, are disclosed by the Unitt-Aronson

combination as described above for claim 1.

[15a] (a) receiving a first optical signal through the optical interface port at the bidirectional optical assembly of the PON optical transceiver module;

Unitt's ONU has an optical interface port at a bidirectional optical assembly that receives optical signals from the headend. The bidirectional optical assembly comprises Unitt's optical transmitter and optical receiver, which are "bidirectional." (Ex. 1002, ¶105). The optical interface port is where fiber optic path 122 connects to Unitt's ONU, as described above in connection with claim element [1b]. *Id.*

[15b] (b) converting the first optical signal to an electrical signal at the bidirectional optical assembly and conveying the electrical signal to the PON protocol processor of the PON optical transceiver module;

Unitt's ONU includes an optical receiver that "converts ... the optical signal to an electrical signal ..." (Ex. 1004, ¶[0055]). The output of the optical receiver is input to the MAC 1114 in Unitt's ONU, which is part of the processor of the ONU. (Ex. 1004, Fig. 4; Ex. 1002, ¶106).

[15c] (c) processing the electrical signal at the PON protocol processor to determine a first optical data link layer frame and de-encapsulating a first user payload data from the first optical data link layer frame;

Unitt's ONU discloses a PON protocol processor that processes the

electrical signals from the optical receiver as described above in connection with claim element [1a]. A POSITA would understand that for Unitt's ONU to forward frames received from the optical network to the customer premises via Ethernet, the downstream frames would need to be de-encapsulated and then re-encapsulated. (Ex. 1002, ¶108). Indeed, Unitt's Figure 3 shows how the frames are encapsulated for transmission to the customer premises and a POSITA would understand that, before the frame can be encapsulated in the manner shown in Figure 3, the frame received by the ONU first needs to be de-encapsulated to identify the payload 305, along with the destination address information 301 and source address information 302. (Ex. 1004, ¶¶[0058]-[0059], Fig. 3; Ex. 1002, ¶108). Unitt further teaches de-encapsulation of the payload because Unitt shows the capability of deleting the VLAN tag information, sending only the resulting data frames to the customer. (Ex. 1004, ¶[0061]). Unitt's processor also determines the optical data link layer frame as part of the layer 2 MAC addressing performed by Unitt's ONU processor. (Ex. 1004, ¶[0058], Ex. 1002, ¶109). Thus, Unitt discloses this claim element.

*[15d] (d) conveying the first user payload data from the PON
protocol processor to the Ethernet MAC;*

In Unitt, after the processor processes the frames, the frames are conveyed to the Ethernet MAC 1118. (Ex. 1004, Fig. 4). The frames include the payload data

as shown in Unitt's Fig. 3. Thus, Unitt discloses this claim element. (Ex. 1002, ¶111).

[15e] (e) encapsulating the first user payload data in a first Ethernet data frame by the Ethernet MAC and conveying the first Ethernet data frame to the switch, router or media converter through the electrical network interface port;

After Unitt's Ethernet MAC 1118 (Ex. 1004, Fig. 4) processes the frames, the frames are conveyed to the line driver and receiver 1119 and output, via the port 116, to an external device, such as the router 116 (Ex. 1004, Fig. 1). The payload is encapsulated in the frame, as shown in Unitt's Figure 3. Thus, Unitt discloses this claim element. (Ex. 1002, ¶112).

[15f] (f) receiving a second Ethernet data frame from the switch, router or media converter through the electrical network interface port of the PON optical transceiver module;

This claim element starts the upstream communication portion of claim 15. In Unitt's upstream communications, the Ethernet frames are received by Unitt's interface port 116. (Ex. 1004, ¶[0053]; Fig. 4). The communications can be from a router, as shown in Figure 1. It would have been obvious that the upstream communications use different frames (e.g., a "second" frame) than the downstream communications (e.g., a "first" frame) because they are two different communications (one upstream and one downstream). (Ex. 1002, ¶114). Thus, Unitt suggests this claim element.

[15g] (g) de-encapsulating a second user payload data from the second Ethernet data frame by the Ethernet MAC;

Unitt discloses that “the ONU can add the customer-specific VLAN tag to frames of upstream traffic originating on the customer premises.” (Ex. 1004, ¶[0062]). It would have been obvious to a POSITA that the payload data from the customer premises can be de-encapsulated and conveyed (see claim element 15h below) to the PON protocol processor for addition of the customer-specific VLAN tags. A POSITA would further understand that for Unitt’s ONU to forward frames received from the customer premises, via Ethernet, to the headend via the fiber optic network, the upstream frames would need to be de-encapsulated and then correspondingly re-encapsulated for subsequent transmission via the fiber optic network (see claim element 15i below). (Ex. 1002, ¶115).

[15h] (h) conveying the second user payload data from the Ethernet MAC to the PON protocol processor;

For Unitt’s upstream communications, after the Ethernet MAC de-encapsulated the payload (see element 305 of Figure 3), the payload is conveyed to the PON protocol processor of Unitt’s ONU. (Ex. 1004, ¶[0062]). It would have been obvious to a POSITA that the payload data from the customer premises can be de-encapsulated (see claim element 15g above) and conveyed to the PON protocol processor for addition of the customer-specific VLAN tags. (Ex. 1002, ¶116).

[15i] (i) encapsulating the second user payload data into a second optical data link layer frame by the PON protocol processor;

Unitt's ONU communicates upstream with the headend using frames. (Ex. 1004, ¶[0062]). Unitt's ONU also uses "MAC layer functionality" for both upstream and downstream communications. (*Id.*, ¶[0069]). A POSITA would understand that "MAC layer functionality" corresponds to layer 2 of the OSI model, which is the data link layer. Thus, Unitt discloses this claim element and it would have been obvious to a POSITA. (Ex. 1002, ¶118).

[15j] (j) converting the second optical data link layer frame to a second optical signal; and

Unitt's ONU comprises an optical transmitter. (Ex. 1004, Fig. 4). A POSITA would understand that Unitt's optical transmitter converts the second optical data link layer from to an optical signal (a "second" optical signal) for sending via the fiber optic network 12 to a headend 101. A POSITA would understand that in order to transmit data via a fiber optic network, like the fiber optical network 12 in Unitt, the data, in this case in a frame, needs to be converted to an optical signal in order to be transmitted. (Ex. 1002, ¶119).

[15k] (k) transmitting the second optical signal from the bidirectional optical assembly through the optical interface port; whereby

Unitt's ONU includes a bidirectional optical assembly, which comprises Unitt's optical transmitter and optical receivers. (Ex. 1004, Fig. 4). The optical

transmitter of the bidirectional optical assembly transmits the upstream optical signal (the “second” optical signal) to a headend via a fiber optic network. Thus, Unitt discloses this claim element and it would have been obvious to a POSITA. (Ex. 1002, ¶120).

[15] (l) the PON optical transceiver module is disposed to optically communicate user data over the passive optical network and is disposed to electrically communicate user data with the switch, router or media converter using Ethernet communications.

Unitt’s ONU is connected between the headend and the customer premises. (Ex. 1004, Fig. 1). The customer premises include at least a router. (Id., Fig. 1 and ¶[0081]). Unitt’s ONU optically communicates with the headend via the fiber optic network and communicates electronically (via Ethernet) with the customer premises. Thus, Unitt discloses this claim element and it would have been obvious to a POSITA. (Ex. 1002, ¶121).

