

**UNITED STATES PATENT AND TRADEMARK OFFICE**

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**PATENT TRIAL AND APPEAL BOARD**

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II-VI Incorporated  
Petitioner

v.

Alexander Soto and Walter Soto  
Patent Owners

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CASE: IPR2021-01495  
U.S. PATENT NO. 8,238,754

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**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**

<b>Exhibit No.</b>	<b>Description</b>
1001	U.S. Pat. No. 8,238,754 to Soto <i>et al.</i> (“’754 Patent”)
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1003	File History of U.S. Patent Application No. 12/982,872
1004	U.S. Pat. Pub. No. 2002/0146026 to Unitt <i>et al.</i> (“Unitt ’026”)
1005	U.S. Pat. Pub. No. 2002/0149821 to Aronson <i>et al.</i> (“Aronson”)
1006	U.S. Pat. No. 7,181,142 to Xu <i>et al.</i> (“Xu”)
1007	U.S. Pat. Pub. No. 2002/0136232 to Dudziak <i>et al.</i> (“Dudziak”)
1008	U.S. Pat. Pub. No. 2002/0063932 to Unitt <i>et al.</i> (“Unitt ’932”)
1009	U.S. Pat. No. 8,958,697 to Soto <i>et al.</i> (“Soto ’697”)
1010	U.S. Pat. No. 7,242,868 to Soto <i>et al.</i> (“Soto ’868”)
1011	U.S. Pat. No. 9,337,948 to Soto <i>et al.</i> (“Soto ’948”)
1012	U.S. Pat. No. 5,039,194 to Block <i>et al.</i> (“Block”)
1013	U.S. Pat. Pub. No. 2004/0208601 to Tan <i>et al.</i> (“Tan”)
1014	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)
1015	Cooperation Agreement for Small Form-Factor Pluggable Transceivers (available at <a href="http://schelto.org/SFP/SFP%20MSA%20091400.htm">schelto.org/SFP/SFP%20MSA%20091400.htm</a> ) (last accessed August 19, 2021)

<b>Exhibit No.</b>	<b>Description</b>
1016	International Telecommunication Union G.984.2, “Gigabit-Capable Passive Optical Networks (GPON): Physical Media Dependent layer specification”, March 16, 2003.
1017	International Telecommunication Union G.983.3, “A Broadband Optical Access System With Increased Service Capability By Wavelength”, March, 2001.
1018	File History of U.S. Patent Application No. 60/477,845
1019	Provisional Application No. 60/480,488
1020	U.S. Pat. Pub. No. 2002/0163921 to Ethridge <i>et al.</i> (“Ethridge”)
1021	File History of U.S. Patent Application No. 10/865,547

**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)<sup>1</sup>:

- II-VI Incorporated
- Finisar Corporation

**B. Related Matters**

Patent Owners Alexander Soto and Walter Soto have, through their exclusive licensee, asserted the ’754 Patent in the following litigation.

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<sup>1</sup> 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 ’754 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*, 4-20-cv-00854 (E.D.Tex.).

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

- U.S. Patent No. 8,958,697;
- U.S. Patent No. 9,887,795;
- U.S. Patent No. 10,26,723;
- 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 IPR2021-01494 challenging certain claims of related U.S. Patent No. 8,958,697.

**C. Lead and Backup Counsel and Service (37 C.F.R. § 42.8(b)(3)-(4))**

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Petitioner consents to electronic service by email.



## **I. INTRODUCTION**

Petitioner requests institution of *Inter Partes* Review (“IPR”) of claims 1-31 (“Challenged Claims”) of U.S. Patent 8,238,754 (“’754 Patent,” Ex. 1001) and cancellation of the Challenged Claims in view of the Grounds described below. This petition is supported by the declaration of Dr. Keith Goossen, an expert in the field of the ’754 Patent and the prior art. (Ex. 1002).

## **II. TECHNICAL BACKGROUND OF THE ’754 PATENT**

### **A. ’754 Patent Technical Summary**

Claim 1 of ’754 Patent claims a “network client optical transceiver module for a passive optical network, the passive optical network having one or more passive optical splitters for coupling the network client optical transceiver module over one or more optical fibers to the head end of the passive optical network and the network client optical transceiver module having a pluggable form factor ....” (Ex. 1001, 16:47-51). Figure 1 (shown below) is a schematic of a passive optical network (“PON”) and depicts head-end optical module 100 in communication with transceiver modules 104A-C via a passive optical distribution network 102. (*Id.*, 5:63-6:6).

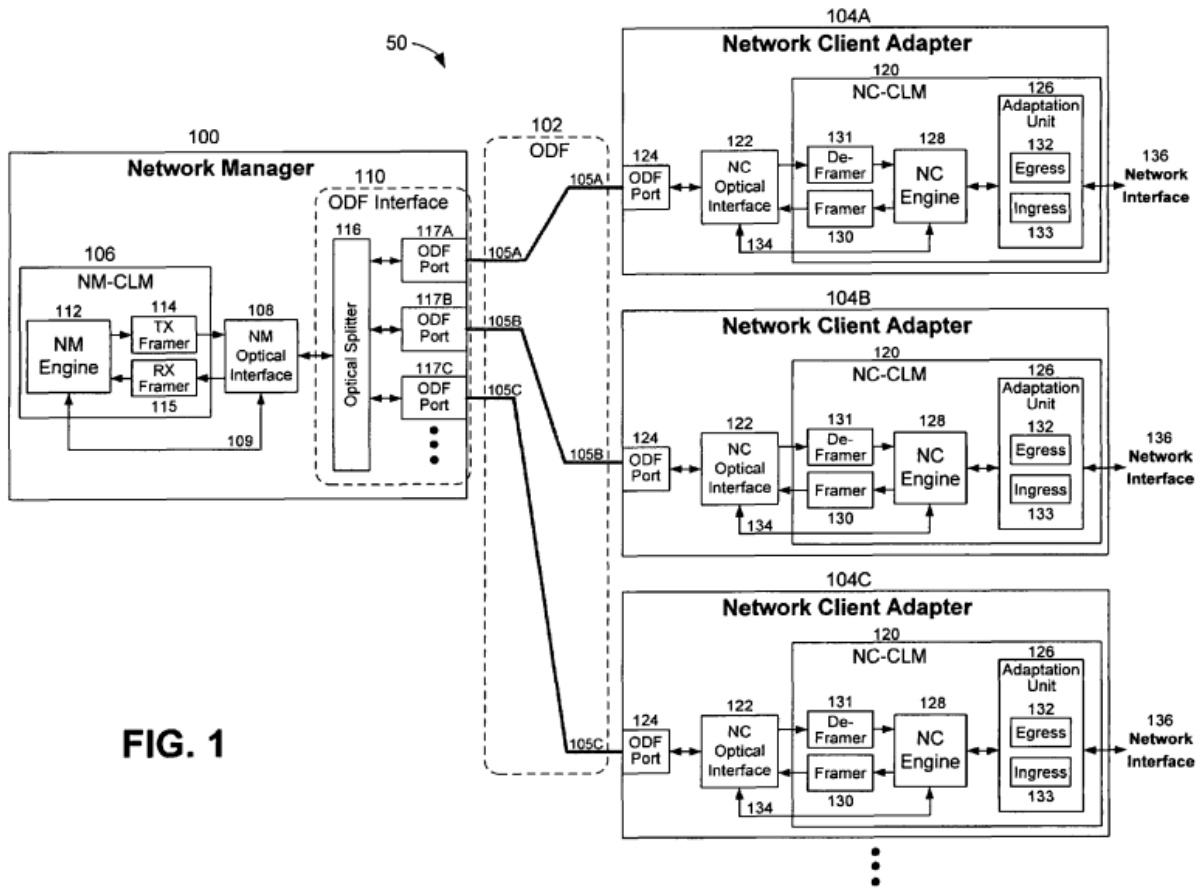


FIG. 1

The PON optical transceiver module is configured to process a PON protocol for an OSI layer-2 protocol including Ethernet media access control (MAC). (*Id.*, 2:31-42). With reference to the transceiver modules 104A-C shown in Figure 1, each transceiver 104 receives an allocated time slot from the network manager/headend 100 that corresponds to a time period to transmit data upstream. (*Id.*, 8:60-9:10). During the allocated time slot, a transceiver has a dedicated transmission interval to transmit data to the headend without a collision resulting with another transceiver. (*Id.*, 8:60-9:18). The headend allocates a time slot to each

transceiver by sending a network communication that identifies the specific transceiver. (*Id.*).

### **B. '754 Patent Overview**

The '754 Patent was filed on December 30, 2010 and issued on August 7, 2012. (Ex. 1001, Cover). The '754 Patent describes and claims processing optical and electrical signals in a passive optical network. (*Id.*, Abstract, 2:31-55; Ex. 1002, ¶¶25-27).

As set forth in this Petition, the '754 Patent fails to add anything to the then-existing state of the art, and merely describes standard electrical-to-optical signal processing components and techniques contained within well-known pluggable form factors. (Ex. 1002, ¶¶29-30).

### **C. Prosecution History of the '754 Patent**

The application leading to the '754 Patent, Application No. 12/982,872, was filed December 30, 2010, and was granted as a first action allowance. (Ex. 1003, 11-12). The Examiner made no prior art rejections and merely stated that the subject application was allowable over U.S. Pub. No. 2002/0163921 to Ethridge *et al.* (Ex. 1020) for failing to disclose “an electrical network interface port electrically coupled to the control module and for coupling into the optical module port of the switch or router.” (Ex. 1003, 11-12).

**D. '754 Patent Priority**

The '754 Patent claims priority to non-provisional Application No. 10/865,547 which itself claims priority to two provisional applications: 60/477,845 and 60/480,488. (Ex. 1010, Cover). For the purposes of this Petition, no determination as to intervening priority need be made; all of the prior art relied upon herein is prior art to the earliest possible priority date in 2003. (Ex. 1002, ¶¶20, 24). All references herein to 35 U.S.C. §§ 102-103 are to the pre-AIA versions thereof which apply to the Challenged Claims.

**III. GROUNDS FOR STANDING**

Petitioner certifies that (1) the '754 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 '754 Patent.

**IV. PAYMENT OF FEES**

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

**V. 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. *In re Coutts*, 726 F. App’x 791, 796 (Fed. Cir. 2018); *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 420–21 (2007).

With respect to the '754 Patent, a POSITA as of June of 2003, had, among other attributes, 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, ¶35). 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. (Ex. 1002, ¶¶35-36). 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. (Ex. 1002, ¶35).

## **VI. CLAIM CONSTRUCTION**

For purposes of this proceeding, Petitioner believes no terms need to be construed as the prior art utilizes substantially the same language such that, under any construction of the terms of the Challenged Claims, the claims are unpatentable. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999). Petitioner reserves its right to respond to any unforeseeable claim constructions Patent owner may advance.

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 e.g.*, Ex. 1001, claims 2 and 19 (optical module form factors); claims 6 and 23 (fiber connectors); claims 7 and 24 (electrical network interface port); and claims 16 and 30 (discrete chip). The listed items in these claims are alternatives, akin to *Markush* claims. *See Abbott Labs v. Baxter Pharmaceutical Products, Inc.*, 334 F.3d 1274, 1280-81 (Fed. Cir. 2003). As alternatives, the prior art need only 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.”).

**VII. 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:

<b>Ground</b>	<b>Basis</b>	<b>Relied-On References</b>	<b>Claim(s)</b>
1	§ 103	US. Pat. Pub. No. 2002/0146026 (“Unitt ‘026”) (Ex. 1004) and US. Pat. Pub. No. 2002/0149821 (“Aronson”) (Ex. 1005)	1-4, 6-12, 14-21, 23-26, 28-31
2	§ 103	Unitt ‘026 and US. Pat. Pub. No. 2004/0208601 (“Tan”) (Ex. 1013)	1-12, 14-26, 28-31

Ground	Basis	Relied-On References	Claim(s)
3	§ 103	Unitt ‘026, Aronson, and US. Pat. No. 5,039,194 (“Block”) (Ex. 1012)	6, 23
4	§ 103	Unitt ‘026, Aronson, and US. Pat. No. 7,181,142 (“Xu”) (Ex. 1006)	13, 27
5	§ 103	Unitt ‘026, Tan, and Xu	13, 27
6	§ 103	Unitt ‘026, Aronson, and US. Pat. Pub. No. 2002/0136232 (“Dudziak”) (Ex. 1007)	17, 31
7	§ 103	Unitt ‘026, Tan, and Dudziak	17, 31

**A. The Petition Should Not Be Discretionarily Denied**

**1. *Becton, Dickinson***

The claims of the ’754 Patent have not been considered in view of any of the prior art relied upon in the asserted grounds of this Petition.<sup>2</sup> 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).

