

**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION**

OPTIC153 LLC,

Plaintiff,

v.

COMCAST CORPORATION AND
COMCAST CABLE COMMUNICATIONS,
LLC.

Defendants.

Civil Action No. 6:20-cv-483

JURY TRIAL DEMANDED

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Optic153 LLC (“Plaintiff” or “Optic153”) hereby allege as follows against Comcast Corporation and Comcast Cable Communications, LLC (collectively, “Comcast” or “Defendants”):

NATURE OF THE ACTION

1. This is an action for patent infringement arising under the Patent Laws of the United States, 35 U.S.C. § 1 *et seq.*

THE PARTIES

2. Plaintiff is a limited liability companies organized under the laws of the State of Delaware and has a place of business at 356 Greenwood Court, Villanova, PA, 19085.

3. Defendant Comcast Corporation is a Pennsylvania corporation with its principal place of business at 1701 John F. Kennedy Blvd., Philadelphia, Pennsylvania 19103. Comcast Corporation may be served through its registered agent CT Corporation System, 1999 Bryan

Street, Suite 900, Dallas, Texas 75201. On information and belief, Comcast Corporation is registered to do business in the State of Texas and has been since at least November 30, 2018.

4. Defendant Comcast Cable Communications, LLC is a Delaware limited liability company with a principal place of business at 1701 John F. Kennedy Blvd., Philadelphia, Pennsylvania 19103. Comcast Cable Communications, LLC may be served through its registered agent Comcast Capital Corporation, 1201 N. Market Street, Suite 1000, Wilmington, Delaware 19801.

5. Comcast conducts business operations within the Western District of Texas in its Comcast Innovation Center at 6200 Bridge Point Parkway, Austin, Texas 78730. Comcast has offices in the Western District of Texas where it sells, develops, and/or markets its products including its Innovation Center in Austin, Texas.

6. Comcast operates and/or deploys, or has operated or deployed, either directly or indirectly, optical communications networks that utilize EDFAs and/or Raman amplifiers to controllably produce Raman amplification, attenuation and/or lossless transmission in said networks.

7. The optical communications networks operated and/or employed by Comcast have deployed at least Cisco's multiservice platforms (e.g., ONS 15454) as well as Fujitsu's ROADM systems and devices (e.g., Flashwave 7500) in addition to other components that are connected to these devices for the purpose of transmitting voice and data traffic.

8. The optical communications networks operated and/or employed by Comcast utilize the functionality of the foregoing systems and devices in a manner designed to facilitate the transmission and reception of voice and data during the normal operation of such networks.

JURISDICTION AND VENUE

9. This is an action for patent infringement arising under the Patent Laws of the United States, 35 U.S.C. § 1, *et seq.*

10. This Court has subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a).

11. The Court has personal jurisdiction over Comcast at least because Comcast has continuous business contacts in the State of Texas and in this District. Comcast has engaged in business activities including transacting business in this District and purposefully directing its business activities, including the provision of infringing communications networks and services, in this District, and the sale or offer for sale of services and goods in this District. For example, Comcast—either directly or through those acting on its behalf—offers infringing communications networks and services in this District (e.g., <https://business.comcast.com/local/texas/austin>).

12. As another example, Comcast—either directly or through those acting on its behalf—has a R&D center in this District in which infringing communications networks and services are researched and developed. *See, e.g.,* <https://www.facebook.com/pages/Comcast-Austin-Innovation-Center/256710298326994>. For example, Comcast, through each of the named parties, has a regular and established place of business within this District, including the Comcast Austin Innovation Center at 6200 Bridge Point Pkwy Austin, Texas 78730. Comcast also offers enterprise business network products and services to businesses in this District. *See, e.g.,* <https://business.comcast.com/local/texas/austin> and <https://business.comcast.com/local/texas/san-antonio>.

13. Comcast is proper in this district under 28 U.S.C. §§ 1391(b)-(d) and 1400(b). Defendant Comcast is registered to do business in the State of Texas, has offices in the State of

Texas, has transacted business in the Western District of Texas, and has committed acts of direct and indirect infringement in the Western District of Texas.

14. Venue is proper in this District pursuant to 28 U.S.C. § 1400(b). On information and belief, Comcast maintains a regular and established place of business in this District, including by maintaining or controlling R&D centers in this District and by maintaining and operating optical communications networks in this District, including on mobile, wireless and/or cell towers and/or other installation sites owned or leased by Comcast. Also, Comcast is engaged in activities including: transacting business in this district and purposefully directing its business activities, including the installation, maintenance, and use of infringing communications networks, services, and other technologies in this District, and the sale or offer for sale of services and goods to this District to aid, abet, or contribute to the infringement of third parties in this District.

THE ASSERTED PATENTS

15. On September 5, 2000, the USPTO duly and legally issued U.S. Patent No. 6,115,174 (“the ’174 Patent”), entitled “Optical Signal Varying Devices.” A copy of the ’174 Patent is attached hereto as Exhibit 1.

16. Optic153 owns all substantial right, title, and interest in the ’174 Patent, and holds the right to sue and recover damages for infringement thereof, including past infringement.

17. On May 22, 2001, the USPTO duly and legally issued U.S. Patent No. 6,236,487 (“the ’487 Patent”), entitled “Optical Communication Control System.” A copy of the ’487 Patent is attached hereto as Exhibit 2.

18. Optic153 owns all substantial right, title, and interest in the ’487 Patent, and holds the right to sue and recover damages for infringement thereof, including past infringement.

19. On Feb. 5, 2002, the USPTO duly and legally issued U.S. Patent No. 6,344,922 (“the ’922 Patent”), entitled “Optical Signal Varying Devices.” A copy of the ’922 Patent is attached hereto as Exhibit 3.

20. Optic153 owns all substantial right, title, and interest in the ’922 Patent, and holds the right to sue and recover damages for infringement thereof, including past infringement.

21. On Mar. 12, 2002, the USPTO duly and legally issued U.S. Patent No. 6,356,383 (“the ’383 Patent”), entitled “Optical Transmission Systems Including Optical Amplifiers Apparatuses and Methods.” A copy of the ’383 Patent is attached hereto as Exhibit 4.

22. Optic153 owns all substantial right, title, and interest in the ’383 Patent, and holds the right to sue and recover damages for infringement thereof, including past infringement.

23. On Jul. 1, 2003, the USPTO duly and legally issued U.S. Patent No. 6,587,261 (“the ’261 Patent”), entitled “Optical Transmission Systems Including Optical Amplifiers Apparatuses and Methods of Use Therein.” A copy of the ’261 Patent is attached hereto as Exhibit 5.

24. Optic153 owns all substantial right, title, and interest in the ’261 Patent, and holds the right to sue and recover damages for infringement thereof, including past infringement.

25. On Aug. 3, 2004, the USPTO duly and legally issued U.S. Patent No. 6,771,413 (“the ’413 Patent”), entitled “Optical Transmission Systems Including Optical Amplifiers, Apparatuses and Methods.” A copy of the ’413 Patent is attached hereto as Exhibit 6.