9. Claim 16

16. The method of claim 15, wherein the PON optical transceiver module conforms to a Multi-Source Agreement (MSA) optical module form factor selected from the group consisting essentially of: Small Form-factor Pluggable (SFP); SFP+; Compact small form-factor pluggable (C-SFP); 10 Gigabit Small Form-factor Pluggable (XFP); C Form-factor Pluggable (CFP); Quad Small Form Factor Pluggable (QSFP); QSFP+; XENPAK; X2; XPAK; and 300pin.

Aronson discloses optical modules that conform to the SFP standard. (Ex. 1005, 4:61-66). A POSITA would have been motivated to embody a transceiver like Unitt's ONU in a SFP standard module for the reasons described above. Thus, this claim would have been obvious to a POSITA. (Ex. 1002, ¶123).

10. Claim 17

17. *The method of claim 15, wherein the PON protocol processor performs functions conforming to a network protocol selected from the group consisting essentially of: ITU-T G.984 Gigabit PON (GPON); IEEE 802.3ah Ethernet PON (EPON); ITU-T G.987 10 Gigabit PON (XG-PON); IEEE 802.3av 10 Gigabit Ethernet PON (10G-EPON); ITU Next Generation PON (NG-PON); ITU NG-PON2; WDM-PON; ITU-T G.983 Broadband Passive Optical Network (BPON); Data over Cable Service Interface Specification (DOCSIS) PON (D-PON/DPON); and RFoG SCTE IPS910.*

Unitt's ONU can use a gigabit Ethernet PON protocol. (Ex. 1004, ¶[0076]). Therefore, claim 17 would have been obvious to a POSITA. (Ex. 1002, ¶¶124-125).

11. Claim 20

20. *The method of claim 15, wherein diagnostic measurements performed within the PON optical transceiver module and conveyed in-band to the switch, router or media converter through Ethernet communications includes one or more of the following measurements: temperature in the optical assembly; optical power output of the optical assembly; and received optical power sensitivity of the optical assembly.*

This claim lists several optional diagnostic measurements, and also recites that the diagnostic measurements are conveyed “in-band.” This claim would have been obvious to a POSITA in view of Unitt and Aronson.

First, Unitt discloses conveying metadata in-band. (Ex. 1002, ¶¶129-130). Based on this disclosure, a POSITA would know that metadata, i.e., data other than the payload, such as diagnostic measurements, can be transmitted “in-band.”

Second, Aronson’s optoelectrical transceiver monitors alarms and diagnostics, and reports the alarms or diagnostics. (Ex. 1005, 6:41-47, 4:61, 7:31-35). Thus, Aronson teaches reporting diagnostic information to a host device or end user. (Ex. 1002, ¶¶127-128).

Third, Aronson discloses measuring and reporting two of the measurements listed in claim 20—temperature and receiver power levels. (Ex. 1005, 1:52-57; Ex. 1002, ¶128). In Aronson, the diagnostic information is reported apparently to the host device via separate connections; that is, not in the main communication channel between the host device and the transceiver. (Ex. 1002, ¶129). Unitt, however, teaches a POSITA to delete and insert “metadata,” in the form of VLAN tags, into the data communication frames passing through the transceiver. (Ex. 1004, ¶¶[0061], [0070]; Ex. 1002, ¶129). A POSITA would understand that Aronson’s alarms and diagnostic feedback from the transceiver could be added as metadata on the communication frames passing through the transceiver, just as

Unitt adds the VLAN tags. (Ex. 1002, ¶129).

Fourth, Unitt teaches deleting and inserting, by the transceiver/ONU, metadata into Ethernet communication frames passing through the transceiver/ONU. (Ex. 1004, ¶¶[0061], [0070]).

In light of Aronson's teaching of monitoring and transmitting alarms and diagnostics by an optoelectric transceiver, including some of the specific diagnostic measurements set forth in claim 20, and Unitt's teachings of a transceiver that deletes and inserts metadata into Ethernet communication frames passing through the transceiver, this claim would have been obvious. (Ex. 1002, ¶130).

12. Claim 21

21. *The method of claim 15, wherein the optical fiber interface port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of: Subscriber Connector (SC); Lucent Connector (LC); Fiber Channel (FC); Straight TP (ST); and Miniature Unit (MU).*

This claim is similar to claim 9 and would have been obvious to a POSITA in view of Unitt and Aronson for analogous reasons. (Ex. 1002, ¶131).

13. Claim 24

24. *The method of claim 15, wherein the Ethernet MAC is selected from the group consisting essentially of: 10Mbit Ethernet MAC;*

100Mbit Ethernet MAC; 1Gigabit Ethernet MAC; 10Gigabit Ethernet MAC; and 100Gigabit Ethernet MAC.

This claim would have been obvious for the same reasons that claim 10 would have been obvious. (Ex. 1002, ¶132).

14. Claim 25

25. *The method of claim 15, wherein the PON optical transceiver module is configured to monitor alarms and diagnostics and reporting of the alarms or diagnostics are performed in-band over the Ethernet communications between the PON optical transceiver module and the switch, router, or media converter.*

This claim would have been obvious for the same reasons that claim 13 would have been obvious. (Ex. 1002, ¶133).

D. Ground 1B: Claims 9 and 21 Would Have Been Obvious over Unitt, Aronson and Block

9. *The PON optical transceiver module of claim 1, wherein the optical fiber interface port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of: Subscriber Connector (SC); Lucent Connector (LC); Fiber Channel (FC); Straight TP (ST); and Miniature Unit (MU).*

21. *The method of claim 15, wherein the optical fiber interface port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of: Subscriber Connector (SC); Lucent Connector (LC); Fiber Channel (FC); Straight TP (ST); and Miniature Unit (MU).*

Claims 9 and 21 would have been obvious over Unitt, Aronson and Block. Claim 1 and 15, from which claims 9 and 21 depend respectively, would have been obvious to a POSITA in view of the Unitt-Aronson combination described above for Ground 1A. Claims 9 and 21 add that the optical fiber interface port includes a connector selected from a list of connector types that were well known to a POSITA by 2003. For example, Block is a patent filed in 1990 that discloses optical components with a FC type optical fiber connector. (Ex. 1021, 5:64-65). It would have been obvious to a POSITA that the Unitt transceiver (modified in light of Aronson to be pluggable) needs an optical fiber connector. There were a finite number of known and common optical fiber connector types in 2003, with the FC type being one of those known types as evidenced by Block. (Ex. 1002, ¶139). Also, a POSITA would have known the benefits and advantages of the FC connector type and would have been motivated to use the FC connector type to achieve those benefits. FC connectors are commonly used in datacom, telecommunications and measurement equipment, for example. It uses an alignment key and is tightened firmly using a screw-like motion, which makes it popular for high vibration environments. A POSITA would have been motivated to use the FC connector type in a high-vibration environment for datacom, telecommunications or measurement equipment, for example. (*Id.*). It, therefore, would have been obvious to a POSITA to at least use the FC type connector taught

in Block for the Unitt-Aronson pluggable optical transceiver. (Ex. 1002, ¶¶134-142).

The relatedness of Block and Aronson is further demonstrated by the fact that Block was considered in the examination of Aronson. (Ex. 1005, p.2).

Therefore, claims 9 and 21 would have been obvious to a POSITA in view of Unitt, Aronson and Block.