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<sup>2</sup> Other patents by Unitt et al. (Patent No. 6,970,461) and Aronson (Patent No. 7,486,894) were considered in the original file history, but they are substantively different from Exs. 1004 and 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 factors 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 '754 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**

The Challenged Claims merely represent a collection of known components modified or combined according to known methods to yield predictable results, and are therefore obvious under 35 U.S.C. § 103. (*See e.g.*, Ex. 1002, ¶¶38-57).

### **1. *Unitt '026* (Ex. 1004)**

*Unitt '026* 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 '026* is 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 only entitled to a December 30, 2010 priority date, *Unitt '026* qualifies as prior art under § 102(b).

*Unitt '026* discloses a PON with headend 101 connected to a number of optical network units (ONUs), as shown in reproduced Figure 2 below. (Ex. 1004,

¶52, Figs. 1-2). “Each ONU converts ... the optical signal to an electrical signal and decodes the information.” (Ex. 1004, ¶55).

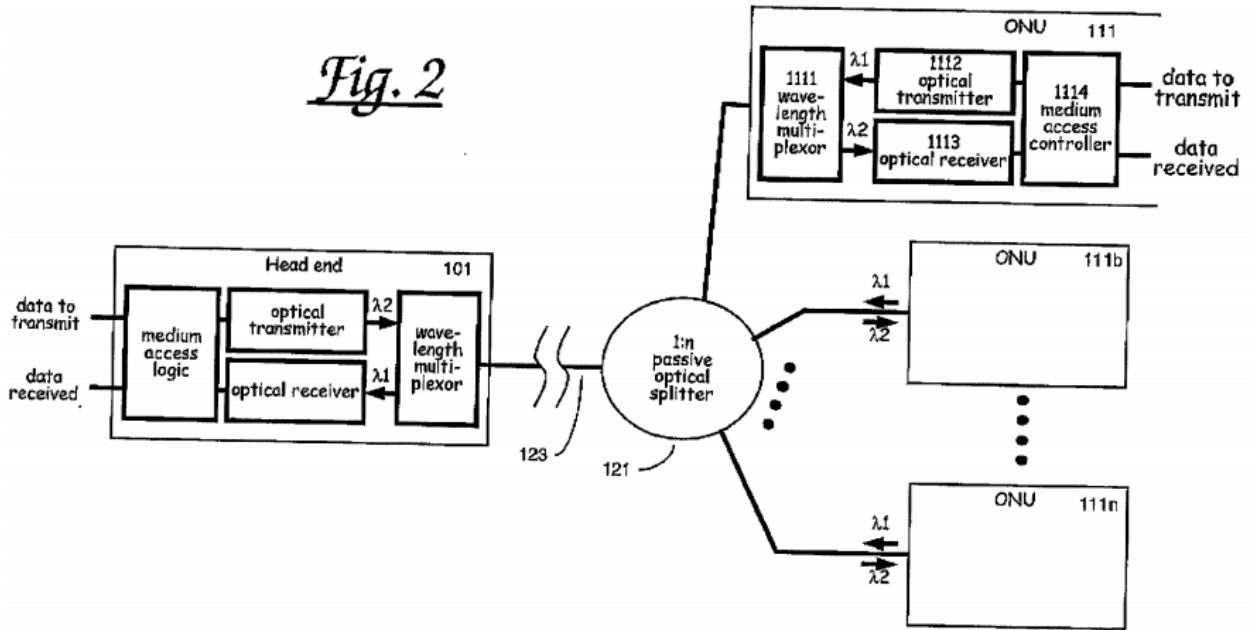
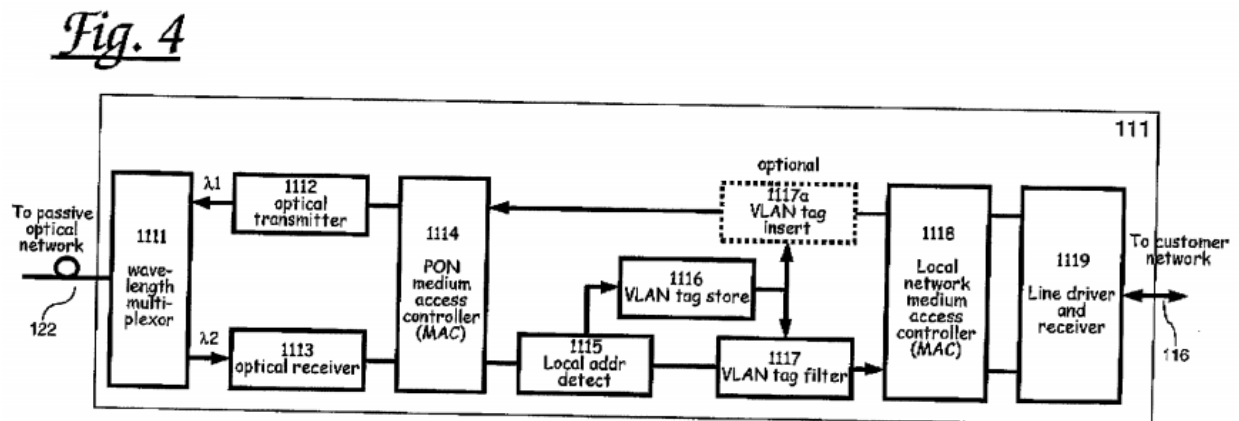


Figure 4 discloses more details of the ONU 111 of *Unitt '026*. The ONU is an optical transceiver because it both transmits and receives optical data and includes both a transmitter 1112 and a receiver 1113 for transmitting and receiving data, respectively, via the passive optical network 122. (Ex. 1004, ¶55, FIGS. 2 and 4).



**2. *Unitt '932* (Ex. 1008)**

*Unitt '932* published on May 30, 2002 and was filed on March 12, 2001, and is prior art to the '754 Patent under at least § 102(a). (Ex. 1008). To the extent a Challenged Claim is entitled to a December 30, 2010 priority date, *Unitt '932* qualifies as prior art under § 102(b).

*Unitt '026* incorporates by reference *Unitt '932* to further describe the control frame messages sent by the headend to the ONU. (Ex. 1004, ¶55). The control frame messages provide an allocated time slot to a downstream ONU. (Ex. 1008, ¶21). In response to a control frame message, the ONU transmits customer premise data to the headend that is stored in a queue. (Ex. 1008, ¶52). The ONU transmits all customer data or for an amount of data can be transmitted without exceeding the allocated time slot. (*Id.*). The allocated time slot prevents a conflict with another ONU transmission. (Ex. 1008, ¶21).

**3. *Aronson* (Ex. 1005)**

*Aronson* is a patent that issued on July 17, 2006 from an application filed February 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 December 30, 2010 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).

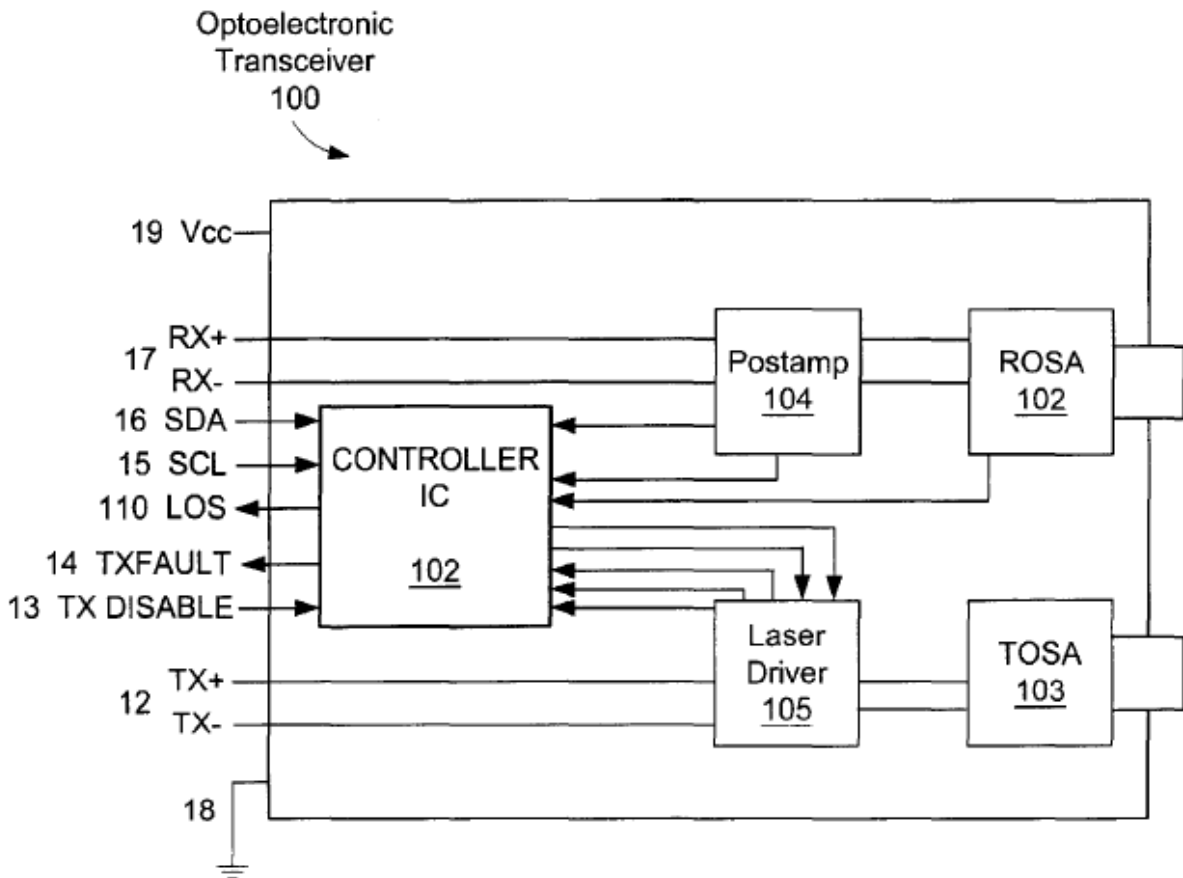


Fig. 2

Referring to 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, ¶62).

#### **4. Block (Ex. 1012)**

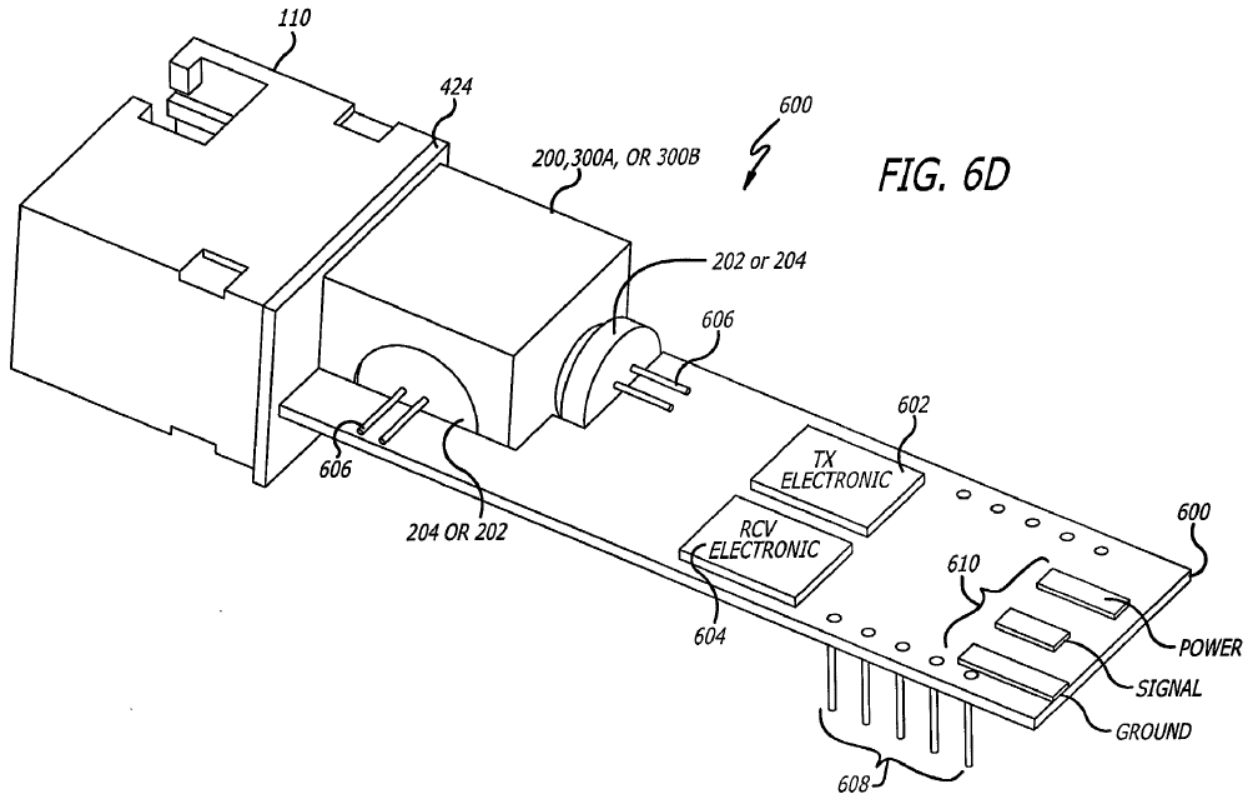
Block is a patent that issued in 1991 and is prior art under 35 U.S.C. § 102(b). (Ex. 1012, Cover).