26. Optic153 owns all substantial right, title, and interest in the ’413 Patent, and holds the right to sue and recover damages for infringement thereof, including past infringement.

COUNT I - INFRINGEMENT OF U.S. PATENT NO. 6,115,174

27. Plaintiff incorporates and realleges the preceding paragraphs as if fully set forth herein.

28. The '174 Patent is directed to systems and methods for controlling signal variation in an optical fiber, as described and claimed in the '174 Patent.

29. Comcast directly infringed at least Claim 19 of the '174 Patent, in this judicial District and elsewhere in the United States, pursuant to 35 U.S.C. § 271(a), literally or under the doctrine of equivalents, by, among other things, by making, using, selling, offering to sell, and/or importing in or into the United States, without authority: products, devices, systems, and/or components of systems that provide pump energy in a plurality of pump wavelengths to controllably produce Raman transmission in an optical fiber (“'174 Accused Instrumentalities”). The '174 Accused Instrumentalities include, for example and without limitation, Comcast’s optical communications networks and systems (e.g., Comcast Xfinity, mesh/DWDM networks, and nationwide fiber-optic networks; *see, e.g.*, <https://business.comcast.com/about-us/our-network>) that employ Raman amplification or Raman amplifiers and/or systems, including Raman optical amplifiers (e.g., Cisco Systems’s (“Cisco”) OPT-RAMP-C, OPT-RAMP-CE, and EDRA-x-xx and Fujitsu Ltd.’s (“Fujitsu”) Raman Amplifier), counter-propagating and co-propagating (e.g., Cisco’s 15454-M-RAMAN-CTP/RAMAN-CTP card and 15454-M-RAMAN-COP/RAMAN-COP card) Raman units, and Raman platforms and systems (e.g., Cisco’s ONS15454 multiservice platforms and Fujitsu’s 1Finity platforms including Flashwave 7500), and/or other telecommunications networks and systems that deploy or have deployed such platforms or components.

30. By way of example, the representative instrumentality, Comcast’s mesh/DWDM networks, has deployed at least Cisco’s ONS 15454 Multiservice platforms in as early as 2008.

See, e.g., “DWDM technology for NGN SP infrastructure” (“**DWDM Technology**”) at 1, available at

https://www.cisco.com/c/dam/global/mk_mk/assets/expo_2008/pdf/DWDMforSP.pdf (“First demo with Comcast in June 2008”) (last visited Apr. 1, 2020). An image of the representative instrumentality, ONS 15454 multiservice transport platform, is shown below:



See “Cisco ONS 15454 Series Multiservice Transport Platforms,” available at

<https://www.cisco.com/c/en/us/products/optical-networking/ons-15454-series-multiservice-transport-platforms/index.html> (last visited Apr. 1, 2020). The ONS 15454 Series Multiservice Transport Platforms includes Raman amplifiers such as, without limitations, OPT-RAMP-C, OPT-RAMP-CE, and EDRA. An image of the OPT-RAMP-C is shown below:



See “Raman C-Band Optical Amplifier for the Cisco ONS 15454 Multiservice Transport Platform” (“**Raman C-Band Datasheet**”) at 1, *available at*

https://www.cisco.com/c/en/us/products/collateral/optical-networking/ons-15454-series-multiservice-provisioning-platforms/data_sheet_c78-500925.html (last visited Apr. 1, 2020).

31. As another example, Comcast’s mesh/DWDM networks, has deployed Fujitsu’s Flashwave 7500 since as early as 2008. See, e.g., “Fujitsu Adds Mid-Range ROADM” (“**Fujitsu Adds Mid-Range ROADM**”) at 1, *available at* <https://www.multichannel.com/news/fujitsu-adds-mid-range-ROADM-154373> (last visited Apr. 1, 2020) (“Its flagship Flashwave 7500 system has been deployed in 220 nodes across five MSOs, including Comcast Corp. ... largely to handle VOD traffic”). An image of the representative instrumentality, Flashwave 7500, is shown below:

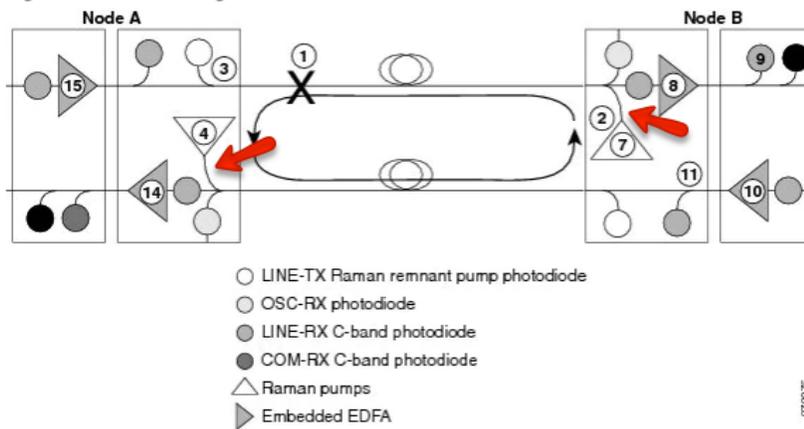


See “Flashwave 7500 Multifunction ROADM/DWDM Platform” (“**Flashwave 7500 Multifunction ROADM/DWDM Platform**”) at 1, *available at*

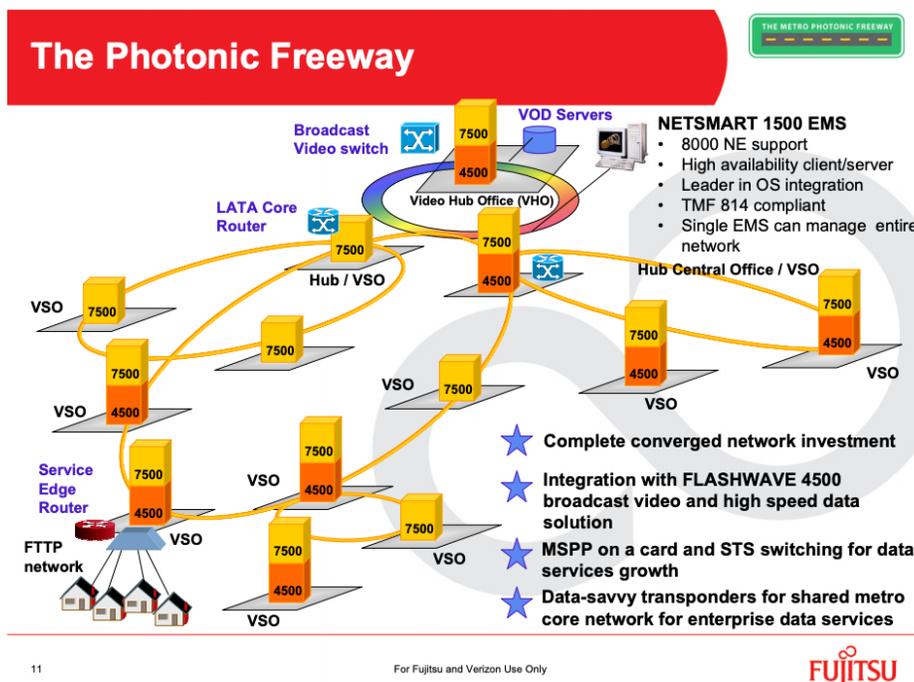
<https://www.fujitsu.com/us/Images/flashwave7500.pdf> (last visited Apr. 1, 2020). The Flashwave 7500 employs EDFA and Raman amplifiers. See “Response to State of Utah Data Communications Products & Services Solicitation JP14001” (“**Fujitsu’s Response to State of Utah**”) at 659, available at https://s3-us-west-2.amazonaws.com/wsca-uploads/1420829097_Fujitsu%20Network%20Communications%20Proposal.pdf (last visited Apr. 1, 2020) (“Raman Amplifiers • Raman Amplifiers Unit Interconnections • Dispersion Compensations • Shelf Hierarchy - HUB Node - ETSI Add/Drop Node Equipment - ETSI HUB Node Equipment with Raman Amplifiers.”); see also “Flashwave 7500 Small Systems,” (“**Flashwave 7500 Small Systems Data Sheet**”) at 1 available at <https://www.fujitsu.com/downloads/TEL/fnc/datasheets/flashwave7500s.pdf> (last visited Apr. 1, 2020) (“Optical Span Lengths • Point-to-point Up to 20 km • Point-to-point with EDFA Up to 100 km”).