E. Ground 2A: Claims 1-3, 9-10, 15-17, 21 and 24 Would Have Been Obvious over Unitt and Tan

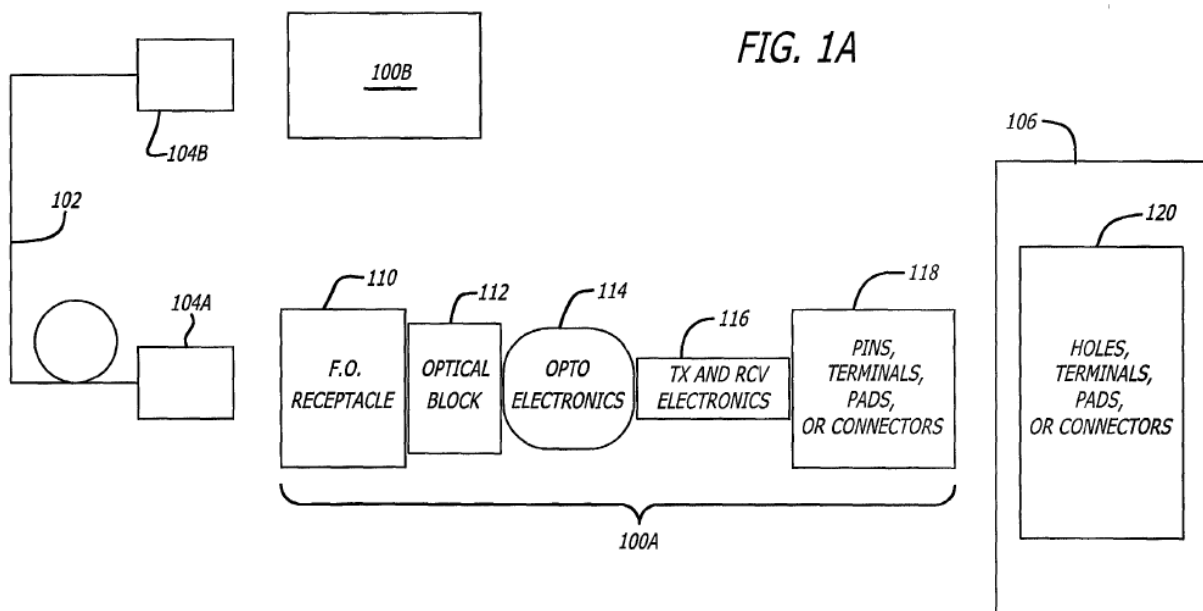
1. Basis for Interpretation

The scope and content of the prior art include Unitt and Tan. Unitt's ONU include practically all of the elements of claim 1-3, 9-10, 15-17, 21 and 24 although Unitt does not explicitly state that Unitt's ONU is "pluggable." (Ex. 1002, ¶143). Unitt, however, teaches that the size and complexity of the ONU should be minimized, and that the logical functions of the ONU lend themselves to integration in a single chip. (Ex. 1002, ¶143). In the same field, Tan discloses bi-directional optical transceiver that is "hot pluggable." (Ex. 1022, ¶¶[0019], [0073]; Ex. 1002, ¶143). Given the skill level of a POSITA, a POSITA would have been motivated to use Tan's "hot pluggable" transceiver modules with Unitt's ONU.

First, Unitt's ONUs are at the client side of the PON. (Ex. 1004, ¶[0055]; Ex. 1002, ¶146). Unitt further describes that "[e]ach ONU converts 1113 the

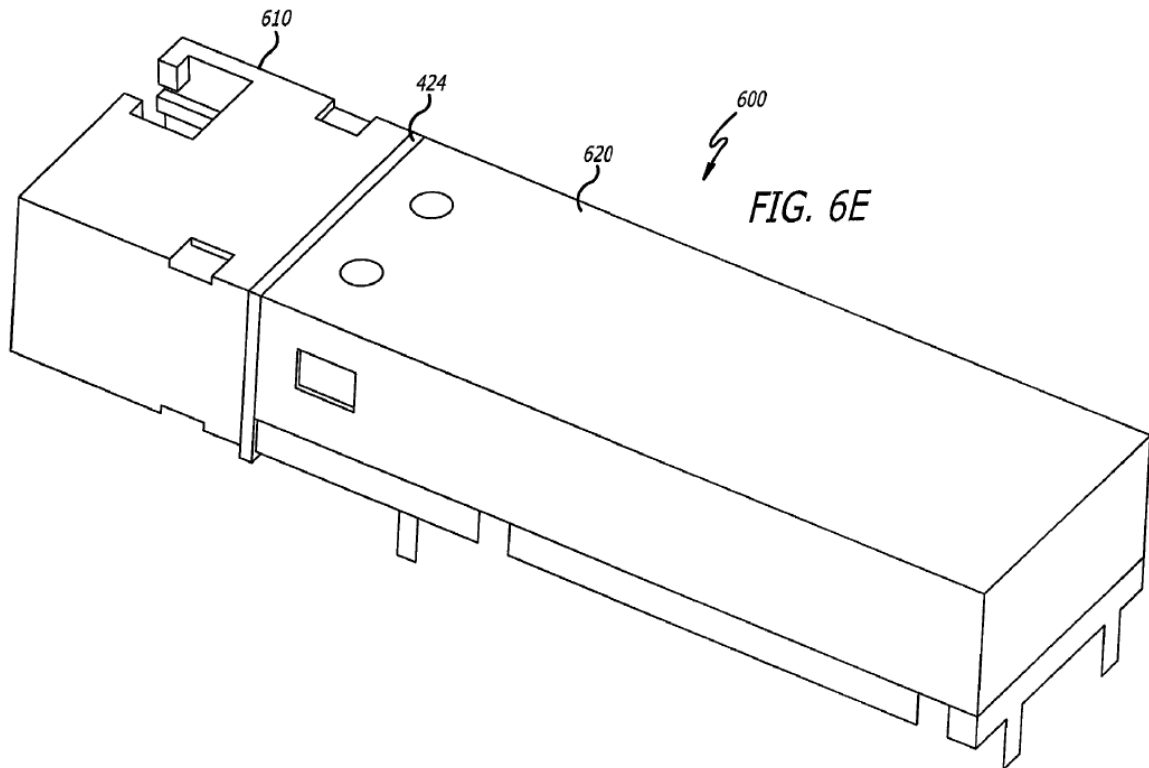
optical signal to an electrical signal and decodes the information. The information includes addressing information which identifies 1114 which components of the information flow are intended for a particular ONU. In the upstream direction, each ONU is allocated a time interval during which it is permitted to impress an optical signal on the upstream fibre.” (*Id.*).

Second, Tan discloses an optical transceiver that is “hot pluggable” into other components and systems. (Ex. 1022, ¶[0073]). Tan also discloses that the optical transceiver is bi-directional because it receives and transmits data from and to a host system and another optical transceiver, as shown in Tan’s Figure 1A (reproduced below). (Ex. 1022, ¶¶[0004], [0020]; Ex 1002, ¶147).