*Block* discloses an optical fiber link card communication module with receptacles. (Ex. 1012, 5:41-60). Some of the receptacles can be “an FC type optical fiber connector.” (*Id.*, 5:64-66).

#### **5. Tan (Ex. 1013)**

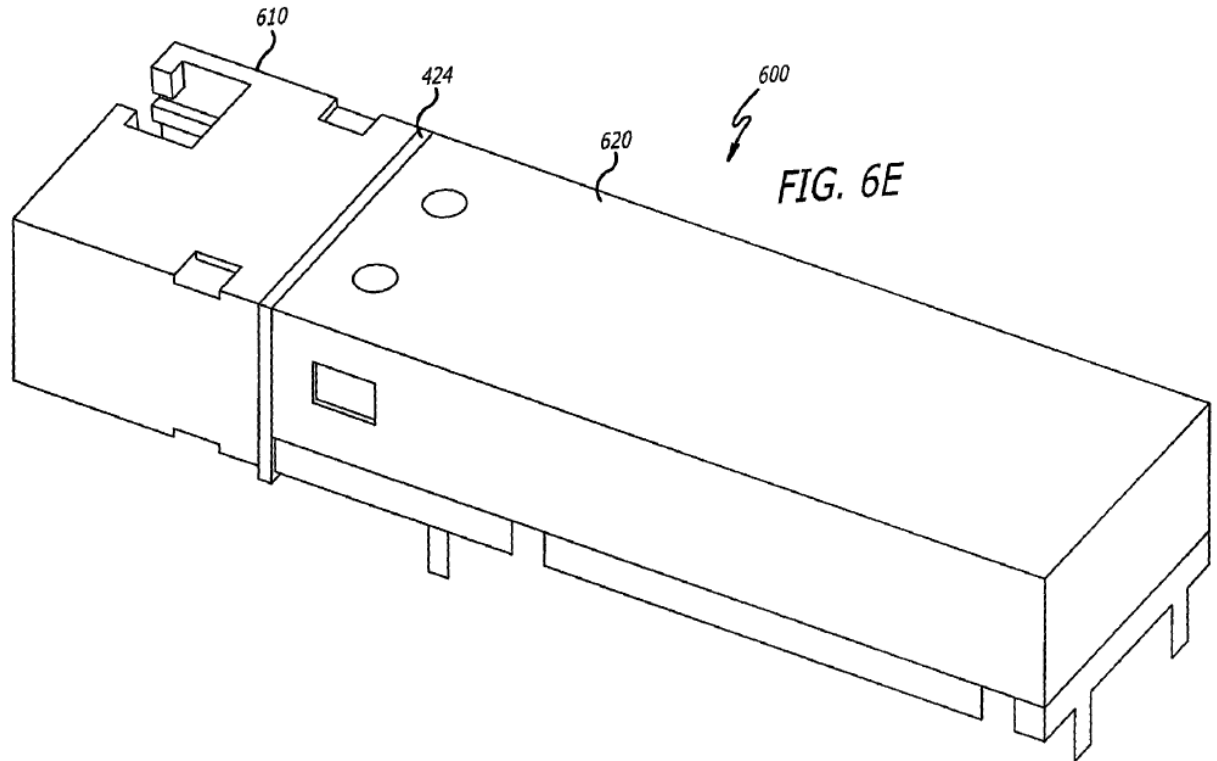
*Tan* published on October 21, 2004 and was filed on June 06, 2002. (Ex. 1013). *Tan* is prior art to the ’754 Patent under at least § 102(a).

*Tan* discloses bi-directional optical transceivers. (Ex. 1013, Abstract). Figures 6A-6F of *Tan* illustrates a bi-directional optical transceiver. Figure 6D illustrates the printed circuit board of the optical transceiver with the transceiver electronics 602 and receiver electronics 604. (*Id.*, ¶71). Element 202 in Fig. 6D is the light source and element 204 is the light/optical receiver.



According to *Tan*, the PCB may include pads 610 “to form an edge connection or alternatively a pluggable connector to allow pluggability into an edge connector or a second pluggable connector respectively of a host printed circuit board.” (Ex. 1013, ¶72). Thus, *Tan* discloses a POSITA how to make the optical transceiver module pluggable, so that it can be plugged into of other components.

*Tan*’s Figure 6E shows the bi-directional optical transceiver with a cover or housing 620 thereon.



## 6. Dudziak (Ex. 1007)

*Dudziak* published on September 26, 2002 and was filed on March 20, 2001.

(Ex. 1007). *Dudziak* is prior art to the '754 Patent under at least § 102(a).

*Dudziak* discloses a downstream terminals (ONU/ONT) that transmits information to the headend based on a central telecom based clock system. (Ex. 1007, ¶¶8-9). The downstream terminal is a gigabit Ethernet transceiver as part of PON employing a gigbit Ethernet protocol that uses 8B/10B line encoding. (Ex. 1007, ¶¶23, 28).

## 7. Xu (Ex. 1006)

*Xu* published on February 20, 2007 and was filed on April 09, 2002. (Ex. 1006). *Xu* is prior art to the '754 Patent under at least § 102(a).

*Xu* discloses a communication system for an optical line terminal (OLT) and an ONU in a broadband PON. (Ex. 1027, 5:10-44). The disclosed communication system operates according to ITU standard G.983 for broadband PON. (Ex. 1006, 3:11-23).

### **C. Ground 1: Challenged Claims 1-4, 6-12, 14-21, 23-26, and 28-31 are Unpatentable Under 35 U.S.C. § 103(a) as Obvious over Unitt '026 and Aronson**

As supported by Dr. Goossen, independent claims 1 and 18, and dependent claims 2-4, 7-12, 14-17, 19-21, 24-26, and 28-31, would have been obvious in view of the combination of *Unitt '026* and *Aronson*. (Ex. 1002, ¶¶59-150).

#### **1. Basis for the Combination of *Unitt '026* and *Aronson***

The scope and content of the prior art includes *Unitt '026* and *Aronson*, which collectively disclose all of the elements of Challenged Claims 1-4, 7-12, 14-22, 24-26, and 28-31. There are no differences between the subject matter of these Challenged Claims and the combination of *Unitt '026* and *Aronson*.

A POSITA would have been motivated to combine *Unitt '026* and *Aronson*; that is, to make *Unitt '026*'s ONU pluggable as taught in *Aronson*. First, *Unitt '026* states that by embodying the ONU (i.e., optical transceiver) as a single application



specific integrated circuit (ASIC), the change would reduce size, complexity, and cost, and would provide higher reliability. (Ex. 1004, ¶¶54, 84). Thus, *Unitt '026* guides a POSITA to miniaturize the ONU, including integration of the ONU functions onto an ASIC. (Ex. 1002, ¶63).

Second, *Unitt '026* 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, ¶63). Thus, the text of *Unitt '026* itself guides a POSITA to make the ONU pluggable in the form taught by, for example, *Aronson*. (Ex. 1002, ¶64).

Third, a POSITA, guided by *Unitt '026* to seek miniaturization and pluggability of the ONU (which is an optical transceiver), would have known that Small Form Factor Pluggable (SFP) optical transceiver technology exists, such as disclosed in *Aronson*. (Ex. 1005, ¶28). *Aronson*'s SFP optical transceiver technology satisfies the teachings of *Unitt '026* for a miniature, pluggable ONU. Thus, a POSITA would have been motivated to meet *Unitt '026*'s need for a miniature, pluggable ONU with SFP technology, such as taught by *Aronson*. (Ex. 1002, ¶66). Further, the '754 Patent in Figure 13, reproduced below, discloses the evolution of a pluggable form factor transceiver as prior art. (Ex. 1001, FIG. 13). This evolution expressly includes the 10 gigabit small form-factor pluggable (XFP) form factor as a known configuration for an optical transceiver. (*Id.*). Thus, a POSITA would have

known to combine the teachings of *Unitt '026* and *Aronson* as shown through applicant admitted prior art (AAPA), and consistent with the August 2020 Memorandum on the treatment of AAPA.<sup>3</sup>

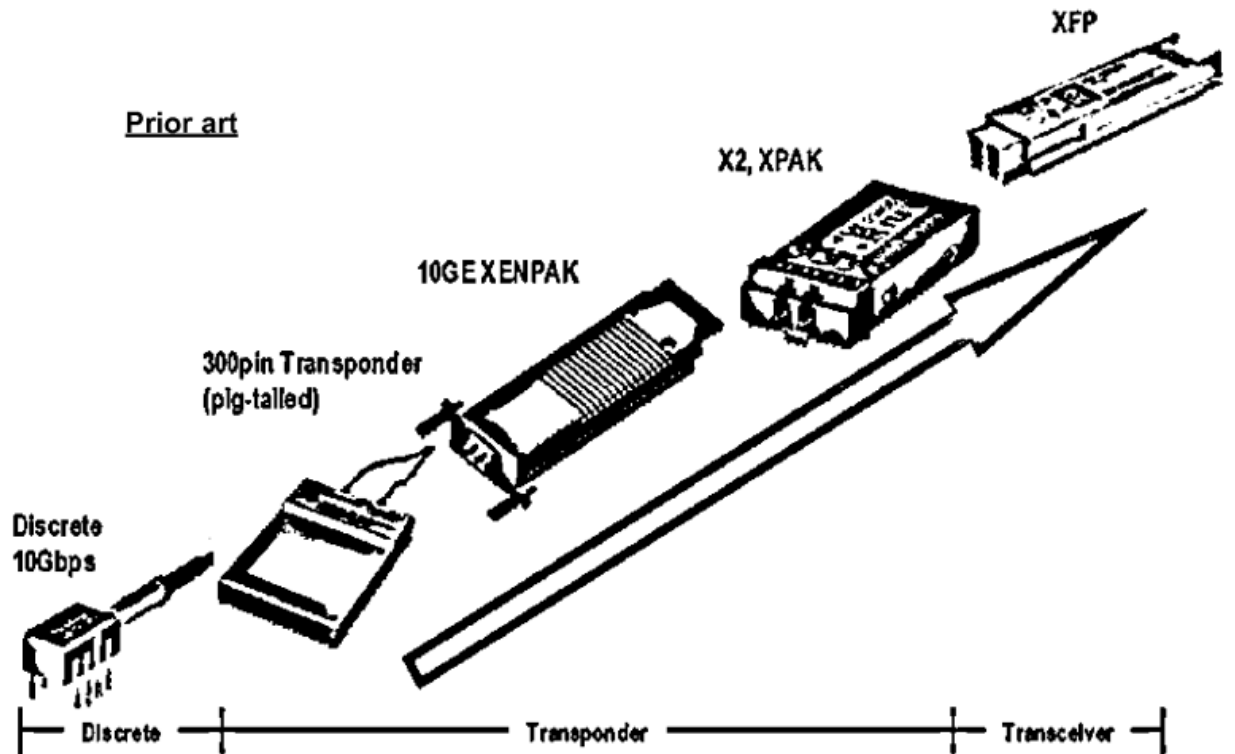


FIG. 13

Fourth, *Unitt '026* incorporates by reference *Unitt '932* that further describes the communication process between the ONU/outstation and the headend. Thus, a POSITA would have been motivated to use the communication method described in

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<sup>3</sup> TREATMENT OF STATEMENTS OF THE APPLICANT IN THE CHALLENGED PATENT IN INTER PARTES REVIEW UNDER § 311, Andrei Iancu (August 18, 2020).

*Unitt '932* with the transceiver disclosed in *Unitt '026*. (Ex. 1002, ¶¶66).

With this combination, *Unitt '026*'s ONU (i.e., an optical transceiver) would be embodied in a miniature, pluggable SFP form factor as taught in *Aronson*. (Ex. 1002, ¶¶64-66).

## **2. Challenged Claims 1-4, 7-12, 14-21, 24-26, and 28-31 are Obvious**

### *a. Independent Claim 1*

- (1) [1Pre] A network client optical transceiver module for a passive optical network, the passive optical network having one or more passive optical splitters for coupling the network client optical transceiver module over one or more optical fibers to the head end of the passive optical network and the network client optical transceiver module having a pluggable form factor and configured to removably couple to an optical module port of a switch or router, the network client optical transceiver module comprising:

*Unitt '026*'s ONU is an optical transceiver that is adapted to process and perform PON data link layer communications and functions. (Ex. 1004, ¶¶69; Ex. 1002, ¶¶70). Because a POSITA would have been motivated to embody *Unitt '026*'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 '026* and *Aronson*. (Ex. 1002, ¶¶71).