32. More specifically, the 174 Accused Instrumentalities, including the representative instrumentality, Comcast’s mesh/DWDM networks, perform a method of controlling signal variation in an optical fiber comprising providing an optical fiber (e.g., optical fiber(s) connected between optical nodes, optical terminal units, and optical network units) configured to produce concentrated Raman gain in a signal wavelength range. See, e.g., “Cisco ONS 15454 DWDM Network Configuration Guide, Release 10.x.x, Chapter: Network Reference” (“**Network Reference**”) at 1, at Fig. 30 available at https://www.cisco.com/c/en/us/td/docs/optical/15000r10_0/dwdm/network_config/guide/b_ons_network_configuration/b_ons_network_configuration_chapter_010110.html (last visited Apr. 1, 2020) (annotated):

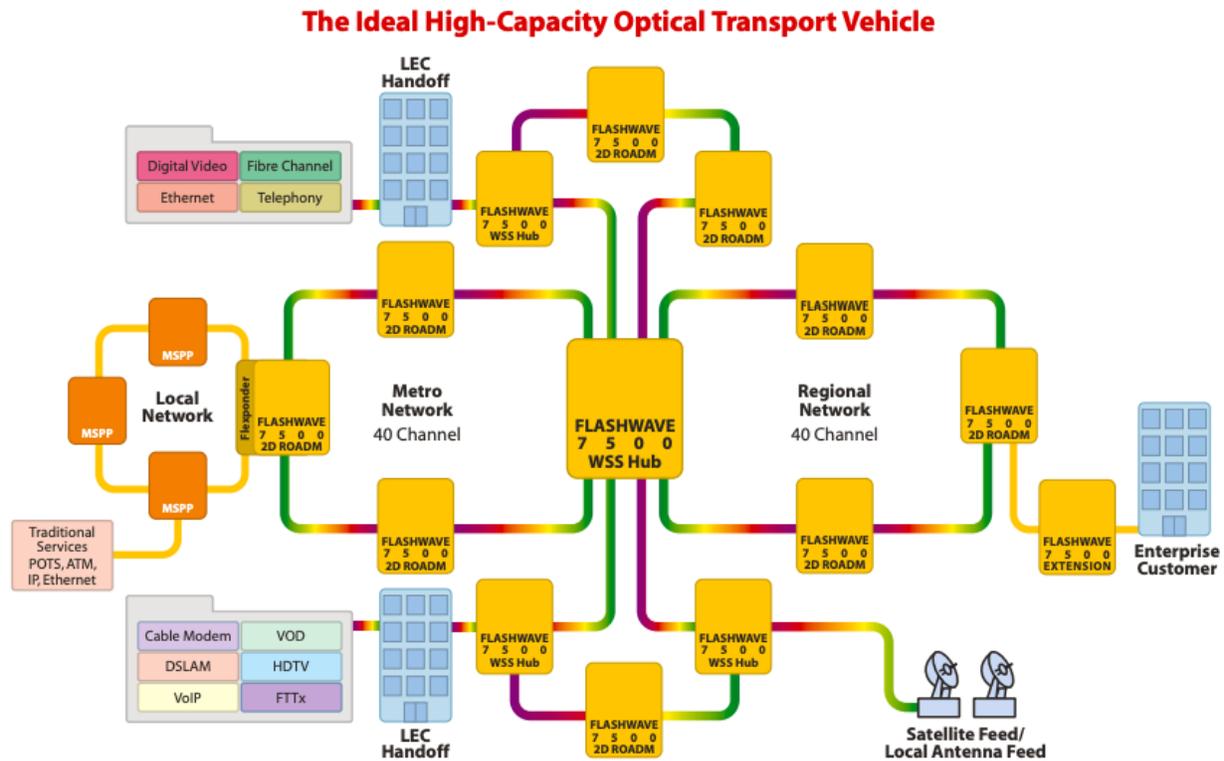
Figure 30. Nodes Using OPT-RAMP-C or OPT-RAMP-CE Cards



See also “Flashwave 7500 ROADM” (“Flashwave 7500 ROADM”) at 11, available at https://www.fujitsu.com/downloads/TEL/fnc/downloads/fw7500_roadm_030305.pdf (last visited Apr. 1, 2020) (showing each VSO (video serving office) and VHO (video hub office) connected via optical transmission fibers, which are connected to the fibers that produce Raman amplification):



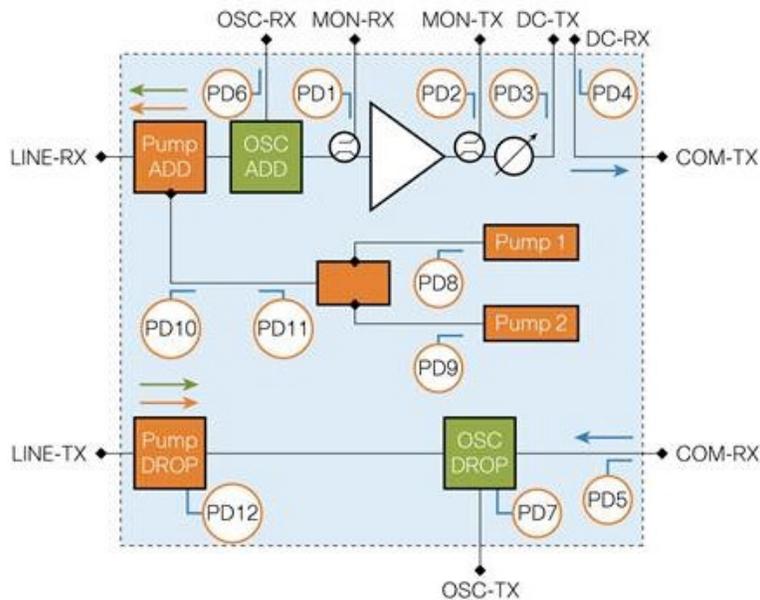
See also Flashwave 7500 Multifunction ROADM/DWDM Platform at 5 (showing each hub/ROADM being connected via optical fibers):