Tan’s optical transceiver can also include a printed circuit board that

includes transceiver and transmitting electronics. (Ex. 1022, ¶¶[0071], Fig. 6D). Thus, like Unitt’s ONU, Tan’s transceiver includes integrated circuits and connects to external components. Also, Tan’s optical transceiver has components to make it “hot pluggable” to external components. (*Id.*, ¶¶[0072]). Also, while Tan does not expressly refer to the optical transceiver as a small form factor pluggable optical transceiver, that is what Tan shows in Figure 6E (shown below). (Ex. 1002, ¶¶[148-149]).



Third, Unitt describes that ONU should be “externally mountable” and that the size and complexity of the ONU should be “miminised.” (Ex. 1004, ¶¶[0054]). Unitt also describes that ONU lends itself “to integration into a single application

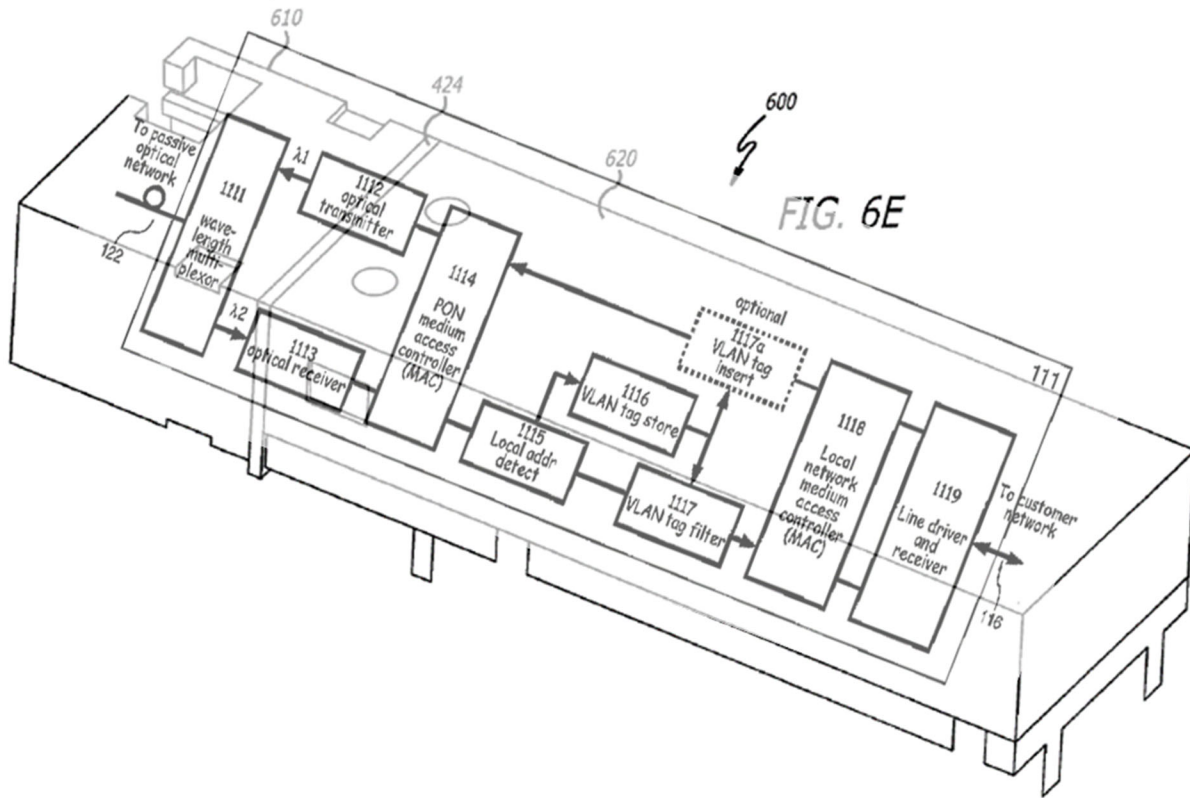
specific integrated circuit (ASIC)” that “contain[s] the MAC logic for both the PON interface and the local customer connection. The resulting reduction in ONU parts count leads potentially to lower cost and higher reliability.” (*Id.*, ¶[0084]). Thus, Unitt guides and motivates a POSITA to seek miniaturization of the ONU, including integration of the ONU functions onto integrated circuits. (Ex. 1002, ¶150).

Fourth, Unitt describes that “[i]n a practical network, it is highly desirable that the system should be ‘plug and play’, that is, no re-configuration of the ONU should be needed when attaching a new ONU to an existing system.” (Ex. 1004, ¶[0063]). Thus, Unitt also guides and motivates a POSITA to seek to make the ONU able to be attached to a working system; that is, to be pluggable. Such a POSTIA, given his/her skill level, being guided and motivated to seek miniaturization and pluggability of the ONU, which comprises an optical transceiver, would have known, and it would have been obvious, to use a pluggable transceiver structure, such as taught by Tan. (Ex. 1002. ¶151).

Finally, Tan states that its transceiver may have application as an ONU on customer premises. (Ex. 1022, ¶¶[0023], [0031]; Ex. 1002, ¶152).

By combining the ONU shown in Unitt’s Figure 4 with the small form factor pluggable transceiver module shown in Tan’s Figure 6E, the result would be small form factor pluggable transceiver module, as taught by Tan, that has all the

components of Unitt's ONU, as shown in the diagram below. (Ex. 1002, ¶153).



A POSITA would have expected that using a small form factor pluggable module, as taught by Tan, with Unitt's ONU, would result in a small, pluggable optical transceiver module for a PON that uses Ethernet communications. (Ex. 1002, ¶154). A POSITA would also realize that using a small form factor pluggable module, as taught by Tan, would improve Unitt's ONU by making it small and pluggable, especially in view of Unitt's teaching that the ONU should be small and connectable to external components. Thus, a POSITA would have been

motivated to use Tan’s hot pluggable optical transceiver module configuration to improve Unitt’s ONU in accordance with the guidance given by Unitt. (Ex. 1002, ¶155).

2. Claim 1

[1pre]

As described above for claim element [1pre] for Ground 1A, Unitt discloses an ONU for a PON that satisfies all of the limitations of this claim element except that Unitt’s ONU is not explicitly “pluggable.” (Ex. 1004, ¶[0069]; Ex. 1002, ¶¶157-158).

Tan teaches and discloses an optical transceiver that is “hot pluggable.” (Ex. 1022, ¶[0073]; Ex. 1002, ¶160). It would have been obvious for a POSITA to use the hot pluggable optical transceiver configuration, as taught by Tan, with Unitt’s ONU, thereby making Unitt’s ONU “pluggable.” Ex. 1002, ¶160).

The combination of Unitt and Tan also teach the other limitations of this claim element.

First, Unitt’s ONU is connected to external devices, such as a router. (Ex. 1004, ¶[0053]). That teaches a POSITA that Unitt’s ONU is configured to be coupled to an optical module port of a router. (Ex. 1002, ¶159).

Second, Tan teaches plugging in an optical transceiver, such as Unitt’s ONU, to an external device (e.g., “host system”). (Ex. 1022, ¶[0073]). By being

“pluggable,” the transceiver can be removably coupled to the other device. Thus, Unitt’s ONU, modified in view of Tan, would be pluggable coupled to another device, such as the router/bridge, shown in Unitt’s Figure 1. (Ex. 1002, ¶160).

Third, Unitt teaches that the ONU is adapted to communicate with the router using an Ethernet protocol. (Ex. 1004, ¶[0053]; Ex. 1002, ¶161).