*Unitt '026* also teaches an ONU that uses an Ethernet protocol for

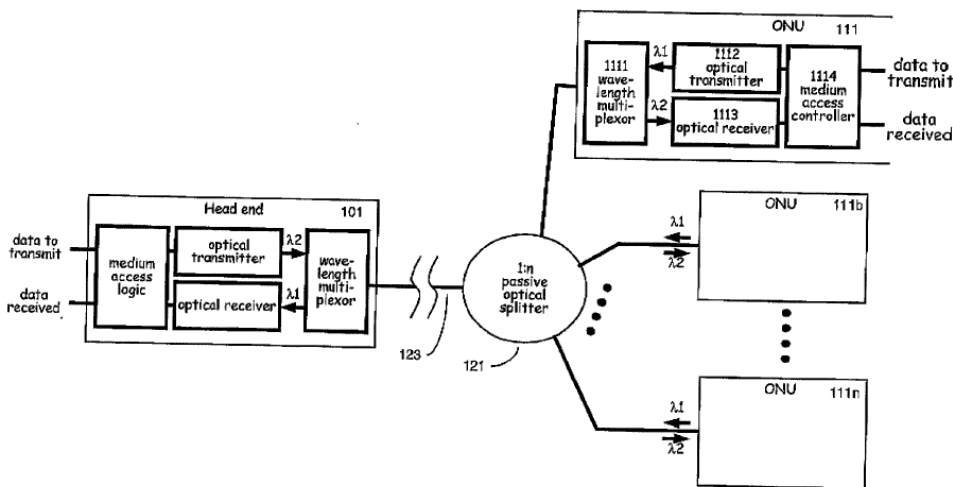
communications, data link layer communication. (Ex. 1004, ¶53). *Unitt '026's* ONU is in direct communication with at least a router of the customer network, to which the ONU is connected. (Ex. 1004, FIGS. 1 and 6 (ONU 111 connected to router 112); ¶53, 81).

Thus, this element would have been obvious to a POSITA. (Ex. 1002, ¶73).

(2) [1a] an optical port configured to optically couple to one or more optical fibers of the passive optical network having one or more passive optical splitters;

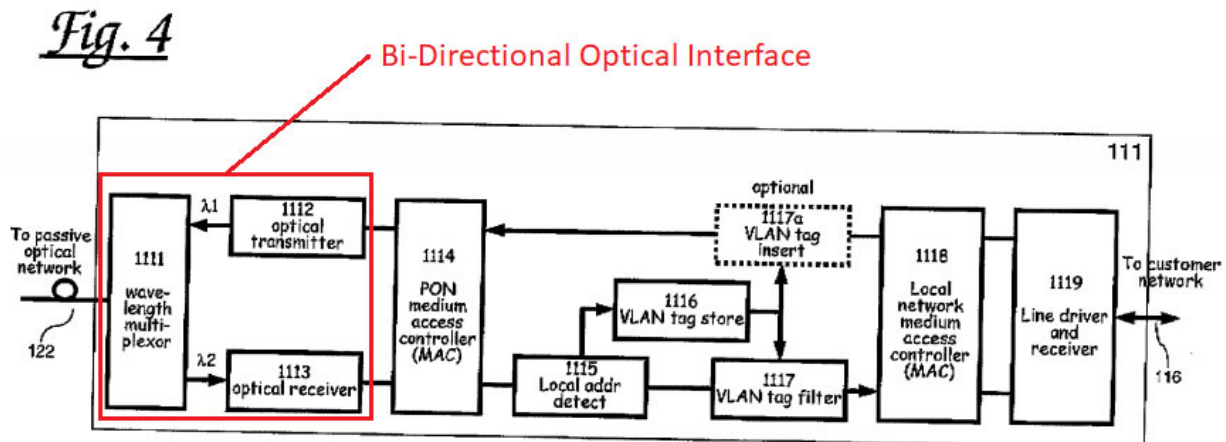
*Unitt '026* describes a PON comprising a passive optical splitter 121 connecting a plurality of ONUs 111. (Ex. 1004, FIG. 2, ¶52, 55). The plurality of ONUs 111 are connected over a fiber optic medium 123 with a headend 101 as illustrated by Figure 2, reproduced below. (*Id.*). A POSITA would find this element obvious. (Ex. 1002, ¶74-75).

Fig. 2



- (3) [1b] a bi-directional optical interface block optically coupled to the optical port and configured to perform optical-to-electrical and electrical-to-optical signal conversion;

*Unitt '026* illustrates a bi-directional optical interface in annotated FIG. 4, reproduced below. (Ex. 1004, FIG. 4). The ONU converts an electrical signal into wavelength  $\lambda_1$  for an upstream transmission to the headend, and converts a downstream optical signal from wavelength  $\lambda_2$  to an electrical signal. (Ex. 1004, FIG. 4, ¶55). A POSITA would understand that a bi-directional optical interface is obvious in view of *Unitt '026*. (Ex. 1002, ¶76).

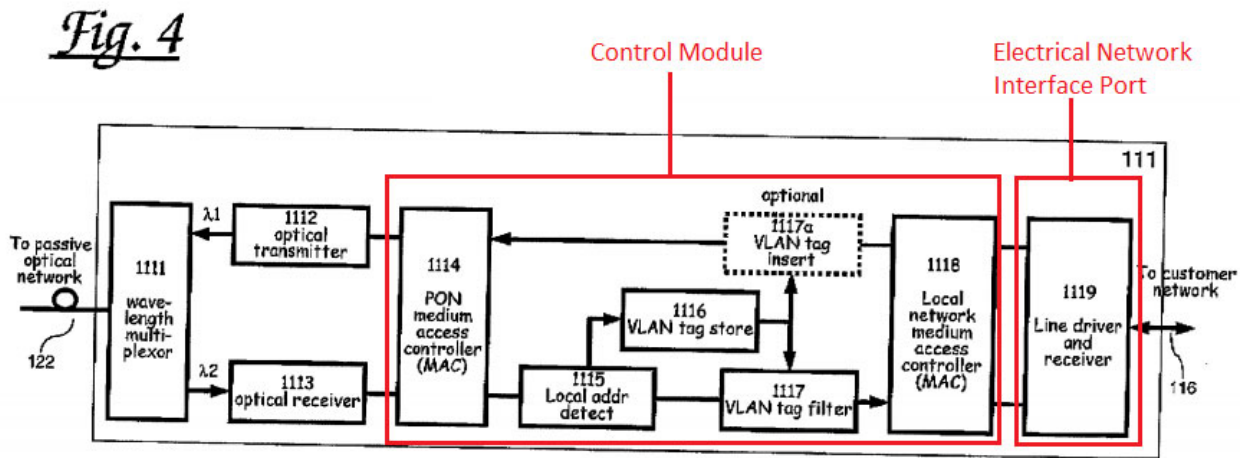


- (4) [1c] a control module electrically coupled to the bi-directional optical interface block and configured to receive from the head end of the passive optical network data communications representing one or more start times for transmitting data communications to the head end of the passive optical network and configured to transmit the data communications to the head end of the passive optical network responsive to the start times;

*Unitt '026* describes an ONU that receives a downstream control frame message from the headend that grants permission to transmit to the headend. (Ex. 1004, ¶56). *Unitt '026* incorporates by reference *Unitt '932* to further describe the communication system. (*Id.*). *Unitt '932* describes a pause frame message, functionally equivalent to the control frame message, that indicates to the ONU to begin to transmit to the headend during the allocated transmission interval. (Ex. 1008, FIG. 4, ¶46). *Unitt '932* describes an embodiment where the ONU transmits to the headend in response to the headend message. (Ex. 1008, ¶62). In another embodiment, *Unitt '932's* ONU determines, in response to the command message, a transmission period that meets operating conditions for the specific ONU. (Ex. 1008, ¶15). A POSITA would understand that the transmission start time is determined by the receipt of the headend message or after the receipt of the headend message, according to the specific conditions for the ONU. (Ex. 1002, ¶¶77-79). Therefore, a POSITA would find this element obvious.

- (5) [1d] an electrical network interface port electrically coupled to the control module and for electrically coupling into the optical module port of the switch or router and for communicating with the switch or router;

*Unitt '026* describes an ONU comprising a network MAC controller 1118 coupled to line driver and receiver 1119. (Ex. 1004, FIG. 4, ¶69). *Unitt '026* further describes the ONU electrically coupled to a router 112 via electrical link 116. (*Id.*). A POSITA would find this element obvious. (Ex. 1002, ¶¶80-81).



- (6) [1e] whereby the network client optical transceiver module is configured to optically communicate with the head end of the passive optical network responsive to start times for transmitting data communications to the head end of the passive optical network and

*Unitt '026's* ONU receives a message from the headend granting permission to begin transmitting data frames, to the headend, for an allocated time slot. (Ex. 1004, ¶56). *Unitt '026* incorporates by reference *Unitt '932* to further describe the upstream transmission by the ONU. (*Id.*). *Unitt '932* discloses a start time for an

upstream transmission indicated by a pause frame message. (Ex. 1008, ¶¶ 62, 15).

Therefore, a POSITA would find this element obvious. (Ex. 1002, ¶82).

(7) [1f] the network client optical transceiver module is configured to removably couple to the optical module port of the switch or router and electrically communicate with the switch or router.

*Unitt '026's* ONU is an optical transceiver that is adapted to process and perform PON data link layer communications and functions. (Ex. 1004, ¶69). Because a POSITA would have been motivated to embody *Unitt '026's* ONU with a SFP module as taught in *Aronson*, 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 '026* and *Aronson*. (Ex. 1002, ¶¶83-84).

*Unitt '026* also teaches using an Ethernet protocol for communications. (Ex. 1004, ¶53). *Unitt '026* 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); ¶¶53, 81) Thus, this element would have been obvious to a POSITA. (Ex. 1002, ¶¶83-84).

*b. Independent Claim 18*

Claims 1 and 18 disclose substantially the same subject matter. The only difference between claim 1 and claim 18 is that claim 1 recites an apparatus for an optical transceiver and claim 18 recites a method for performing the same



functionality that is disclosed by claim 1 for the optical transceiver. (Ex. 1002, ¶87).

Thus, the same analysis of Ground 1 is applicable for independent claims 1 and 18.

- (1) [18Pre] A network client optical transceiver module for a passive optical network, the passive optical network having one or more passive optical splitters for coupling the network client optical transceiver module over one or more optical fibers to the head end of the passive optical network and the network client optical transceiver module having a pluggable form factor and adapted to removably couple to an optical module port of a switch or router, and the network client optical transceiver module having an optical port for coupling to one or more optical fibers of the passive optical network, and the network client optical transceiver module having an optical interface block optically coupled to the optical port and for converting electrical signals to optical signals and for converting optical signals to electrical signals, and the network client optical transceiver module having a control module electrically coupled to the optical interface block and for communicating with the head end of the passive optical network, and the network client optical transceiver module having an electrical network interface port electrically coupled to the control module and for electrically communicating to the switch or router, a method of communicating with the head end of a passive optical network from the network client optical transceiver module comprising the steps of:

The preamble of claim 18 discloses the structural components of the optical transceiver recited in claim 1. For at least the reasons set forth in section VII.C.2.a.(1)-(7), a POSITA would find this element obvious. (Ex. 1002, ¶¶90-92).

- (2) [18a] receiving data from the switch or router through the electrical network interface port of the network client optical transceiver module;

*Unitt '026* describes the ONU receiving local customer premise data from the downstream link 116 before “being forwarded on the PON during the ONU's active time slot.” (Ex. 1004, ¶¶69-70). A POSITA would find this element obvious. (Ex. 1002, ¶¶93-94).

- (3) [18b] storing the received data inside the network client optical transceiver module;

*Unitt '026's* ONU stores customer premise data in a queue, and waits for the allocated upstream transmission time slot to transmit the data to the headend. (Ex. 1004, ¶¶65, 56). A POSITA would find this element obvious. (Ex. 1002, ¶95).

- (4) [18c] receiving a first optical signal from the head end of the passive optical network through the optical port at the optical interface block of the network client optical transceiver module;

*Unitt '026* describes the ONU configured to receive a control frame from the headend through an optical signal on a PON. (Ex. 1004, ¶¶55-56). The ONU receives the optical signal through an optical interface, converts the optical signal to an electrical signal, and decodes the information. (*Id.*). A POSITA would find this element obvious. (Ex. 1002, ¶96).

- (5) [18d] converting the first optical signal to an electrical signal at the optical interface block and conveying the electrical signal to the control module of the network client optical transceiver module;

*Unitt '026's* ONU receives an optical signal through an optical interface, converts the optical signal to an electrical signal, and decodes the information. (Ex. 1004, ¶¶55-56). A POSITA would find this element obvious. (Ex. 1002, ¶97).