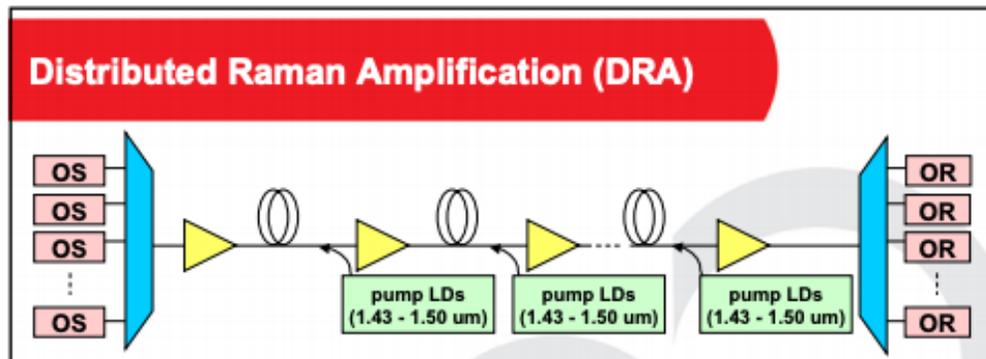
33. Also, the '174 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM network, couple a pump source (e.g., two pump lasers) to the fiber to provide pump energy in a plurality of pump wavelengths (e.g., 1425 nm and 1452 nm) having sufficient pump energy to produce Raman gain and a signal variation profile in the signal wavelength range (e.g., 1529.0 nm to 1562.5 nm) and to controllably produce amplification, attenuation and lossless transmission in the optical fiber. *See, e.g.*, "Cisco ONS 15454 DWDM Network Configuration Guide, Release 10.x.x, Chapter: Node Reference" ("Node Reference") at 1, available at https://www.cisco.com/c/en/us/td/docs/optical/15000r9_6/dwdm/configuration/guide/454d96_configuration/454d96_noderef.html (last visited Apr. 1, 2020) ("The Raman pump is equipped with two different Raman pumps transmitting powers (P1 and P2) at two different wavelengths λ_1 and λ_2 . During installation, the two pumps alternatively turn ON and OFF at

two different power values. Lambda1 and Lambda2 signals are used as probes at the end of spans to measure Raman gain efficiency of the two Raman pumps separately.”); *see also* **Raman C-Band Datasheet** at 1 (“The OPT-RAMP-C features an embedded low-noise EDFA gain block for C-band optical amplification and optimized system performances with Raman amplification. The Raman pumps embedded in the unit use on the latest laser technology, enabling up to 500 milliwatts (mW) of power combining just two pump lasers, thus obtaining very high efficiency and low power consumption (Figure 2). ... A dedicated software application has been incorporated in Cisco Transport Controller to allow a fully automatic and simple configuration and tuning of the optical Raman amplifiers along a DWDM link. This software application, called Raman Tuning Wizard, can take advantage of tunable Transponder or Muxponder units to evaluate the physical characteristics of the span’s fiber, determine the optimal mix of Raman pump wavelengths, and define the contribution of Raman versus EDFA for the overall optical amplification of the unit.”); *see also id.* at Fig. 2:

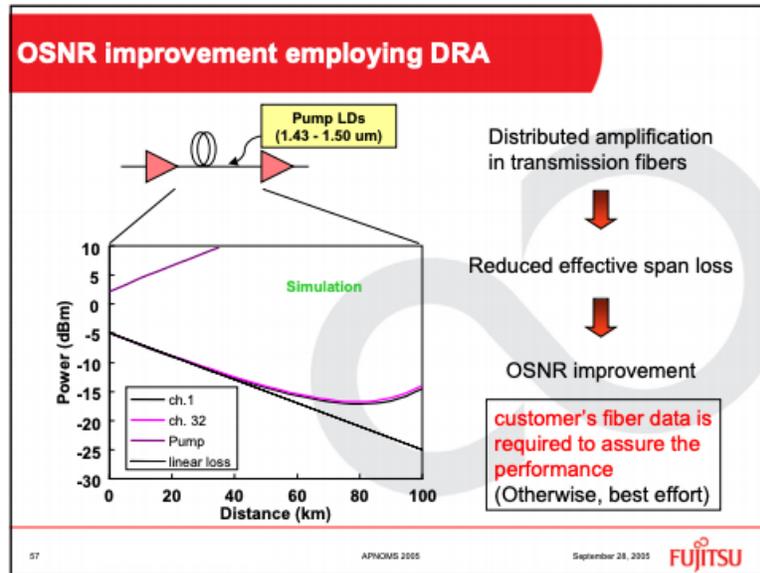
Figure 2. OPT-RAMP-C Block Diagram



34. Also, on information and belief, Comcast’s deployment of Fujitsu’s IFinity platforms in its mesh/DWDM network, such as, without limitations, the Flashwave 7500, includes the deployment and use of Fujitsu’s Raman amplifiers, which include coupling a pump source to the fiber to provide pump energy in a plurality of pump wavelengths (e.g., 1.43 μm – 1.50 μm) to produce Raman gain and a signal variation profile in the signal wavelength range and to controllably produce amplification, attenuation and lossless transmission in the optical fiber (the Flashwave 7500 in order to achieve a span loss of 0.19db/km). *See, e.g., Flashwave 7500 Multifunction ROADM/DWDM Platform* at 1; *see also* “Optical Transport Systems/Networks and Control by Generalized Multi-Protocol Label Switching (GMPLS)” (“Optical Transport Systems/Networks”) at 721, *available at* <http://www.apnoms.org/2005/tutorial/Tutorial%202.pdf> (last visited Apr. 1, 2020):



See also id. at 722 (showing a signal variation profile produced a plurality of pump wavelengths):