[1a]

Unitt discloses the PON protocol processor of this claim element as described above in connection with claim element [1a] for Ground 1A. Ex. 1002, ¶¶162-163).

[1b]

Unitt discloses the optical fiber interface port of this claim element as described above in connection with claim element [1b] for Ground 1A. Ex. 1002, ¶164).

[1c]

Unitt discloses the electrical network interface port of this claim element as described above in connection with claim element [1c] for Ground 1A. Ex. 1002, ¶165).

[1d]

Unitt discloses the bidirectional optical assembly of this claim element as described above in connection with claim element [1d] for Ground 1A. Ex. 1002,

¶166).

[1e]

Unitt discloses the Ethernet MAC of this claim element as described above in connection with claim element [1e] for Ground 1A. Ex. 1002, ¶167).

[1f]

Unitt discloses this claim element as described above in connection with claim element [1f] for Ground 1A. Ex. 1002, ¶168).

3. Claim 2

Tan discloses a small form factor pluggable (SFP) transceiver module to a POSITA. (Ex. 1022, ¶[0073]), Figure 6E). Therefore, this claim would have been obvious to a POSITA. (Ex. 1002, ¶170).

4. Claim 3

Unitt's ONU can use a gigabit Ethernet PON protocol (Ex. 1004, ¶[0076]), which is one of the protocols listed in claim 3. Therefore, claim 3 would have been obvious to a POSITA. (Ex. 1002, ¶172).

5. Claim 9

Tan discloses that three possible standard fiber optic connectors for Tan's optical transceiver—LC, SC and MU. (Ex. 1022, ¶[0069]). Therefore, claim 9 would have been obvious to a POSITA in view of Unitt and Tan. (Ex. 1002,

¶173).

6. Claim 10

Unitt's customer network can use the Ethernet 100baseT standard. (Ex. 1004, ¶[0053]). Ethernet 100baseT is a 100 Mbps standard. Thus, at least the "100 Mbit Ethernet MAC" option in this claim would have been obvious to a POSITA. (Ex. 1002, ¶175).

7. Claim 15

The only noticeable distinction between claim 15 and Unitt is that claim 15 states that the optical transceiver is "pluggable." Pluggable transceivers, however, were well-known in June 2003 as shown by Tan (Ex. 1022; Ex. 1002, ¶178). Also, Unitt discloses all of the elements of claim 15 for the reasons stated above in connection with claim 15 for Ground 1A. (Ex. 1002, ¶¶179-196). It would have been obvious to modify Unitt's ONU to include a pluggable, small form factor module in view of Tan for the reasons described herein. (Ex. 1002, ¶178). Thus, claim 15 would have been obvious to a POSITA in view of Unitt and Tan.

8. Claim 16

Tan discloses optical modules that conform to the SFP standard, (Ex. 1022, Fig. 6E), which is listed in claim 16. A POSITA would further have been motivated to embody a transceiver like Unitt's ONU in a SFP standard module for

the reasons described above. (Ex. 1002, ¶198). Thus, this claim would have been obvious to a POSITA.

9. Claim 17

Unitt's ONU can use a gigabit Ethernet PON protocol. (Ex. 1004, ¶[0076]). Therefore, claim 17 would have been obvious to a POSITA. (Ex. 1002, ¶¶199-200).

10. Claim 21

Claim 21 is similar to claim 9. Claim 21 would have been obvious to a POSITA in view of Unitt and Tan for analogous reasons. (Ex. 1002, ¶201).

11. Claim 24

Claim 24 is similar to claim 10. Claim 24 would have been obvious to a POSITA in view of Unitt and Tan for analogous reasons. (Ex. 1002, ¶202).

F. Ground 2B: Claims 13, 20 and 25 Would Have Been Obvious Over Unitt, Tan and Aronson

1. Motivation to Combine

A POSITA would have been motivated to modify Unitt's ONU to make it "hot pluggable," with a small form factor in view of Tan as described above. (Ex. 1002, ¶203). A POSITA would further be motivated to modify the Unitt's ONU to include the diagnostic capabilities of Aronson.

Aronson's optoelectrical transceiver monitors and reports alarms and diagnostics. Aronson discloses that "FIG. 2 shows a number of connections from the laser driver 105 to the controller IC 110, as well as similar connections from the ROSA 106 and Postamp 104 to the controller IC 110. These are analog monitoring connections that the controller IC 110 uses to provide diagnostic feedback to the host device" (Ex. 1005, 6:41-47). The host device is connected to the transceiver via the interface 121. (*Id.*, 4:61). Also, Aronson discloses that "the limit flags are also sometimes call [sic] alarm and warning flags. The host device (or end user) can monitor these flags to determine whether conditions exist that are likely to have caused a transceiver link to fail (alarm flags) or whether conditions exist which predict that a failure is likely to occur soon." (*Id.*, 7:31-35). Thus, Aronson teaches reporting diagnostic information to a host device or end user. (Ex. 1002, ¶204).

A POSITA would have been motivated to include Aronson's diagnostic reporting capability in Unitt's ONU (as modified by Tan to be "pluggable") so that the host device, e.g., the head end in Unitt, could receive diagnostic information about the ONU and take remedial actions where necessary. This is suggested to a POSITA by ¶[0033] of Unitt, which states: "The invention also provides for signals arranged to support operation of the apparatus and methods." A POSITA would understand this statement to refer to signals from the ONUs to support their

operation, which would include diagnostic information about the ONUs. In light of this teaching, a POSITA would be motivated to seek out the methods shown in Aronson to provide those signals. (Ex. 1022, ¶205).

The modification would operate exactly as a POSITA would expect. Unitt's ONU would be "hot pluggable" as taught in Tan; and the ONU would report diagnostic information to the head end as taught in Aronson. (Ex. 1022, ¶206).

2. Claim 13

Aronson's optoelectrical transceiver monitors and reports alarms and diagnostics. (Ex. 1002, ¶98; Ex. 1005, 6:41-47). While Aronson's diagnostic information is reported apparently to the host device via separate connections, Unitt teaches a POSITA to delete and/or insert metadata (e.g., VLAN tags) in the Ethernet data communication frames passing through the transceiver. (Ex. 1004, ¶¶[0061], [0070]; Ex. 1002, ¶207). A POSITA would understand that Aronson's alarms and diagnostic feedback from the transceiver could be added as metadata on the communication frames passing through the transceiver, just as Unitt adds the VLAN tags. (Ex. 1002, ¶208).

In light of Aronson's teaching of monitoring and transmitting alarms and diagnostics by an optoelectric transceiver, and Unitt's teachings of a transceiver

that deletes and inserts metadata into Ethernet communication frames passing through the transceiver, this claim would have been obvious. (Ex. 1002, ¶208).

3. Claim 20

Claim 20 lists specific types of diagnostic measurements, and states that the diagnostic measurements are “conveyed in-band” Aronson teaches the diagnostic measurements (Ex. 1005, 6:41-47; Ex. 1002, ¶210) and Unitt teaches conveying metadata “in-band.” (Ex. 1004, ¶¶[0061], [0070]; Ex. 1002, ¶212). Thus, claim 20 would have been obvious in view of Unitt, Tan and Aronson.