- (6) [18e] processing the electrical signal at the control module to determine one or more start times for data transmissions from the network client optical transceiver module to the head end of the passive optical network;

*Unitt '026* describes a control frame that grants permission to the ONU to transmit customer premise to the head end. (Ex. 1004, ¶56). *Unitt '932*, incorporated by reference, provides a more detailed description of this communication. (*Id.*). *Unitt '932* describes a pause message, functionally equivalent to the control frame message, sent by the headend that indicates the start of a predetermined transmission interval for the ONU. (Ex. 1008, ¶62). *Unitt '932's* ONU transmits to the headend in response to the headend message. (Ex. 1008, ¶62). In another embodiment, *Unitt '932's* ONU determines, in response to the command message, a transmission period that meets operating conditions for the specific ONU. (Ex. 1008, ¶15). A POSITA would understand that the transmission start time is determined by the receipt of the headend message or after the receipt of the headend message, according to the

specific conditions for the ONU. (Ex. 1002, ¶98). Therefore, a POSITA would find this element obvious.

- (7) [18f] converting a portion of the stored received data to a second optical signal; and

*Unitt '026's* ONU stores customer data in a queue and transmits the upstream data in a converted wavelength,  $\lambda_1$ , to the headend. (Ex. 1004, ¶¶55-56). The upstream wavelength,  $\lambda_1$ , is separate from the downstream optical wavelength,  $\lambda_2$ . (*Id.*). A POSITA would find this element obvious. (Ex. 1002, ¶99).

- (8) [18g] transmitting the second optical signal from the optical interface block through the optical port responsive to the one or more start times for data transmissions to the head end of the passive optical network;

*Unitt '026's* ONU transmits the customer data in an upstream wavelength,  $\lambda_1$ , to the headend during the allocated time slot for the ONU. (Ex. 1004, ¶¶55-56). A POSITA would find this element obvious. (Ex. 1002, ¶100).

- (9) [18h] whereby the network client optical transceiver module optically communicates with the head end of the passive optical network responsive to start times for data transmissions and the network client optical transceiver module electrically communicates with the switch or router.

*Unitt '026's* ONU is coupled to a customer premise router or switch through the customer interface port 116, and transmits customer data received and stored in

a queue to the head end. (Ex. 1004, ¶¶81, 70, 55-56). A POSITA would find this element obvious. (Ex. 1002, ¶101).

*c. Dependent Claims 2-4, 7-12, 14-17, 19-21, 24-26, and 28-31*

- (1) Claim 2 and 19: 2. The network client optical transceiver module of claim 1, wherein the pluggable form factor of the network client optical transceiver module is selected from the group consisting essentially of: Small Form-factor Pluggable (SFP); 10 Gigabit Small Form-factor Pluggable (XFP); XENPAK; X2; and XPAK.

*Aronson* describes an optical transceiver for use in a fiber optic network comprising a laser transmitter and a photodiode receiver that is configured for the small form-factor pluggable (SFP) standard. (Ex. 1005, ¶28). *Unitt '026* describes an ONU that is advantageous to “minimize the size and complexity of the ONU”, “to allow easy access by service technicians”. (Ex. 1004, ¶54). A POSITA would find this element obvious. (Ex. 1002, ¶¶105-16).

Claim 19 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

- (2) Claims 3 and 20: 3. The network client optical transceiver module of claim 1, wherein the control module is configured to receive from the head end of the passive optical network data communications representing one or more end times for transmitting data communications to the head end of the passive optical network and the control module is configured to end transmissions to the head end of the passive optical network response to the end times.

*Unitt '026* describes a communication system for transmitting customer premise data from an ONU to the headend. (Ex. 1004, ¶56). The headend allocates a time slot to each ONU in the system to transmit premise data to the headend. (*Id.*). *Unitt '026* incorporates by reference *Unitt '932* to further describe the transmission by the ONU to the headend. (*Id.*). *Unitt '932* further describes the time slot, received in the pause/control frame message sent by the headend, that indicates the start of the predetermined transmission interval. (Ex. 1008, ¶56). Prior to the expiration of the transmission interval, the ONU stops the data transmission and switches off the transmitting laser. (*Id.*). A POSITA would find this element obvious. (Ex. 1002, ¶109).

Claim 20 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

- (3) Claims 4 and 21: 4. The network client optical transceiver module of claim 1, wherein the control module is configured to receive from the head end of the passive optical network data communications representing one or more lengths of times respectively to the start times for transmitting data communications to the head end of the passive optical network and the control module is configured to transmit to the head end of the passive optical network response to the lengths of times.

*Unitt '026* describes an ONU configured to transmit data from the customer premise to the head end. (Ex. 1004, ¶56). *Unitt '026* incorporates by reference *Unitt '932* to further describe this communication. (*Id.*). *Unitt '932* describes an ONU that receives a control frame from a headend that includes a predetermined transmission interval for the ONU. (Ex. 1008, ¶¶56-57). The control frame message indicates the beginning of the transmission interval for the ONU. (*Id.*). Therefore, claim 4 would have been obvious to a POSITA in view of *Unitt '026* and *Aronson*. (Ex. 1002, ¶112).

Claim 21 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

- (4) Claims 6 and 23: 6. The network client optical transceiver module of claim 1, wherein the optical 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, ¶116). 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 6. Therefore, claim 6 would have been obvious to a POSITA in view of *Unitt '026* and *Aronson*. (Ex. 1002, ¶¶116-118).

Claim 23 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

- (5) Claims 7 and 24: 7. The network client optical transceiver module of claim 1, wherein the electrical network interface port includes an interface selected from the group consisting essentially of: a serial interface; a parallel interface; and a XAUI interface.

*Unitt '026* discloses an ONU that employs IEEE 100BaseT standard for the customer facing interface port. (Ex. 1004, ¶76). IEEE 100BaseT is a well known parallel interface standard and a POSITA would know that this teaches an electrical



network interface port, of the optical transceiver, that comprises a parallel interface. (Ex. 1014; Ex. 1002, ¶122).

Additionally, *Aronson* describes an optoelectronic transceiver comprising a serial interface consisting of a clock input and a data input. The serial interface couples the host device to the optoelectronic transceiver. (Ex. 1005, ¶¶14, 28). Therefore, claim 7 would have been obvious to a POSITA in view of *Unitt '026* and *Aronson*. (Ex. 1002, ¶¶122-123).

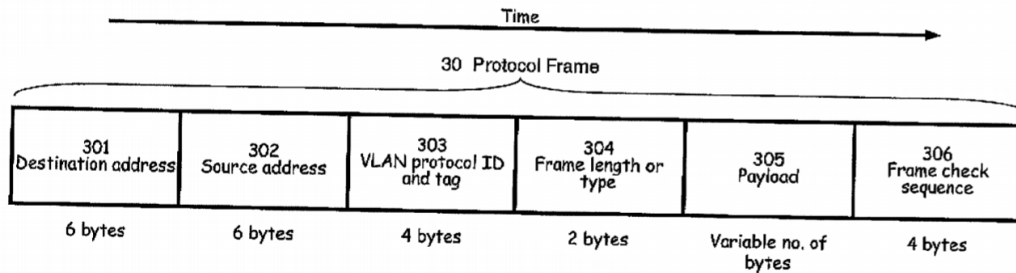
Claim 24 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(6) Claim 8. The network client optical transceiver module of claim 1, wherein the network client optical transceiver module includes a framing block electrically coupled to the bi-directional optical interface block and the control module is electrically coupled to the framing block and wherein the framing block is configured for framing data communications for transmission in accordance with a framing protocol for the passive optical network.

*Unitt '026* illustrates a protocol frame 30, in FIG. 3, that is received by the ONU in a downstream frame, before the ONU forwards the frame to the customer port. The VLAN tag filter 1117 of the ONU deletes the VLAN tag before forwarding to the customer premise network. (Ex. 1004, ¶61). A POSITA would understand the protocol frame 30 may be sent and received by the ONU in a bi-direction

communication. (Ex. 1002, ¶¶126-127). Therefore, claim 8 would have been obvious to a POSITA in view of *Unitt '026*. (*Id.*).

Fig. 3



(7) Claims 9 and 25: 9. The network client optical transceiver module of claim 1, wherein the control module is configured to receive from the head end of the passive optical network an assigned network identification address and wherein the assigned network identification address can be used for receiving data addressed to the network client optical transceiver module.

*Unitt '026* discloses the headend sending a VLAN notification message to the ONU, where the VLAN notification message includes a unique VLAN tag and the ONU MAC address as the destination address in the address frame. (Ex. 1004, ¶67). The ONU stores the VLAN tag for future upstream transmissions to the headend. (Ex. 1004, ¶69). The VLAN tag is used by the headend to uniquely identify the communication by the ONU. (Ex. 1004, ¶¶67, 69). Therefore, claim 9 would have been obvious to a POSITA in view of *Unitt '026*. (Ex. 1002, ¶¶129-130).

Claim 25 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(8) Claim 10. The network client optical transceiver module of claim 1, wherein the control module is configured to respond to the head end of the passive optical network responsive to a network operating protocol for new network clients.

*Unitt '026* describes a communication system that is configured to be a plug-and-play system for new ONUs. (Ex. 1004, ¶63). A new ONU can automatically associate the VLAN tag as their identifier and does not need to be pre-configured with the VLAN tag. (*Id.*). The headend discovers the MAC address of the new ONU and assigns a unique VLAN tag to the new ONU in a VLAN notification message. (*Id.*, ¶¶65-67). The new ONU stores the VLAN tag in order to respond to the headend in a normal polling loop. (*Id.*). Therefore, claim 10 would have been obvious to a POSITA in view of *Unitt '026*. (Ex. 1002, ¶¶132-133).

(9) Claims 11 and 26: 11. The network client optical transceiver module of claim 1, wherein the control module is configured to respond to a response delay message from the head end of the passive optical network, wherein the response delay message is used to determine the delay in responses from the network client optical transceiver module.

*Unitt '026* describes a headend that transmits a control frame message for allocating a time slot to an ONUs. (Ex. 1004, ¶56). *Unitt '026* incorporates by reference *Unitt '932* to further describe this communication. (*Id.*). *Unitt '932*

discloses a guard time value included in the time slot interval that accounts for propagation delays and avoids transmission collisions among ONUs. (Ex. 1008, ¶¶5, 49, 56-57). *Unitt '932* further describes that the guard time is determined based on the distance between the ONU and the headend, and the round trip signal time. (*Id.*). Therefore, claim 11 would have been obvious to a POSITA in view of *Unitt '026* and *Unitt '932*. (Ex. 1002, ¶¶136-137).

Claim 26 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(10) Claim 12. The network client optical transceiver module of claim 1, wherein the control module is configured to align data communication transmissions with the network period of the optical network to account for transmission delays responsive to a response delay process.

*Unitt '026* describes a headend that transmits a control frame message for allocating a time slot to an ONUs. (Ex. 1004, ¶56). *Unitt '026* incorporates by reference *Unitt '932* to further describe this communication. (*Id.*). *Unitt '932* discloses an ONU/outstation that transmits data frames stored in a queue before they are transmitted to the headend during an allocated time slot. (Ex. 1008, ¶¶57). The ONU only transmits the amount of data frames during the allocated time slot that can be transmitted before the allocated interval expires and the next command frame is sent to another ONU. (*Id.*). Therefore, claim 12 would have been obvious to a POSITA. (Ex. 1002, ¶¶139-140).

(11) Claims 14 and 28: 14. The network client optical transceiver module of claim 1, wherein the control module is configured to encapsulate at least a portion of the data received through the electrical network interface port into a payload section of a framing protocol for the passive optical network.

*Unitt '026*'s ONU receives customer data from the link 116 and transmits the data frames via the upstream facing interface 122. (Ex. 1004, ¶69). *Unitt '026* incorporates by reference *Unitt '932* to further describe this communication. (Ex. 1004, ¶56). *Unitt '932* describes a “join” control frame sent by the ONU to the headend containing payload. (Ex. 1008, ¶63). Therefore, claim 14 would have been obvious to a POSITA. (Ex. 1002, ¶143).

Claim 28 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(12) Claims 15 and 29: 15. The network client optical transceiver module of claim 1, wherein the network client optical transceiver module includes one or more of the following: a laser; a laser driver; a photodiode; a transimpedance amplifier; and a limiting amplifier.

*Unitt '026* describes an ONU for transmitting data from an ONU at a customer premise to the head end. (Ex. 1004, ¶56). *Unitt '026* incorporates by reference *Unitt '932* to further describe the system. (*Id.*). *Unitt '932* describes an ONU comprising an optical transmitter that typically consists of a laser (Ex. 1008, ¶¶47, 39). Therefore, claim 15 would have been obvious to a POSITA. (Ex. 1002, ¶¶146-147).

Claim 29 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(13) Claims 16 and 30: 16. The network client optical transceiver module of claim 1, wherein the network client optical transceiver module is an optical network terminal (ONT) and includes a discrete chip selected from the group consisting essentially of: a media access controller (MAC) discrete chip; and a transmission convergence layer (TC-Layer) discrete chip.