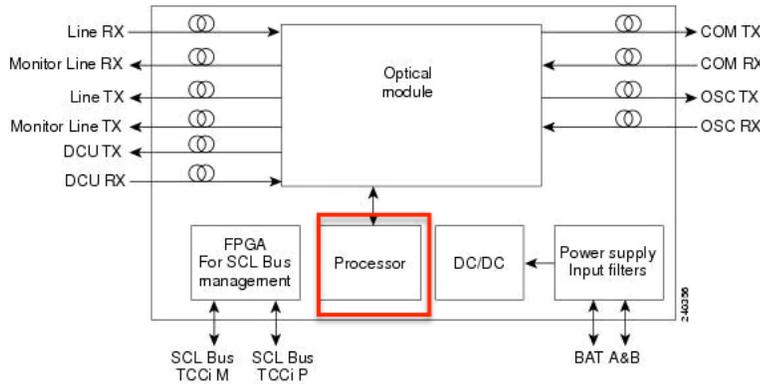


35. Further, the '174 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, control the pump energy provided in at least one of said pump wavelengths to vary the signal variation profile (e.g., from 8.5dB to 13.5dB) over the signal wavelength range (e.g., 1529.0 nm to 1562.5 nm) in the optical fiber and produce amplification, attenuation and lossless transmission in the optical fiber. *See, e.g., Network Reference* at 1 ("After the GEDFA is set, APC regulates the power on the VOA (DC-TX port) of the OPT-RAMP-C or OPT-RAMP-CE card to match the target Power (COM-TX port) value, and accounts for the actual DCU loss. ... The APC adjusts the VOA attenuation of the OPT-RAMP-C or OPT-RAMP-CE card if the Total Power (LINE-TX port) does not match the expected value that is equal to the maximum power multiplied by the number of active channels. The VOA attenuation value on the OPT-RAMP-C or OPT-RAMP-CE cards is set to 15 dB. This value ensures that the system turns up in any circumstance."); *see also Raman C-Band Datasheet* at 1 ("The OPT-RAMP-C also provides an embedded fast Gain Control for transient suppression to respond quickly to network changes without impairments and degradation of existing wavelengths. In addition to this, the unit features an embedded Gain Flattening Filter

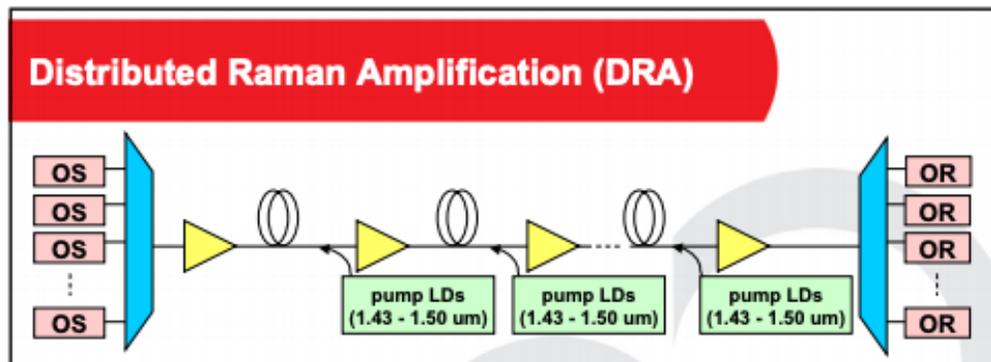
(GFF) for the compensation of the ripple generated by the cascaded Raman and EDFA stages. The amplifier integrates a software-controllable variable optical attenuator (VOA) to provide gain tilt control capabilities and to optimize and control the per-channel power at the input of the mid-access loss for dispersion compensation units (DCUs). ... A dedicated software application has been incorporated in Cisco Transport Controller to allow a fully automatic and simple configuration and tuning of the optical Raman amplifiers along a DWDM link. This software application, called Raman Tuning Wizard, can take advantage of tunable Transponder or Muxponder units to evaluate the physical characteristics of the span's fiber, determine the optimal mix of Raman pump wavelengths, and define the contribution of Raman versus EDFA for the overall optical amplification of the unit."); *see also* **Node Reference** at 1 ("Automatic Raman Pump Calculation The Raman gain depends on the characteristics of the span (fiber type and span loss). To obtain optimum Raman gain, a correct mix of pump powers must be provisioned. Tuning of the four Raman pumps is crucial before traffic is provisioned. The tuning procedure is called Automatic Raman Power Calculation (ARPC). This procedure assesses the Raman gain on a C-band signal using pre-defined Raman pump values. ARPC applies to the RAMAN-CTP and EDRA cards.") *see also* "Cisco ONS 15454 DWDM Configuration Guide, Release 9.6.x, Chapter: Chapter 5, Optical Amplifier Cards" ("**Release 9.6x Optical Amplifier Cards**") at 1, *available at* https://www.cisco.com/c/en/us/td/docs/optical/15000r9_6/dwdm/configuration/guide/454d96_configuration/454d96_optamp.html (last visited Apr. 1, 2020) (showing a processor to control the pump energy to vary the signal variation profile) (annotated):

Figure 5-20 shows a simplified block diagram of the OPT-RAMP-C and OPT-RAMP-CE card features.

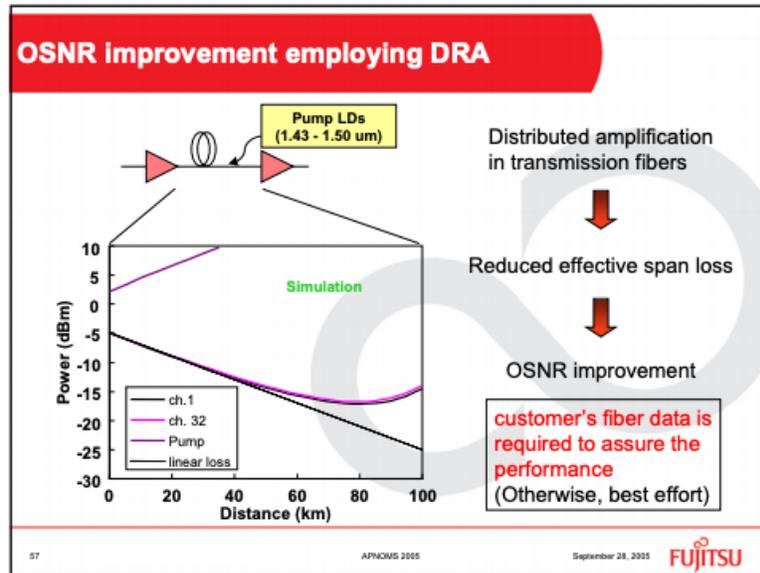
Figure 5-20 OPT-RAMP-C and OPT-RAMP-CE Block Diagram



36. Also, on information and belief, Comcast’s deployment of Fujitsu’s 1Finity platforms in its mesh/DWDM network, such as, without limitations, the Flashwave 7500, also requires controlling the pump energy provided in the at least one of the pump wavelengths to vary the signal variation profile over the signal wavelength range in the optical fiber and produce amplification, attenuation and lossless transmission in the optical fiber (e.g., to provide up to 41db in span loss with Raman amplification). *See, e.g., Flashwave 7500 at 1; see also Optical Transport Systems/Networks at 721:*



See also id. at 722 (showing a signal variation profile produced a plurality of pump wavelengths):



37. Discovery is expected to uncover the full extent of Comcast's unlawful use of Optic153's patented technology in the '174 Patent beyond the '174 Accused Instrumentalities already identified through public information.

38. On information and belief, Comcast also directly infringed at least Claim 19 of the '174 Patent by testing the '174 Accused Instrumentalities, including in relation to network testing and improvement responsive to user/customer feedback, and demonstration at trade shows, sales facilities, customer sites, and training/tutorial videos.