Aronson’s optoelectrical transceiver monitors alarms and diagnostics, and Aronson teaches reporting them to a host device/end user. (Ex. 1005, 6:41-47, 4:61, 7:31-35; Ex. 1002, ¶210). Aronson also teaches specific types of diagnostics to be measured and monitored, including “laser bias current, laser output power, *receiver power levels*, supply voltage and *temperature*. Ideally, these parameters should be monitored and reported to, or made available to, a host device and thus to the user of the transceiver.” (Ex. 1005, 1:52-57) (emphasis added). Thus, Aronson discloses two of the diagnostic measurement listed in claim 20: received optical power sensitively and temperature. Aronson also states that these parameters should be “reported.” In order to be “reported,” they need to be

“measured,” as set forth in claim 20. A POSITA would understand this given the skill level of a POSITA. (Ex. 1002, ¶211).

In Aronson, the diagnostic information is reported apparently to the host device via separate connections; that is, not in the main communication channel between the host device and the transceiver. Unitt, however, discloses deleting and inserting metadata (VLAN tags) in Ethernet frames passing through the ONU. (Ex. 1004, ¶¶[0061], [0070]; Ex. 1002, ¶212). A POSITA would understand that Aronson’s alarms and diagnostic feedback from the transceiver could be added as metadata on the communication frames passing through the transceiver, just as Unitt adds the VLAN tags described above. (Ex. 1002, ¶212).

In light of (1) Aronson’s teaching of monitoring and transmitting alarms and diagnostics by an optoelectric transceiver, including some of the specific diagnostic measurements set forth in claim 20, (2) Unitt’s teachings of a transceiver that deletes and inserts metadata into Ethernet communication frames passing through the transceiver, and (3) Tan’s teaching of a “hot pluggable” optical transceiver, this claim would have been obvious. (Ex. 1002, ¶213).

4. Claim 25

This claim is similar to claim 13. Claim 25 would have been obvious for the same reasons set forth above for claim 13. (Ex. 1002, ¶214).

G. Ground 3: Claims 1-3, 9-10 and 13 Would Have Been Obvious over Li

1. Basis for Interpretation

The scope and content of the prior art includes Li. The differences between Li and claims 1-3, 9-10 and 13 are exceedingly minor. The subject matter of claims 1-3, 9-10 and 13 would have been obvious to a POSITA in view of Li.

2. Claim 1

[Ipre]

Li discloses “an optical network system 10 [that] includes a pluggable optical transceiver 100” (Ex. 1006, ¶[0017], Fig. 1). The transceiver can be used in, for example, “BPON, EPON, GPON, WDN-PON and active Ethernet.” (*Id.*, ¶[0002]; *see also* ¶[0031]). “PON” here refers to passive optical network. Thus, Li’s transceiver can be used in an optical network that uses Ethernet. (Ex. 1002, ¶[217]).

Li’s transceiver also “can perform system-layer functions comprising media access control (MAC), Ethernet/ATM switching, forward error correction, or OAM message processing” (Ex. 1006, ¶[0004]). MAC addressing constitutes “data link layer communications and functions ...” as recited in claim 1. (Ex. 1002, ¶[222]).

The fact that Li’s pluggable transceiver can use form factors such as SFP,

etc. (Ex. 1006, ¶[0007]) shows that Li's transceiver can be configured to removably couple to an optical module port of a host device. (*Id.*, ¶¶[0019]-[0020], Fig. 2). Li does not explicitly state what types of components the host device can be, but states that there can be "different types of host device ..." (*Id.*, ¶[0008]). The fact that Li's host device is not limited to a specific type of device teaches a POSITA that the host device could be any suitable device, such as a device that includes a switch or router, because switches and routers are common network components. (Ex. 1002, ¶220).

Thus, this element would have been obvious over Li.

[1a]

Li's transceiver includes a PON protocol processor, shown below, "that is configured to process PON related protocols and other management commands for physical/optical layer." (Ex. 1006, ¶[0031]). The processing unit (also referred to as "data processing unit" in Li) manages the transmission and reception of data link layer optical network communications. For example, "[i]n the reception data path, optical subassembly 310 receives an optical signal containing reception data at the interface 304 and sends an electric signal containing the reception data to the post amplifier in the unit 312. The post amplifier amplifies the electric signal and sends it to the data processing unit 314, which subsequently processes the reception data and sends it to the data path interface 301." (*Id.*, ¶[0033]). "In the

control path, a control signal is communicated through a control path interface 302 between the management unit 316 in the pluggable optical transceiver 300 and the management unit 310 in the host device 200.” (*Id.*, ¶[0034]).

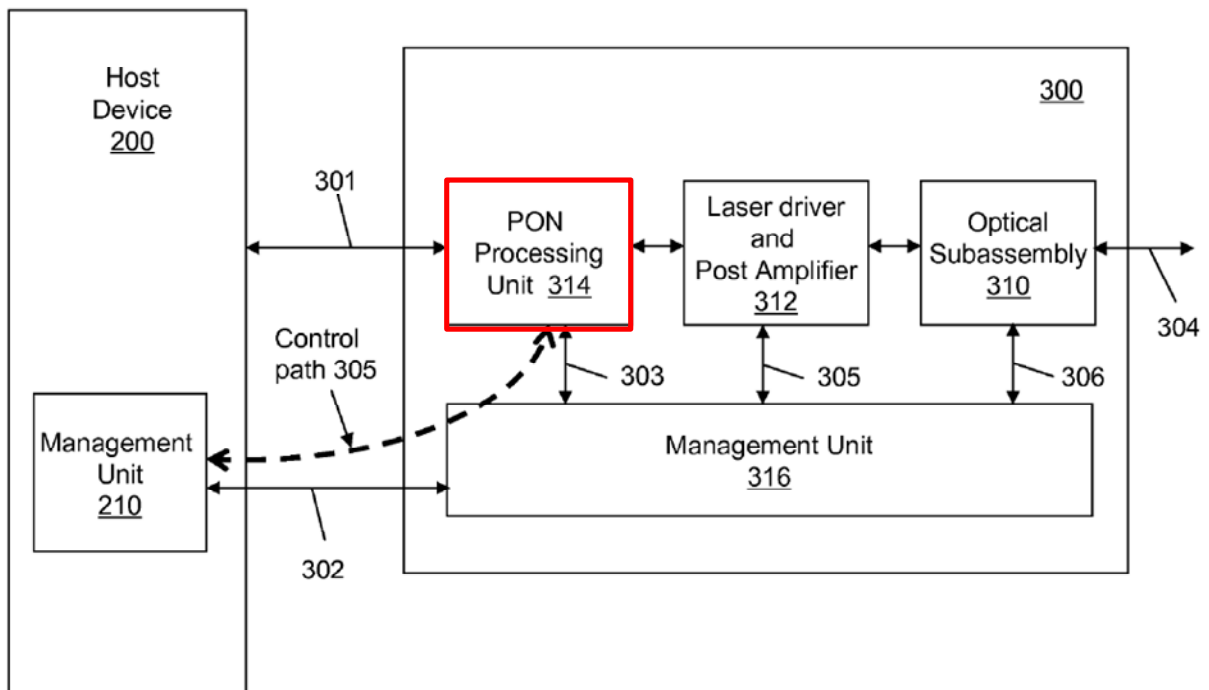


Figure 3

The processing unit can also “perform system-layer functions that include media access control (MAC), Ethernet/ATM switching, forward error correction, or OAM message processing.” (*Id.*, ¶[0044]).

Thus, Li discloses this claim element. (Ex. 1002, ¶¶224-226).