*Unitt '026* describes an ONU at the customer premise that comprises a PON MAC 1114 and local network MAC 1118 on an application specific integrated circuit (ASIC). (Ex. 1004, ¶¶53, 69, 84). Therefore, claim 16 would have been obvious to a POSITA. (Ex. 1002, ¶150).

Claim 30 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(14) Claims 17 and 31: 17. The network client optical transceiver module of claim 1, wherein the network client optical transceiver module includes 8/10 bit encoding for communications sent and 8/10 bit decoding for communications received through the electrical network interface port.

*Unitt '932* describes an upstream transmission that employs the use of GbE MAC to generate the upstream transmission. (Ex. 1008, ¶21). The Gigabit Ethernet (GbE) standard specifies a physical coding sublayer that includes 8/10 bit encoding and thus, a POSITA would find claim 17 obvious. (Ex. 1002, ¶153).

Claim 31 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

**D. Ground 2: Challenged Claims 1-12, 14-26, and 28-31 are Unpatentable Under 35 U.S.C § 103(a) as Obvious over *Unitt '026*, and *Tan***

As supported by Dr. Goossen, independent claims 1 and 18, and dependent claims 2-12, 14-17, 19-26, and 28-31 are obvious in view of *Unitt '026* and *Tan*. (Ex. 1002, ¶¶155-260).

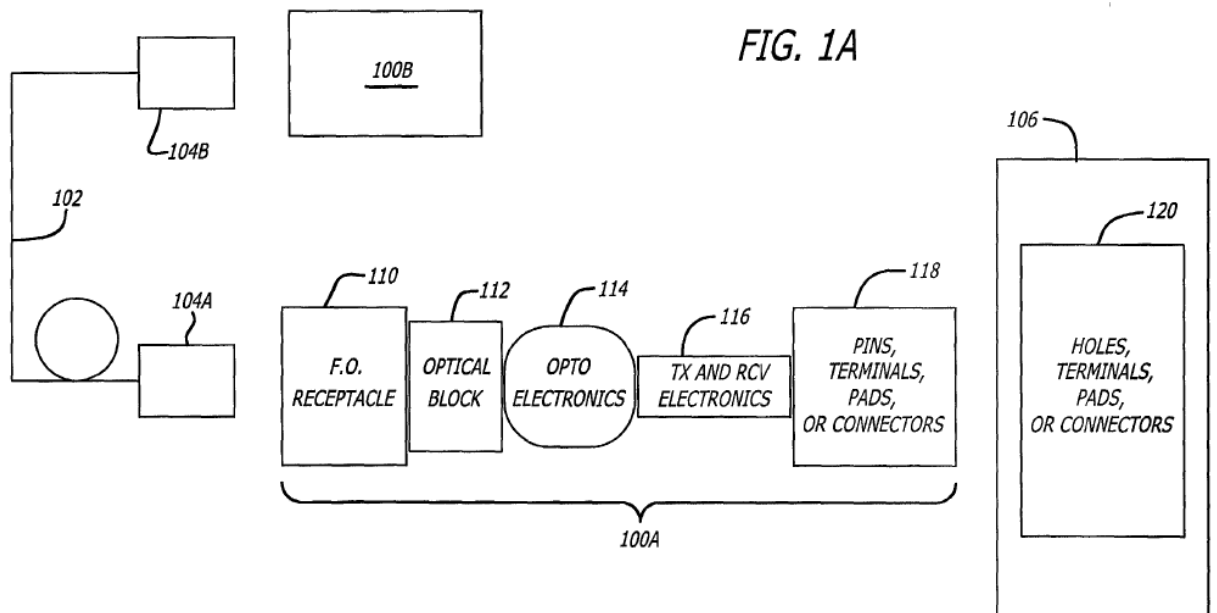
**1. Basis for the Combination of *Unitt '026* and *Tan***

The scope and content of the prior art include *Unitt '026* and *Tan*. *Unitt '026*'s ONU include practically all of the elements of claim 1-12, 14-26, and 28-31 although *Unitt '026* does not explicitly state that *Unitt '026*'s ONU is “pluggable.” (Ex. 1002, ¶157). *Unitt '026*, 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, ¶157). In the same field, *Tan* discloses bi-directional optical transceiver that is “hot pluggable.” (Ex. 1013, ¶¶19, 73; Ex. 1002, ¶158). Given the skill level of a POSITA, a POSITA would have been motivated to use *Tan*'s “hot pluggable” transceiver modules with *Unitt '026*'s ONU.

First, *Unitt '026*'s ONUs are at the client side of the PON. (Ex. 1004, ¶55; Ex. 1002, ¶160). *Unitt '026* 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.*).

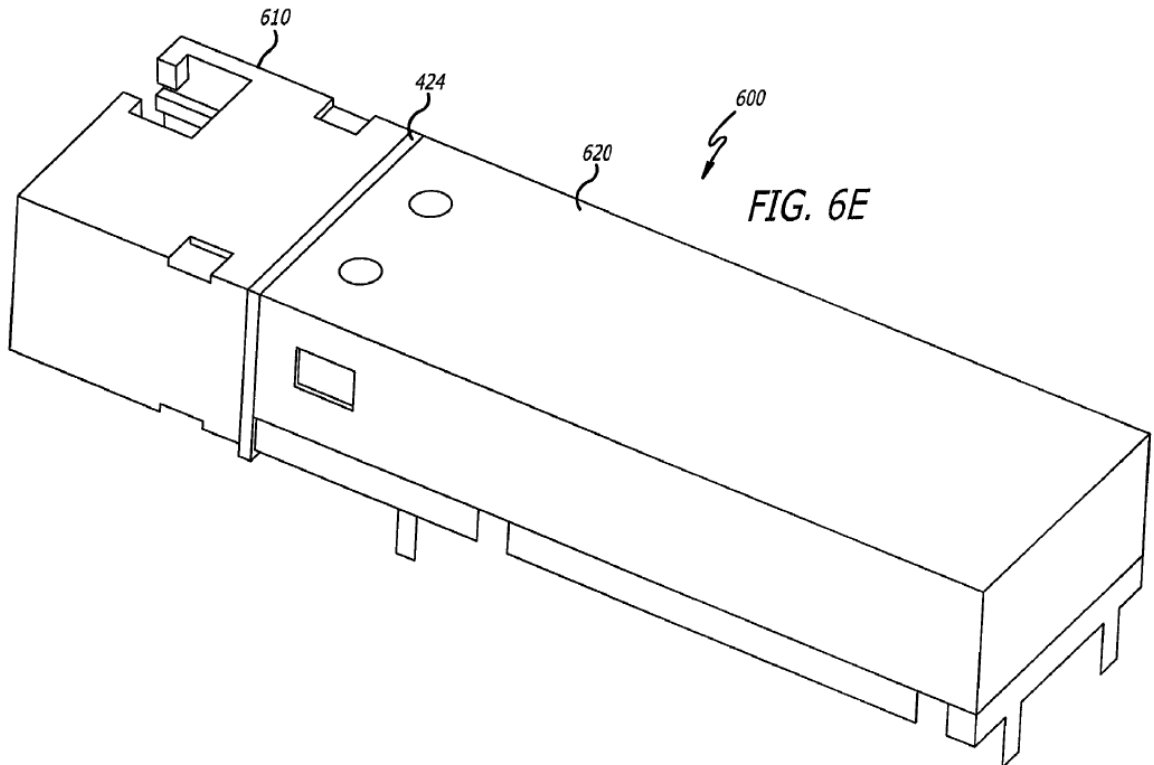
Second, *Tan* discloses an optical transceiver that is “hot pluggable” into other components and systems. (Ex. 1013, ¶73). *Tan* also discloses that the optical transceiver is bi-directional because it receives and transmits data from and to a host system and another optical transceiver, as shown in *Tan*’s Figure 1A (reproduced below). (Ex. 1013, ¶¶4, 20; Ex 1002, ¶161).



*Tan*’s optical transceiver can also include a printed circuit board that includes transceiver and transmitting electronics. (Ex. 1013, ¶71, Fig. 6D). Thus, like *Unitt* ’026’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. (Ex. 1013, ¶72). Also, while *Tan* does not expressly use the words “small form pluggable optical transceiver” to describe its optical transceiver, that is exactly what *Tan* shows in Figure 6E (shown below). (Ex. 1002, ¶162; Ex. 1001, FIG. 13).



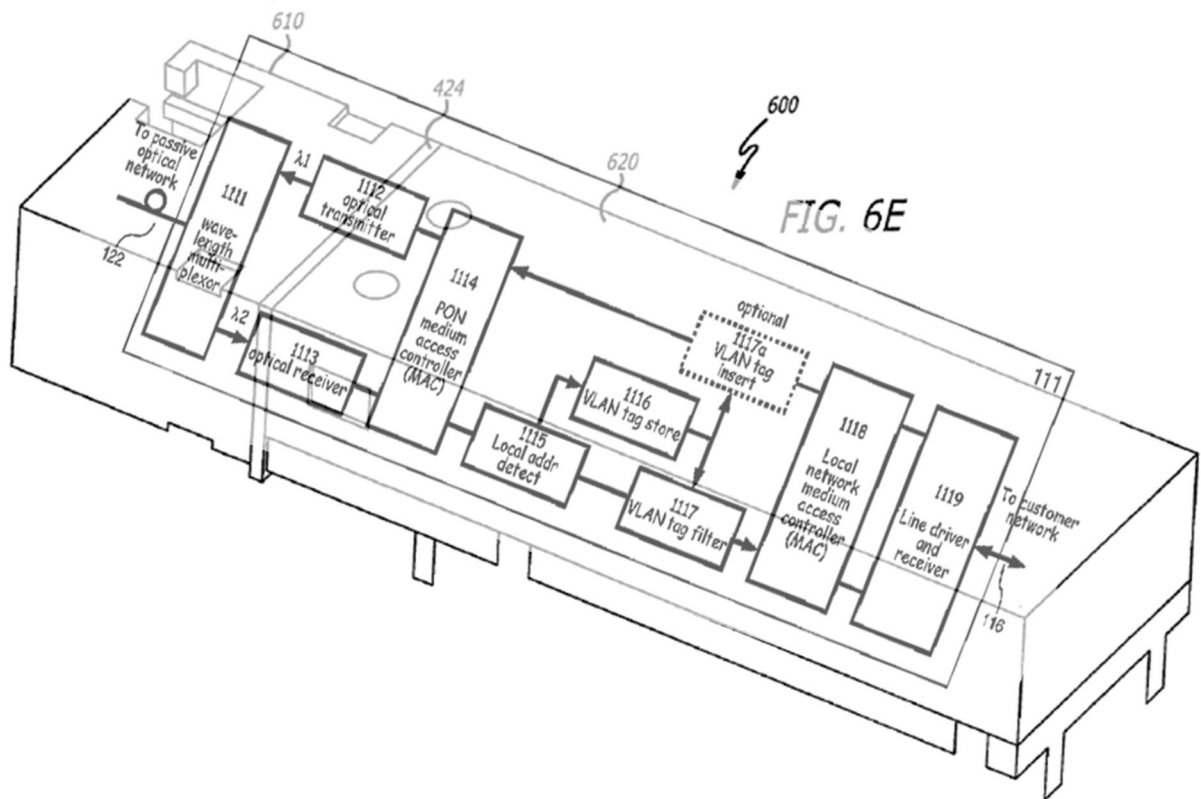
Third, *Unitt '026* describes that ONU should be “externally mountable” and that the size and complexity of the ONU should be “minimised.” (Ex. 1004, ¶54). *Unitt '026* also describes that ONU lends itself “to integration into a single application specific integrated circuit (ASIC)” that “contain[s] 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.*, ¶84).

Thus, *Unitt '026* guides and motivates a POSITA to seek miniaturization of the ONU, including integration of the ONU functions onto integrated circuits. (Ex. 1002, ¶163).

Fourth, *Unitt '026* states 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, ¶63). Thus, *Unitt '026* 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 POSITA, 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, ¶164; Ex. 1001, FIG. 13).

Finally, *Tan* states that its transceiver may have application as an ONU on customer premises. (Ex. 1013, ¶¶23, 31; Ex. 1002, ¶166).

By combining the ONU shown in *Unitt '026*'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 '026*'s ONU, as shown in the diagram below. (Ex. 1002, ¶166).



A POSITA would have expected that using a small form factor pluggable module, as taught by *Tan*, with *Unitt '026's* ONU, would result in a small, pluggable optical transceiver module for a PON that uses Ethernet communications. (Ex. 1002, ¶¶167-168). A POSITA would also realize that using a small form factor pluggable module, as taught by *Tan*, would improve *Unitt '026's* ONU by making it small and pluggable, especially in view of *Unitt '026'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 '026's* ONU in accordance with the guidance given by *Unitt '026*. (Ex. 1002, ¶168).