39. Plaintiff has suffered damages as a result of Comcast's infringement of the '174 Patent.

40. Plaintiff reserves the right to modify its infringement theories as discovery progresses in this case. Plaintiff shall not be estopped for purposes of its infringement contentions or its claim constructions by the foregoing discussions on how the '174 Accused Instrumentalities infringe the '174 Patent. Plaintiff intends only that the foregoing discussions satisfy the notice requirements of Rule 8(a)(2) of the Federal Rule of Civil Procedure, and that they should not be construed as Plaintiff's preliminary or final infringement contentions or

preliminary or final claim construction positions.

COUNT II - INFRINGEMENT OF U.S. PATENT NO. 6,236,487

41. Plaintiff incorporates and realleges the preceding paragraphs as if fully set forth herein.

42. The '487 Patent is directed to systems and methods for controlling an optical transmission system, as described and claimed in the '487 Patent.

43. Comcast directly infringed at least Claims 26-28 of the '487 Patent, in this judicial District and elsewhere in the United States, pursuant to 35 U.S.C. § 271(a), literally or under the doctrine of equivalents, by, among other things, by making, using, selling, offering to sell, and/or importing in or into the United States, without authority: products, devices, systems, and/or components of systems that control a concentrated optical amplifier to vary an optical signal to have at least one desired signal characteristics when the optical signal reaches an optical processing node (“'487 Accused Instrumentalities”). The '487 Accused Instrumentalities include, for example and without limitation, Comcast’s optical communications networks and systems (e.g., Comcast Xfinity, mesh/DWDM networks, and nationwide fiber-optic networks; *see, e.g.*, <https://business.comcast.com/about-us/our-network>) that has deployed Cisco’s ONS 15454 Series platform, NCS 2000 Series network platform, and GS7000 Optical Hub, and Fujitsu’s IFinity platforms including Flashwave 7500, and/or other telecommunications networks and systems that deploy or have deployed such platforms or components.

44. By way of example, the representative instrumentality, Comcast’s mesh/DWDM network, has deployed at least Cisco’s ONS 15454 Multiservice platform in as early as 2008. *See, e.g.*, **DWDM Technology** at 1. The ONS 15454 Multiservice platform includes erbium doped fiber amplifiers (e.g., OPT-AMP-xx-x, OPT-EDFA-xx, SMRX-X, and Enhanced C-Band

96-Channel EDFA Amplifiers) and Raman amplifiers (e.g., OPT-RAMP-C, OPT-RAMP-CE, and EDRA-x-xx). *See, e.g.*, “Enhanced C-Band 96-Channel EDFA Amplifiers for the Cisco ONS 15454 MSTP Data Sheet” (“**Enhanced C-Band for 15454 MSTP Data Sheet**”) at 1, available at https://www.cisco.com/c/en/us/products/collateral/optical-networking/ons-15454-series-multiservice-transport-platforms/data_sheet_c78-658542.html (last visited Apr. 1, 2020); *see also* “Cisco ONS 15454 DWDM Line Card Configuration Guide, Release 10.x.x Chapter: Provisioning Optical Amplifier Cards” (“**Provisioning Optical Amplifier Cards**”) at 1, available at https://www.cisco.com/c/en/us/td/docs/optical/15000r10_0/dwdm/linecard_config/guide/b_ons_line_card_configuration/b_ons_line_card_configuration_chapter_0101.html (last visited Apr. 1, 2020).

45. As another example, Comcast’s mesh/DWDM networks has deployed Fujitsu’s Flashwave 7500 since as early as 2008. *See, e.g.*, **Fujitsu Adds Mid-Range ROADM** at 1 (“Its flagship Flashwave 7500 system has been deployed in 220 nodes across five MSOs, including Comcast Corp. and Cox Communications Inc., largely to handle VOD traffic”). The Flashwave 7500 employs EDFA and Raman amplifiers. *See* **Fujitsu’s Response to State of Utah** at 659; *see also* **Flashwave 7500 Small Systems Data Sheet** at 1.

46. More specifically, the ’487 Accused Instrumentalities, including the representative instrumentality, Comcast’s mesh/DWDM networks, perform a method of controlling an optical transmission system comprising positioning at least one signal varying device including a concentrated optical amplifier (e.g., EDFA or Raman amplifiers) remote from an optical processing node to vary an optical signal passing to the optical processing node. *See, e.g.*, **Release 9.6x Optical Amplifier Cards** at 1 (listing all suitable concentrated optical

amplifiers including OPT-EDFA-xx, EDRAx-xx, OPT-AMP-C, OPT-AMP-17C, OPT-RAMP-C, OPT-RAMP-CE, RAMAN-CTP, and RAMAN-COP):

Table 5-1 Optical Amplifier Cards for the ONS 15454

Card	Port Description	For Additional Information
OPT-PRE	The OPT-PRE amplifier has five optical ports (three sets) located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-PRE Amplifier Card" section.
OPT-BST	The OPT-BST amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-BST and OPT-BST-E Amplifier Card" section.
OPT-BST-E	The OPT-BST-E amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-BST and OPT-BST-E Amplifier Card" section.
OPT-BST-L	The OPT-BST-L L-band amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-BST-L Amplifier Card" section.
OPT-AMP-L	The OPT-AMP-L L-band preamplifier has five sets of optical ports located on the faceplate. It is a two-slot card that operates in Slots 1 to 6 and 12 to 17.	See the "OPT-AMP-L Card" section.
OPT-AMP-17-C	The OPT-AMP-17-C C-band low-gain preamplifier/booster amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-AMP-17-C Card" section.
OPT-AMP-C	The OPT-AMP-C C-band high-gain, high-power preamplifier/booster amplifier has five sets of optical ports located on the faceplate. It operates as a preamplifier when equipped and provisioned in Slots 2 to 6 and 11 to 16 or as a booster amplifier when equipped and provisioned in Slot 1 and 17.	See the "OPT-AMP-C Card" section.
OPT-RAMP-C	The OPT-RAMP-C C-band amplifier has five sets of optical ports located on the faceplate and operates in Slots 1 to 5 and 12 to 16.	See the "OPT-RAMP-C and OPT-RAMP-CE Cards" section.
OPT-RAMP-CE	The OPT-RAMP-CE C-band amplifier has five sets of optical ports located on the faceplate and operates in Slots 1 to 5 and 12 to 16.	See the "OPT-RAMP-C and OPT-RAMP-CE Cards" section.
RAMAN-CTP	The RAMAN-CTP amplifier is a single-slot card and has six optical ports located on the faceplate. The RAMAN-CTP and RAMAN-COP units must be installed in adjacent slots (Slots 2 and 3, 4 and 5, or 6 and 7) in the ONS 15454 M6 chassis and Slots 2 and 3 in the ONS 15454 M2 chassis.	See the "RAMAN-CTP and RAMAN-COP Cards" section. 
RAMAN-COP	The RAMAN-COP amplifier has one optical port located on the faceplate. It is a single-slot card and works in conjunction with the RAMAN-CTP amplifier.	See the "RAMAN-CTP and RAMAN-COP Cards" section.
OPT-EDFA-17	The OPT-EDFA-17 amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-EDFA-17 and OPT-EDFA-24 Cards" section
OPT-EDFA-24	The OPT-EDFA-24 amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-EDFA-17 and OPT-EDFA-24 Cards" section

See also **Raman C-Band Datasheet** at 1 (“A Raman amplifier uses intrinsic properties of silica fibers to obtain signal amplification. This means that transmission fibers can be used as a medium for amplification, and hence that the intrinsic attenuation of data signals transmitted over the fiber can be combated within the fiber. An amplifier working on the basis of this principle is commonly known as a distributed Raman amplifier (DRA) or simply Raman amplifier. The OPT-RAMP-C unit not only embeds efficient next-generation pump lasers to generate counter-propagating Raman effect in the span fiber but also a low-noise Erbium Doped Fiber Amplifier (EDFA) to optimize the overall Noise Figure of the Node.”).