[1b]

Li’s transceiver includes an optical fiber interface. (*Id.*, ¶[0043]). Because

Li's transceiver can comply with form factor standards like SFP (*Id.*, ¶[0046]), the transceiver can be "removably" coupled to an optical fiber. (Ex. 1002, ¶¶227-228).

[1c]

Li's transceiver connects to an optical via a "data path interface" 201/301. (Ex. 1006, Figs. 2-3). Li's data path interface constitutes the claimed "electrical network interface." It is electrically couples the transceiver to a host device, which could be a variety of devices, (*id.*, ¶[0008]), such as a switch or router. It also connects to the optical link in a "pluggable manner" because it "complies with the SFP standard." (*Id.*, ¶[0046]). It also communicates via Ethernet. (*Id.*, ¶[0018]). Thus, Li discloses this claim element. (Ex. 1002, ¶¶229-231).

[1d]

Li's transceiver includes an optical subassembly that includes an optical transmitter and optical transmitter that "respectively send and receive data at an interface 204 for transmission and reception of optical signals" (Ex. 1006, ¶[0020]). Thus, Li's optical subassembly constitutes the claimed "bidirectional optical assembly." (Ex. 1002, ¶232). Li's optical subassembly 110/310 is connected to the port 204/304; is coupled to the PON processing unit 114/314; and both receives and transmits optical signals via the port 204/304. (Ex. 1006, Figs. 2-3; Ex. 1002, ¶234). The signals it sends to the network equipment are responsive to electrical signals from the PON processing unit; and the signals is send to the

PON processing unit are responsive to optical signals received from the network equipment. (Ex. 1006, ¶¶[0022]-[0023]). Thus, Li discloses this element. (Ex. 1002, ¶¶232-237).

[1e]

Li's PON processing unit (aka, "data processing unit") "can perform system-layer functions that include media access control (MAC), Ethernet/ATM switching, forward error correction, or OAM message processing." (Ex. 1006, ¶[0044]). Thus, Li includes an Ethernet MAC that is part of the PON processing unit. (Ex. 1002, ¶¶238-242).

[1f]

Li's transceiver manages the PON data link layer optical network data communications between the host device and the network equipment. (Ex. 1006, ¶[0018]). It also uses Ethernet. (*Id.*). A POSITA would understand that Li's host device could be a switch or router. (Ex. 1002, ¶242). Therefore, this element would have been obvious to a POSITA.

3. Claim 2

Li's transceiver can comply "with the SFP standard." (Ex. 1006, ¶[0046]). SFP is a MSA form factor. (*Id.*, ¶[0036]). This claim would have been obvious. (Ex. 1002, ¶244).

4. Claim 3

Li's pluggable optical transceiver "is configured to process PON related protocols" (Ex. 1006, ¶[0031]; *see also* ¶[0003] (GPON, EPON, BPON, WDN-PON)). Thus, this claim would have been obvious. (Ex. 1002, ¶[246]).

5. Claim 9

Claim 9 would have been obvious to a POSITA in light of Li. First, Li discloses that the pluggable optical transceiver can be connected to the network equipment via a single fiber or a fiber bundle. (Ex. 1006, ¶[0019]). From this, it would have been clear to a POSITA that Li's optical transceiver would likely require some sort of connector to connect the optical transceiver to the single fiber or fiber bundle. (Ex. 1002, ¶[247]).

Second, Li discloses that pluggable optical transceiver can assume one of the then-known standard form factors, such as GBIC, SFF, small form-factor pluggable (SFP), XFP, X2, XENPAK, and SFP+. (Ex. 1006, ¶[0017]). It was well-known to a POSITA prior to 2012 that these standard form factor can use standard fiber connectors, such as LC for SFP or XFP. (Ex. 1002, ¶[248]). Therefore, a POSITA would have found claim 9 to be obvious.

6. Claim 10

Li's transceiver can work with EPON and GPON networks. (Ex. 1006,

¶[0002]). The “E” stands for Ethernet and “G” stands for gigabit. (Ex. 1001, 1:50-51). Thus, claim 10 would have been obvious. (Ex. 1002, ¶250).

7. Claim 13

Li’s transceiver receives a “control signal” from a management unit in the host device. (Ex. 1006, ¶[0034]). The control signal “can include diagnostic data” (*Id.*). Based on the received control signal, Li’s transceiver “monitor[s] optical signals and related parameters, track[s] and respond[s] to warnings and alarms,” (*Id.*). It would have been obvious to a POSITA to report these alarms and diagnostics “in band” because Li teaches the PON processing unit can insert data into signals. (Ex. 1002, ¶¶252-253).

VII. CONCLUSION

This Petition demonstrates a reasonable likelihood that at least one claim of the ’697 Patent is unpatentable under 37 C.F.R. § 42.108(c). Accordingly, all grounds in this Petition should be instituted. *SAS Institute Inc. v. Iancu*, 138 S.Ct. 1348, 1359–60 (2018); Trial Practice Guide Update, 31 (July 2019).

Respectfully submitted by

K&L GATES LLP,

By: /Jason A. Engel/
Jason A. Engel
Reg. No. 51,654

Claim Appendix of the Challenged Claims

- [1pre] An integrated pluggable Passive Optical Network (PON) optical transceiver module adapted to process and perform PON data link layer communications and functions and configured to removably couple to an optical module port of a switch, router or media adapter and adapted to communicate with the switch, router or media adapter using an Ethernet protocol, the PON optical transceiver module comprising:
- [1a] a PON protocol processor for managing the transmission and reception of data link layer optical network communications including performing one or more of the following functions comprising: encapsulating user data into data link layer frames; frame synchronization; forward error correction; physical layer addressing; data packet queuing, and operation administration and maintenance (OAM) message processing;
- [1b] an optical fiber interface port disposed to removably couple an optical fiber to the PON optical transceiver module; an electrical network interface port disposed for electrically coupling the PON optical transceiver module in a pluggable manner to a switch, router or media converter and for receiving and transmitting Ethernet electrical signals to the switch, router or media converter;
- [1c] an electrical network interface port disposed for electrically coupling the PON optical transceiver module in a pluggable manner to a switch, router or media converter and for receiving and transmitting Ethernet electrical signals to the switch, router or media converter;
- [1d] a bidirectional optical assembly optically coupled to the optical fiber interface port and electrically coupled to the PON protocol processor and disposed for transmitting optical signals through the optical fiber interface port responsive to electrical signals received from the PON protocol processor and disposed to conveying an electrical communication signal to the PON protocol processor responsive to receiving an optical communication signal through the optical fiber interface port;

- [1e] an Ethernet MAC electrically coupled to the PON protocol processor and electrically coupled to the electrical network interface, the Ethernet MAC disposed to enable communications between the PON protocol processor and the switch, router or media converter using an Ethernet protocol,
- [1f] whereby the PON optical transceiver module is disposed to manage the PON data link layer optical network data communications, and communicate with a switch, router or media converter using an Ethernet protocol.
- [2] The PON optical transceiver module of claim 1, wherein the PON optical transceiver module conforms to a Multi-Source Agreement (MSA) optical module form factor selected from the group consisting essentially of: Small Form-factor Pluggable (SFP); SFP+; Compact small form-factor pluggable (C-SFP); 10 Gigabit Small Form-factor Pluggable (XFP); C Form-factor Pluggable (CFP); Quad Small Form Factor Pluggable (QSFP); QSFP+; XENPAK; X2; XPAK; and 300pin.
- [3] The PON optical transceiver module of claim 1, wherein the PON protocol processor performs functions conforming to a network protocol selected from the group consisting essentially of: ITU-T G.984 Gigabit PON (GPON); IEEE 802.3ah Ethernet PON (EPON); ITU-T G.987 10 Gigabit PON (XG-PON); IEEE 802.3av 10 Gigabit Ethernet PON (10G-EPON); ITU Next Generation PON (NG-PON); ITU NG-PON2; WDM-PON; ITU-T G.983 Broadband Passive Optical Network (BPON); Data over Cable Service Interface Specification (DOCSIS) PON (D-PON/DPON); and RFoG SCTE IPS910.
- [9] The PON optical transceiver module of claim 1, wherein the optical fiber interface port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of: Subscriber Connector (SC); Lucent Connector (LC); Fiber Channel (FC); Straight TP (ST); and Miniature Unit (MU).