**2. Challenged Claims 1-12, 14-26, and 28-31 would have been Obvious**

*a. Independent Claim 1*

(1) [1Pre]

As described above for claim element [1pre] for Ground 1, *Unitt '026* discloses an ONU for a PON that satisfies all of the limitations of this claim element except that *Unitt '026*'s ONU is not explicitly “pluggable.” (Ex. 1004, ¶¶62, 69; Ex. 1002, ¶174).

*Tan* teaches and discloses an optical transceiver that is “hot pluggable.” (Ex. 1013, ¶73; Ex. 1002, ¶¶174-175). It would have been obvious for a POSITA to use the hot pluggable optical transceiver configuration, as taught by *Tan*, with *Unitt '026*'s ONU, thereby making *Unitt '026*'s ONU “pluggable.” (Ex. 1002, ¶176; ; Ex. 1001, FIG. 13).

The combination of *Unitt '026* and *Tan* also teach the other limitations of this claim element.

First, *Unitt '026*'s ONU is connected to external devices, such as a router. (Ex. 1004, ¶53). That teaches a POSITA that *Unitt '026*'s ONU is configured to be coupled to an optical module port of a router. (Ex. 1002, ¶175).

Second, *Tan* teaches plugging in an optical transceiver, such as *Unitt '026*'s ONU, to an external device (e.g., “host system”). (Ex. 1013, ¶73). By being “pluggable,” the transceiver can be removably coupled to the other device. Thus,

*Unitt '026's* ONU, modified in view of *Tan*, and would be pluggable coupled to another device, such as the router/bridge, shown in *Unitt '026's* Figure 1. (Ex. 1002, ¶176).

Third, *Unitt '026* teaches that the ONU is adapted to communicate with the router using an Ethernet protocol. (Ex. 1004, ¶53; Ex. 1002, ¶¶173-176).

(2) [1a]

For at least the reasons set forth in section VII.C.2.a.(2), a POSITA would find this element obvious. (Ex. 1002, ¶¶177-178).

(3) [1b]

For at least the reasons set forth in section VII.C.2.a.(3), a POSITA would find this element obvious. (Ex. 1002, ¶179).

(4) [1c]

For at least the reasons set forth in section VII.C.2.a.(4), a POSITA would find this element obvious. (Ex. 1002, ¶¶180-182).

(5) [1d]

For at least the reasons set forth in section VII.C.2.a.(5), a POSITA would find this element obvious. (Ex. 1002, ¶¶183-184).

(6) [1e]

For at least the reasons set forth in section VII.C.2.a.(6), a POSITA would find this element obvious. (Ex. 1002, ¶185).

(7) [1f]

*Unitt '026's* ONU is an optical transceiver that is adapted to process and perform PON data link layer communications and functions. (Ex. 1004, ¶69). Because a POSITA would have been motivated to embody *Unitt '026's* ONU with the “hot pluggable” transceiver of *Tan*, 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 '026* and *Tan*. (Ex. 1002, ¶¶186-188).

*Unitt '026* also teaches using an Ethernet protocol for communications. (Ex. 1004, ¶53). *Unitt '026* 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); ¶¶53, 81). Thus, this element would have been obvious to a POSITA. (Ex. 1002, ¶¶186-188).

*b. Independent Claim 18*

Claims 1 and 18 disclose substantially the same subject matter. The only difference between claim 1 and claim 18 is that claim 1 recites an apparatus for an optical transceiver and claim 18 recites a method for performing the same functionality that is disclosed by claim 1 for the optical transceiver. (Ex. 1002, ¶87). Thus, the same ground is applicable for independent claims 1 and 18.

(1) [18Pre]

The preamble of claim 18 discloses the structural components of the optical transceiver recited in claim 1. For at least the reasons set forth in section VII.D.2.a.(1)-(7), a POSITA would find this element obvious. (Ex. 1002, ¶¶190-191).

(2) [18a]

For at least the reasons set forth in section VII.C.2.b.(2), a POSITA would find this element obvious. (Ex. 1002, ¶¶199-200).

(3) [18b]

For at least the reasons set forth in section VII.C.2.b.(3), a POSITA would find this element obvious. (Ex. 1002, ¶201).

(4) [18c]

For at least the reasons set forth in section VII.C.2.b.(4), a POSITA would find this element obvious. (Ex. 1002, ¶202).

(5) [18d]

For at least the reasons set forth in section VII.C.2.b.(5), a POSITA would find this element obvious. (Ex. 1002, ¶203).

(6) [18e]

For at least the reasons set forth in section VII.C.2.b.(6), a POSITA would find this element obvious. (Ex. 1002, ¶204).

(7) [18f]

For at least the reasons set forth in section VII.C.2.b.(7), a POSITA would find this element obvious. (Ex. 1002, ¶205).

(8) [18g]

For at least the reasons set forth in section VII.C.2.b.(8), a POSITA would find this element obvious. (Ex. 1002, ¶206).

(9) [18g]

For at least the reasons set forth in section VII.C.2.b.(9), a POSITA would find this element obvious. (Ex. 1002, ¶207).

*c. Dependent Claims 2-12, 14-17, 19-26, and 28-31*

(1) Claims 2 and 19

*Tan* discloses a small form factor pluggable (SFP) transceiver module to a POSITA. (Ex. 1013, ¶73), FIG. 6E). Therefore, the elements of claim 2 would have been obvious to a POSITA. (Ex. 1002, ¶¶211-212). Claim 19 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(2) Claims 3 and 20

*Unitt '026* and *Unitt '932* disclose an allocated transmission interval for the ONU to transmit to the headend, where the start point and end point are dictated by a control frame. (Ex. 1004, ¶56; Ex. 1008, ¶56). Additionally, for at least the reasons



set forth in section VII.C.2.c.(2), a POSITA would find the elements of claim 3 obvious. (Ex. 1002, ¶215). Claim 20 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(3) Claims 4 and 21

*Unitt '026* and *Unitt '932* disclose a control frame message received from the headend, that indicates the allocated time slot transmission interval for the ONU to transmit to the headend. (Ex. 1004, ¶56; Ex. 1008, ¶56). A POSITA would find the elements of claim 4 obvious. (Ex. 1002, ¶218). Claim 21 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(4) Claim 5. The network client optical transceiver module of claim 1, wherein the optical port is adapted to optically couple to one or more optical fibers selected from the group consisting of: multimode optical fibers; and single mode optical fibers.

*Tan* discloses a single mode optical transceiver coupled to one single mode optical fiber. (Ex. 1013, ¶23). Therefore, a POSITA would find the elements of claim 5 obvious. (Ex. 1002, ¶¶221-222). Claim 22 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

- (5) Claim 6. The network client optical transceiver module of claim 1, wherein the optical 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).

*Tan* discloses a nose assembly of the optical transceiver, where the “nose assembly is for receiving a fiber optic connector, such as an LC, SC or MU standard fiber optic connector.” (Ex. 1013, ¶69, FIG. 6B). Therefore, a POSITA would find the elements of claim 6 obvious. (Ex. 1002, ¶¶225-226). Claim 23 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(6) Claims 7 and 24

*Unitt '026's* transceiver employs IEEE 100BaseT standard for the customer facing interface port. (Ex. 1004, ¶76). IEEE 100BaseT is a well known parallel interface standard. (Ex. 1014; Ex. 1002, ¶230). Thus, a POSITA would find the elements of claim 7 obvious. (Ex. 1002, ¶¶229-231). Claim 24 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (Ex. 1002, ¶228).

(7) Claim 8

For at least the reasons set forth in section VII.C.2.c.(6), a POSITA would find the elements of claim 8 obvious in view of *Unitt '026*. (Ex. 1002, ¶¶233-234).

(8) Claims 9 and 25

For at least the reasons set forth in section VII.C.2.c.(7), a POSITA would find the elements of claim 9 obvious in view of *Unitt '026*. (Ex. 1002, ¶¶236-237). Claim 25 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(9) Claim 10

For at least the reasons set forth in section VII.C.2.c.(8), a POSITA would find the elements of claim 10 obvious in view of *Unitt '026*. (Ex. 1002, ¶¶239-240).

(10) Claims 11 and 26

For at least the reasons set forth in section VII.C.2.c.(9), a POSITA would find the elements of claim 11 obvious in view of *Unitt '026*. (Ex. 1002, ¶¶243-244). Claim 26 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(11) Claim 12

For at least the reasons set forth in section VII.C.2.c.(10), a POSITA would find the elements of claim 12 obvious in view of *Unitt '026*. (Ex. 1002, ¶¶246-247).

(12) Claims 14 and 28

For at least the reasons set forth in section VII.C.2.c.(11), a POSITA would find the elements of claim 14 obvious. (Ex. 1002, ¶250). Claim 28 recites

substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(13) Claim 15 and 29

*Tan* discloses an optical receiver of the optoelectronic transceiver comprising a photodiode and the optical transmitter comprising a laser. (Ex. 1013, ¶39). A POSITA would find the elements of claim 15 obvious. (Ex. 1002, ¶¶253-254). Claim 29 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(14) Claims 16 and 30

For at least the reasons set forth in section VII.C.2.c.(13), a POSITA would find the elements of claim 16 obvious. (Ex. 1002, ¶257). Claim 30 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

(15) Claims 17 and 31

For at least the reasons set forth in section VII.C.2.c.(14), a POSITA would find the elements of claim 17 obvious. (Ex. 1002, ¶260). Claim 31 recites substantially the same subject matter and is therefore obvious for the same reasons described above. (*Id.*).

**E. Grounds 3: Challenged Claims 6 and 23 are Unpatentable Under 35 U.S.C § 103(a) as Obvious over *Unitt '026*, *Aronson*, and *Block* (Ground 3)**

Claim 6 recites: The network client optical transceiver module of claim 1, wherein the optical 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). (Ex. 1001, Claim 6). Claim 23 recites: The method of claim 18, wherein the optical port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of: SC; LC; FC; ST; and MU. (Ex. 1001, Claim 23).

Claims 6 and 23 would have been obvious over *Unitt '026*, *Aronson* and *Block*. Claims 1 and 18, from which claims 6 and 23 depend respectively, would have been obvious to a POSITA in view of the *Unitt-Aronson* combination described above for Ground 1. Claims 6 and 23 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. 1012, 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*. It 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, ¶¶263-269).

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).

Claims 6 and 23 would have been obvious to a POSITA in view of *Unitt*, *Aronson* and *Block*.

**F. Grounds 4 and 5: Challenged Claims 13 and 27 are Unpatentable Under 35 U.S.C § 103(a) as Obvious over *Unitt '026*, *Aronson*, and *Xu* (Ground 5); and *Unitt '026*, *Tan* and *Xu* (Ground 6)**

Claim 13 recites: The network client optical transceiver module of claim 1, wherein the control module is configured to adjust the transmitting optical power level responsive to a message received from the head end of the passive optical network. (Ex. 1001, Claim 13). Claim 27 recites: The method of claim 18, further comprising the step of: (e1) processing the electrical signal at the control module to determine an optical power level and adjusting the transmit optical power level of the network client optical transceiver module to the determined optical power level. (Ex. 1001, Claim 27).

**Ground 4:** Claims 13 and 27 would have been obvious over *Unitt '026*, *Aronson* and *Xu*. Claims 1 and 18, from which claims 13 and 27 depend respectively, would have been obvious to a POSITA in view of the *Unitt '026-Aronson*

combination described above for Ground 1. Claims 13 and 27 add that the transceiver receives a communication from the headend and adjust the power level of the transmitted optical signal based on the message. *Unitt '932*, incorporated by reference, discloses that the larger distance between the headend and the ONU results in a reduced optical power signal received at each respective end. (Ex. 1008, ¶4). *Unitt '932* further references the International Telecommunication Union (ITU) specification standard G.983.1 for “Broadband Optical Access Systems Based on Passive Optical Network” as a predecessor to G.984 “Gigabit-Capable Passive Optical Networks (GPON): Physical Media Dependent layer specification.” (Ex. 1008, ¶4; Ex. 1002, ¶273). The first iteration of ITU G.984 was developed in March of 2003, before the earliest filing date of the priority application of July 2003. Both ITU G.983 and G.984 discuss the relationship between transmission distance, signal attenuation, and a reduced signal power level at the receiving end. (Ex. 1016, pp.7; Ex. 1017, pp.27). ITU G.984 expressly provides for power level requirements in the protocol standard. (Ex. 1016, pp.7).

*Xu* further discloses “a special OLT-ONU signaling protocol can be developed that allows the ONUs to adjust their respective transmitter power based on OLT feedback such that power levels received by the OLT from all the ONUs are the same.” (Ex. 1006, 4:14-30). *Xu* also describes the maximum range between

the ONUs and the OLT based on the ITU G.983.1 specification standard. (Ex. 1006, 11:58-12:8).