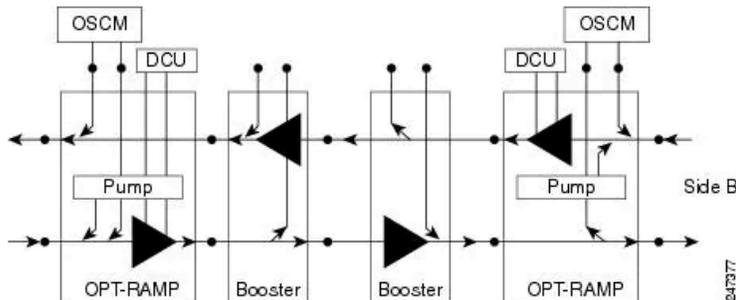
47. The system includes, for example, one or more optical processing nodes. See, e.g., **Node Reference** at Fig. 70:

OPT-RAMP-C or OPT-RAMP-CE Card in a Line Site Node with Booster Amplification

The OPT-RAMP-C or OPT-RAMP-CE card can be equipped in a line site node with a booster amplifier in the following configurations:

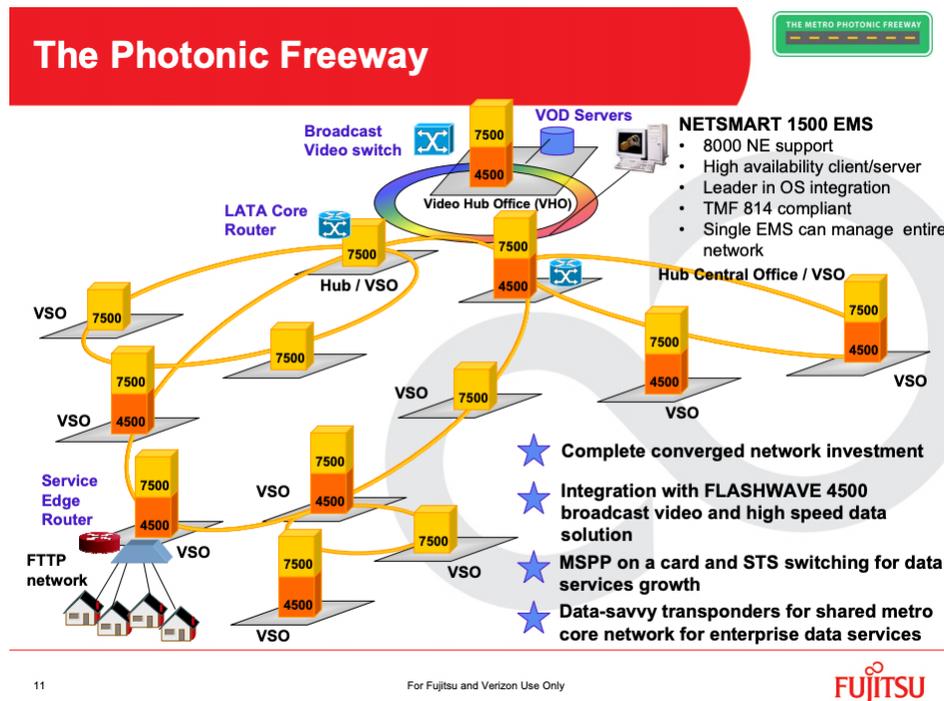
- OPT-BST and OPT-BST-E can be used as booster in a line site node with OPT-RAMP-C or OPT-RAMP-CE. The booster cards need to be cabled as bidirectional units. The following figure shows the OPT-RAMP-C or OPT-RAMP-CE card in a line site configuration.

Figure 70. OPT-RAMP-C Card or OPT-RAMP-CE Card in a Line Site Configuration



48. As another example, on information and belief, the IFinity platforms, such as the Flashwave 7500 deployed in Comcast’s mesh/DWDM network, include Raman amplifiers and EDFAs. The ’487 Accused Instrumentalities, including the representative instrumentality, Flashwave 7500, perform a method of controlling an optical transmission system comprising

positioning at least one signal varying device including a concentrated optical amplifier (e.g., EDFA or Raman amplifiers) remote from an optical processing node to vary an optical signal passing to the optical processing node. For example, the optical amplifier can be positioned between VSOs and VHSs:



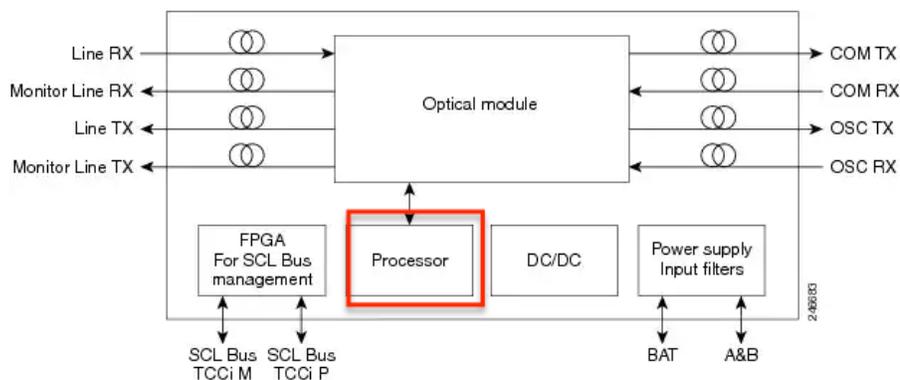
See **Flashwave 7500 ROADM** at 1.