- [10] The PON optical transceiver module of claim 1, wherein the Ethernet MAC is selected from the group consisting essentially of: 10Mbit Ethernet MAC; 100Mbit Ethernet MAC; 1Gigabit Ethernet MAC; 10Gigabit Ethernet MAC; and 100Gigabit Ethernet MAC.
- [13] The PON optical transceiver module of claim 1, wherein the PON optical transceiver module is configured to monitor alarms and diagnostics and reporting of the alarms or diagnostics are performed in-band over the Ethernet communications between the PON optical transceiver module and the switch, router or media converter.
- [15pre] A Passive Optical Network (PON) optical transceiver module for a passive optical network, the PON optical transceiver module having a pluggable form factor and adapted to removably couple to an optical module port of a switch, router or media converter, and the PON optical transceiver module having an optical interface port for coupling to one or more optical fibers of the passive optical network, and the PON optical transceiver module having a bidirectional optical assembly optically coupled to the optical port and for converting electrical signals to optical signals and for converting optical signals to electrical signals, and the PON optical transceiver module having a PON protocol processor electrically coupled to the bidirectional optical assembly and for processing and performing optical data link layer network communications, and the PON optical transceiver module having an Ethernet media access controller (MAC) electrically coupled to the PON protocol processor and the PON optical transceiver module having an electrical network interface port electrically coupled to the Ethernet MAC and for electrically communicating to the switch or router, a method of communicating on a passive optical network from the PON optical transceiver module comprising the steps of:
- [15a] (a) receiving a first optical signal through the optical interface port at the bidirectional optical assembly of the PON optical transceiver module;

- [15b] (b) converting the first optical signal to an electrical signal at the bidirectional optical assembly and conveying the electrical signal to the PON protocol processor of the PON optical transceiver module;
- [15c] (c) processing the electrical signal at the PON protocol processor to determine a first optical data link layer frame and de-encapsulating a first user payload data from the first optical data link layer frame;
- [15d] (d) conveying the first user payload data from the PON protocol processor to the Ethernet MAC;
- [15e] (e) encapsulating the first user payload data in a first Ethernet data frame by the Ethernet MAC and conveying the first Ethernet data frame to the switch, router or media converter through the electrical network interface port;
- [15f] (f) receiving a second Ethernet data frame from the switch, router or media converter through the electrical network interface port of the PON optical transceiver module;
- [15g] (g) de-encapsulating a second user payload data from the second Ethernet data frame by the Ethernet MAC;
- [15h] (h) conveying the second user payload data from the Ethernet MAC to the PON protocol processor;
- [15i] (i) encapsulating the second user payload data into a second optical data link layer frame by the PON protocol processor;
- [15j] (j) converting the second optical data link layer frame to a second optical signal; and
- [15k] (k) transmitting the second optical signal from the bidirectional optical assembly through the optical interface port;
- [15l] whereby the PON optical transceiver module is disposed to optically communicate user data over the passive optical network and is disposed to electrically communicate user data with the switch, router or media converter using Ethernet communications.

- [16] The method of claim 15, wherein the PON optical transceiver module conforms to a Multi-Source Agreement (MSA) optical module form factor selected from the group consisting essentially of: Small Form-factor Pluggable (SFP); SFP+; Compact small form-factor pluggable (C-SFP); 10 Gigabit Small Form-factor Pluggable (XFP); C Form-factor Pluggable (CFP); Quad Small Form Factor Pluggable (QSFP); QSFP+; XENPAK; X2; XPAK; and 300pin.
- [17] The method of claim 15, wherein the PON protocol processor performs functions conforming to a network protocol selected from the group consisting essentially of: ITU-T G.984 Gigabit PON (GPON); IEEE 802.3ah Ethernet PON (EPON); ITU-T G.987 10 Gigabit PON (XG-PON); IEEE 802.3av 10 Gigabit Ethernet PON (10G-EPON); ITU Next Generation PON (NG-PON); ITU NG-PON2; WDM-PON; ITU-T G.983 Broadband Passive Optical Network (BPON); Data over Cable Service Interface Specification (DOCSIS) PON (D-PON/DPON); and RFoG SCTE IPS910.
- [20] The method of claim 15, wherein diagnostic measurements performed within the PON optical transceiver module and conveyed in-band to the switch, router or media converter through Ethernet communications includes one or more of the following measurements: temperature in the optical assembly; optical power output of the optical assembly; and received optical power sensitivity of the optical assembly.
- [21] The method of claim 15, wherein the optical fiber interface port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of: Subscriber Connector (SC); Lucent Connector (LC); Fiber Channel (FC); Straight TP (ST); and Miniature Unit (MU.)

- [24] The method of claim 15, wherein the Ethernet MAC is selected from the group consisting essentially of: 10Mbit Ethernet MAC; 100Mbit Ethernet MAC; 1Gigabit Ethernet MAC; 10Gigabit Ethernet MAC; and 100Gigabit Ethernet MAC.
- [25] The method of claim 15, wherein the PON optical transceiver module is configured to monitor alarms and diagnostics and reporting of the alarms or diagnostics are performed in-band over the Ethernet communications between the PON optical transceiver module and the switch, router, or media converter.

Certification of Service Under 37 C.F.R. § 42.6(e)(4)

A copy of this Petition for *Inter Partes* Review and supporting materials has been served at the following correspondence address of record for the subject patent via Federal Express Priority Overnight® on this 10th day of September, 2021:

**Alexander Soto
7673 Hazard Center Dr.
San Diego, CA 92108**

By: /Jason A. Engel/
Jason A. Engel
Reg. No. 51,654
Customer No. 24573
K&L GATES LLP
Jason.Engel.PTAB@klgates.com
telephone number: (312) 807-4236
fax number: (312) 827-8145
70 W. Madison Street, Suite 3100
Chicago, IL 60602

Certification of Word Count Under 37 C.F.R. § 42.24(d)

The undersigned hereby certifies that the foregoing Petition for *Inter Partes* Review contains **11,363** words, not including a table of contents, table of authorities, mandatory notices under § 42.8, certificate of service, certificate of word count, appendix of exhibits or appendix of claim listing as specified by 37 C.F.R. § 42.24, according to the word count feature of the word-processing software used to prepare the Petition.

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K&L GATES LLP
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telephone number: (312) 807-4236
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