Therefore, it would have been obvious to a POSITA that the *Unitt '026* transceiver (modified in light of *Aronson* to be pluggable) may adjust the optical power of the transmitted optical signal in view of *Xu*. The ITU GPON specification standard G.984 articulates this relationship between an OLT and ONU. The first iteration of ITU GPON specification standard G.984 was approved March 16, 2003, before the earliest filing date of the priority application of July 2003. Therefore, it would have been obvious to a POSITA to at least adjust the optical signal power level based on a headend message, as disclosed in *Xu*, for the *Unitt '026-Aronson* pluggable optical transceiver. (Ex. 1002, ¶¶273-274). Therefore, claims 13 and 27 would have been obvious to a POSITA in view of *Unitt '026*, *Aronson* and *Xu*.

**Ground 5:** Claims 13 and 27 would have been obvious over *Unitt '026*, *Tan* and *Xu*. Claims 1 and 18, from which claims 13 and 27 depend respectively, would have been obvious to a POSITA in view of the *Unitt '026-Tan* combination described above for Ground 2. For at least the reasons described above, it would have been obvious to a POSITA to at least adjust the optical signal power level based on a headend message, as disclosed in *Xu*, for the *Unitt '026-Tan* pluggable optical transceiver. (Ex. 1002, ¶¶273-275). Therefore, claims 13 and 27 would have been obvious to a POSITA in view of *Unitt '026*, *Tan* and *Xu*.



**G. Grounds 6 and 7: Challenged Claims 17 and 31 are Unpatentable Under 35 U.S.C § 103(a) as Obvious over Unitt '026, Aronson, and Dudziak (Ground 6); Unitt '026, Tan, and Dudziak (Ground 7);**

Claim 17 recites: The network client optical transceiver module of claim 1, wherein the network client optical transceiver module includes 8/10 bit encoding for communications sent and 8/10 bit decoding for communications received through the electrical network interface port. (Ex. 1001, Claim 17). Claim 31 recites: The method of claim 18, further comprising the steps of: (b1) performing 8/10 bit decoding on the received data; and (h) performing 8/10 bit encoding on data sent through the electrical network interface port. (Ex. 1001, Claim 31).

**Ground 6:** Claims 17 and 31 would have been obvious over *Unitt '026*, *Aronson* and *Dudziak*. Claims 1 and 18, from which claims 17 and 31 depend respectively, would have been obvious to a POSITA in view of the *Unitt '026-Aronson* combination described above for Ground 1. Claims 17 and 31 add to the transceiver, the explicit functionality of encoding an outgoing transmission with 8Bit/10Bit line encoding. *Unitt '932*, as incorporated by reference by *Unitt '026*, describes an upstream transmission that employs the use of GbE MAC to generate the upstream transmission. (Ex. 1008, ¶21). The Gigabit Ethernet (GbE) standards specify a physical coding sublayer that includes 8/10 bit encoding.

*Dudziak* expressly discloses a Gigabit Ethernet (GbE) transceiver as part of PON, and employs a GbE protocol that uses 8 Bit/10 Bit line encoding. (Ex. 1007,

¶¶23, 28). Thus, it would have been obvious to a POSITA that the *Unitt* '932 transceiver (modified in light of *Aronson* to be pluggable) employs 8B/10B line encoding in an upstream transmission, as disclosed in *Dudziak*, for the *Unitt* '026-*Aronson* pluggable optical transceiver. (Ex. 1002, ¶¶279-281). Therefore, claims 17 and 31 would have been obvious to a POSITA in view of *Unitt* '026, *Aronson* and *Dudziak*.

**Ground 7:** Claims 17 and 31 would have been obvious over *Unitt* '026, *Tan* and *Dudziak*. Claims 1 and 18, from which claims 17 and 31 depend respectively, would have been obvious to a POSITA in view of the *Unitt-Tan* combination described above for Ground 2. For at least the reasons described above, it would have been obvious to a POSITA to at least employ 8B/10B line encoding in an upstream transmission, as disclosed in *Dudziak*, for the *Unitt-Tan* pluggable optical transceiver. (Ex. 1002, ¶¶279-281). Therefore, claims 17 and 31 would have been obvious to a POSITA in view of *Unitt* '026, *Tan* and *Dudziak*.

## VIII. CONCLUSION

This Petition demonstrates a reasonable likelihood that at least one claim of the '754 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

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### Claim Appendix of the Challenged Claims

- [1pre] A network client optical transceiver module for a passive optical network, the passive optical network having one or more passive optical splitters for coupling the network client optical transceiver module over one or more optical fibers to the head end of the passive optical network and the network client optical transceiver module having a pluggable form factor and configured to removably couple to an optical module port of a switch or router, the network client optical transceiver module comprising:
- [1a] an optical port configured to optically couple to one or more optical fibers of the passive optical network having one or more passive optical splitters;
- [1b] a bi-directional optical interface block optically coupled to the optical port and configured to perform optical-to-electrical and electrical-to-optical signal conversion;
- [1c] a control module electrically coupled to the bi-directional optical interface block and configured to receive from the head end of the passive optical network data communications representing one or more start times for transmitting data communications to the head end of the passive optical network and configured to transmit the data communications to the head end of the passive optical network responsive to the start times; and
- [1d] an electrical network interface port electrically coupled to the control module and for electrically coupling into the optical module port of the switch or router and for communicating with the switch or router;
- [1e] whereby the network client optical transceiver module is configured to optically communicate with the head end of the passive optical network responsive to start times for transmitting data communications to the head end of the passive optical network and
- [1f] the network client optical transceiver module is configured to removably couple to the optical module port of the switch or router and electrically communicate with the switch or router.

- [2] The network client optical transceiver module of claim 1, wherein the pluggable form factor of the network client optical transceiver module is selected from the group consisting essentially of: Small Form-factor Pluggable (SFP); 10 Gigabit Small Form-factor Pluggable (XFP); XENPAK; X2; and XPAK.
- [3] The network client optical transceiver module of claim 1, wherein the control module is configured to receive from the head end of the passive optical network data communications representing one or more end times for transmitting data communications to the head end of the passive optical network and the control module is configured to end transmissions to the head end of the passive optical network response to the end times.
- [4] The network client optical transceiver module of claim 1, wherein the control module is configured to receive from the head end of the passive optical network data communications representing one or more lengths of times respectively to the start times for transmitting data communications to the head end of the passive optical network and the control module is configured to transmit to the head end of the passive optical network response to the lengths of times.
- [5] The network client optical transceiver module of claim 1, wherein the optical port is adapted to optically couple to one or more optical fibers selected from the group consisting of: multimode optical fibers; and single mode optical fibers
- [6] The network client optical transceiver module of claim 1, wherein the optical 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).

- [7] The network client optical transceiver module of claim 1, wherein the electrical network interface port includes an interface selected from the group consisting essentially of: a serial interface; a parallel interface; and a XAUI interface.
- [8] The network client optical transceiver module of claim 1, wherein the network client optical transceiver module includes a framing block electrically coupled to the bi-directional optical interface block and the control module is electrically coupled to the framing block and wherein the framing block is configured for framing data communications for transmission in accordance with a framing protocol for the passive optical network.
- [9] The network client optical transceiver module of claim 1, wherein the control module is configured to receive from the head end of the passive optical network an assigned network identification address and wherein the assigned network identification address can be used for receiving data addressed to the network client optical transceiver module.
- [10] The network client optical transceiver module of claim 1, wherein the control module is configured to respond to the head end of the passive optical network responsive to a network operating protocol for new network clients.
- [11] The network client optical transceiver module of claim 1, wherein the control module is configured to respond to a response delay message from the head end of the passive optical network, wherein the response delay message is used to determine the delay in responses from the network client optical transceiver module.

- [12] The network client optical transceiver module of claim 1, wherein the control module is configured to align data communication transmissions with the network period of the optical network to account for transmission delays responsive to a response delay process.
- [13] The network client optical transceiver module of claim 1, wherein the control module is configured to adjust the transmitting optical power level responsive to a message received from the head end of the passive optical network.
- [14] The network client optical transceiver module of claim 1, wherein the control module is configured to encapsulate at least a portion of the data received through the electrical network interface port into a payload section of a framing protocol for the passive optical network.
- [15] The network client optical transceiver module of claim 1, wherein the network client optical transceiver module includes one or more of the following: a laser; a laser driver; a photodiode; a transimpedance amplifier; and a limiting amplifier.
- [16] The network client optical transceiver module of claim 1, wherein the network client optical transceiver module is an optical network terminal (ONT) and includes a discrete chip selected from the group consisting essentially of: a media access controller (MAC) discrete chip; and a transmission convergence layer (TC-Layer) discrete chip.
- [17] The network client optical transceiver module of claim 1, wherein the network client optical transceiver module includes 8/10 bit encoding for communications sent and 8/10 bit decoding for communications received through the electrical network interface port.

- [18pre] A network client optical transceiver module for a passive optical network, the passive optical network having one or more passive optical splitters for coupling the network client optical transceiver module over one or more optical fibers to the head end of the passive optical network and the network client optical transceiver module having a pluggable form factor and adapted to removably couple to an optical module port of a switch or router, and the network client optical transceiver module having an optical port for coupling to one or more optical fibers of the passive optical network, and the network client optical transceiver module having an optical interface block optically coupled to the optical port and for converting electrical signals to optical signals and for converting optical signals to electrical signals, and the network client optical transceiver module having a control module electrically coupled to the optical interface block and for communicating with the head end of the passive optical network, and the network client optical transceiver module having an electrical network interface port electrically coupled to the control module and for electrically communicating to the switch or router, a method of communicating with the head end of a passive optical network from the network client optical transceiver module comprising the steps of:
- [18a] (a) receiving data from the switch or router through the electrical network interface port of the network client optical transceiver module;
- [18b] (b) storing the received data inside the network client optical transceiver module;
- [18c] (c) receiving a first optical signal from the head end of the passive optical network through the optical port at the optical interface block of the network client optical transceiver module;
- [18d] (d) converting the first optical signal to an electrical signal at the optical interface block and conveying the electrical signal to the control module of the network client optical transceiver module;
- [18e] (e) processing the electrical signal at the control module to determine one or more start times for data transmissions from the network client optical transceiver module to the head end of the passive optical network;



- [18f] (f) converting a portion of the stored received data to a second optical signal; and
- [18g] (g) transmitting the second optical signal from the optical interface block through the optical port responsive to the one or more start times for data transmissions to the head end of the passive optical network;
- [18h] whereby the network client optical transceiver module optically communicates with the head end of the passive optical network responsive to start times for data transmissions and the network client optical transceiver module electrically communicates with the switch or router.
- [19] The method of claim 18, wherein the pluggable form factor of the optical transceiver module is selected from the group consisting essentially of: SFP; XFP; XENPAK; X2; and XPAK.
- [20] The method of claim 18, further comprising the steps of: (e1) processing the electrical signal at the control module to determine one or more end times for data transmissions from the network client optical transceiver module to the head end of the passive optical network; and (g1) terminating the transmission of the second optical signal responsive to an end time for data transmissions to the head end of the passive optical network.
- [21] The method of claim 18, further comprising the steps of: (e1) processing the electrical signal at the control module to determine one or more lengths of times respective to the start times for data transmissions from the network client optical transceiver module to the head end of the passive optical network; and (g1) transmitting the second optical signal responsive to a length of time for data transmissions to the head end of the passive optical network.
- [22] The method of claim 18, wherein the optical port is adapted to optically couple to one or more optical fibers selected from the group consisting of: multimode optical fibers; and single mode optical fibers.

- [23] The method of claim 18, wherein the optical port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of: SC; LC; FC; ST; and MU.
- [24] The method of claim 18, wherein the electrical network interface port includes an interface selected from the group consisting essentially of: a serial interface; a parallel interface; and a XAUI interface.
- [25] The method of claim 18, further comprising the step of:  
(e1) processing the electrical signal at the control module to determine an assigned network identification address from the head end of the passive optical network for addressing data to the network client optical transceiver module at the control module.
- [26] The method of claim 18, further comprising the step of: (g1) adjusting the transmission of the second optical signal from the optical interface block through the optical port to account for the response delay of the optical transceiver module.
- [27] The method of claim 18, further comprising the step of: (e1) processing the electrical signal at the control module to determine an optical power level and adjusting the transmit optical power level of the network client optical transceiver module to the determined optical power level.
- [28] The method of claim 18, further comprising the step of: (e1) processing the electrical signal at the control module to determine an optical power level and adjusting the transmit optical power level of the network client optical transceiver module to the determined optical power level.
- [29] The method of claim 18, wherein the network client optical transceiver module includes one or more of the following: a laser; a laser driver; a photodiode; a transimpedance amplifier; and a limiting amplifier.

- [30] The method of claim 18, wherein the network client optical transceiver module is ONT and includes a discrete chip selected from the group consisting essentially of: a MAC discrete chip; and a TC-Layer discrete chip.
- [31] The method of claim 18, further comprising the steps of: (b1) performing 8/10 bit decoding on the received data; and (h) performing 8/10 bit encoding on data sent through the electrical network interface port.

**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:

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**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 **11,359** 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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