49. Also, the '487 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, control the at least one concentrated optical amplifier to vary the optical signal to have at least one desired signal characteristic when the optical signal reaches the optical processing node. See, e.g., **Network Reference** at 1 (The Automatic Power Control "APC algorithms manage the optical parameters of the OPT-BST, OPT-PRE, OPT-AMP-17-C, 32DMX, 40-DMX-C, 40-DMX-CE, 40-SMR1-C, 40-SMR2-C, OPT-BST-L, OPT-AMP-L, 32DMX-L, OPT-AMP-C, OPT-PRE, OPT-BST-E, OPT-AMP-17C, OPT-EDFA-17, OPT-EDFA-24, 80-WXC-C, 40-WXC-C, 40-WSS, 32-WSS, 40-MUX, 40-

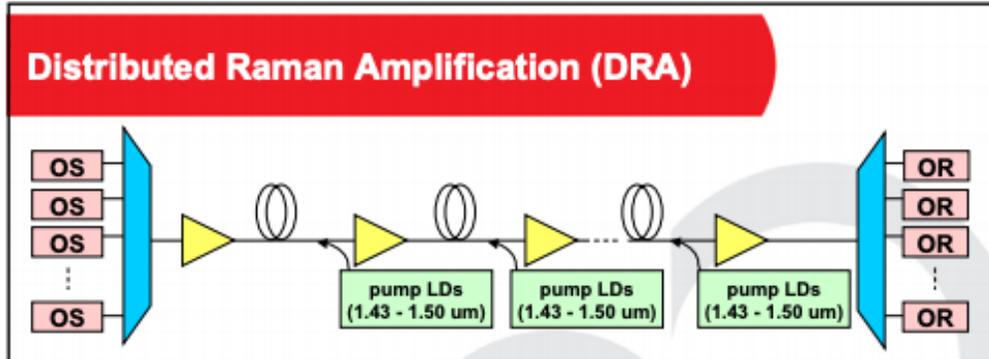
DMX, RAMAN-CTP, RAMAN-COP, OPT-RAMP-C, OPT-RAMP-CE, EDRA-1, EDRA-2, SMR-20, SMR-9, 16-WXC, and PSM cards. ... The APC changes the Gain setpoint of the embedded EDFA to reach the value that is equal to Power (DC-TX port) value multiplied by the number of active channels. The APC can set the Gain setpoint of the embedded EDFA (GEDFA) in the following ranges: OPT-RAMP-C 10 dB < GEDFA < 18 dB OPT-RAMP-CE 7 dB < GEDFA < 13 dB.”); *see also* **Release 9.6x Optical Amplifier Cards** at 1 (showing a processor to control the at least one concentrated optical amplifier to vary the optical signal to have at least one desired signal characteristic) (annotated):

Figure 5-27 shows a simplified block diagram of the OPT-EDFA-17 and OPT-EDFA-24 card features.

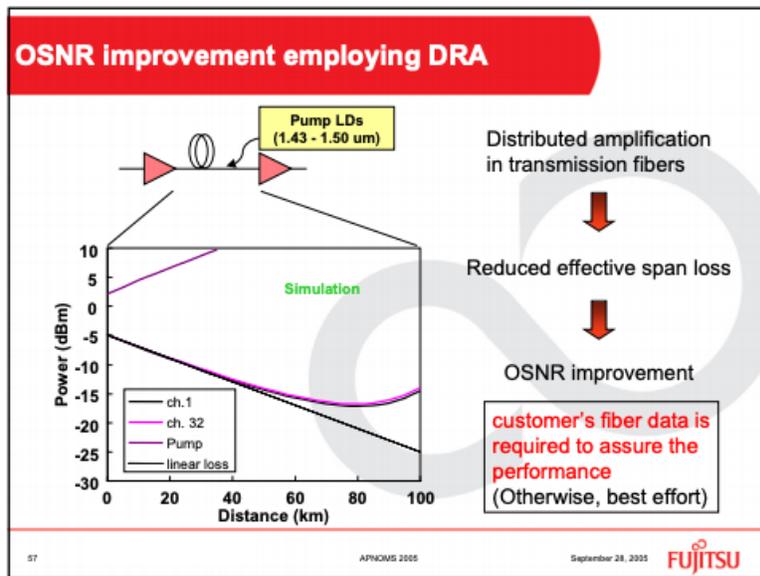
Figure 5-27 OPT-EDFA-17 and OPT-EDFA-24 Block Diagram



50. As another example, on information and belief, the 1Finity platforms, such as the Flashwave 7500 deployed in Comcast’s in mesh/DWDM network, control the at least one concentrated optical amplifier (e.g., EDFA or Raman amplifiers) to vary the optical signal to have at least one desired signal characteristic (e.g., power/gain) when the optical signal reaches the optical processing node (e.g., at either VSO or VHO). *See also* **Fujitsu’s Response to State of Utah** at 659 (showing the use and control of Raman amplifiers in Flashwave 7500); *see also* **Flashwave 7500 Small Systems** at 1 (showing the use and control of EDFA); *see also* **Flashwave 7500** at 1; *see also* **Optical Transport Systems/Networks** at 721:



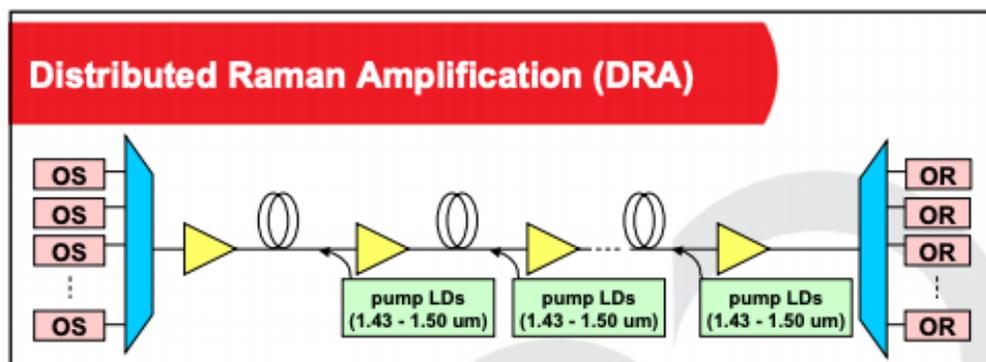
See also *id.* at 722:



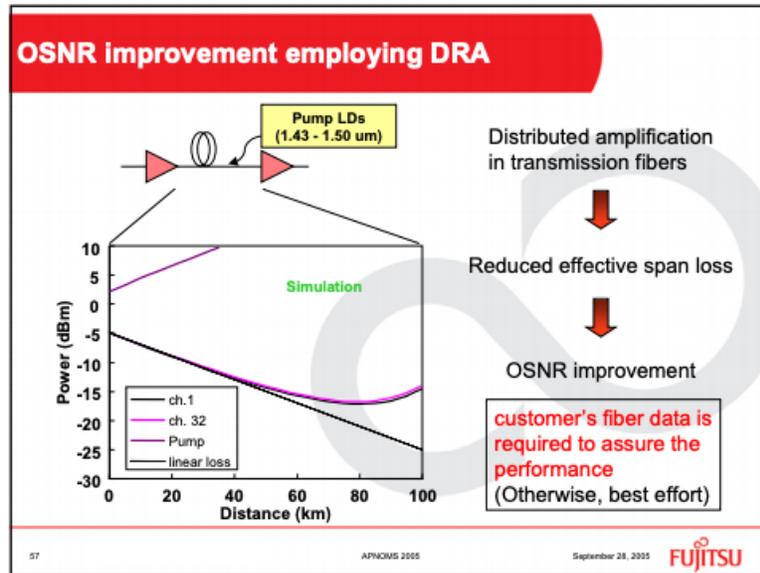
51. Further, the '487 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM network, also detect characteristics of the optical signal and compare detected characteristics of the optical signal to the at least one desired characteristic, wherein controlling includes controlling the at least one signal varying device to vary the optical signal until the detected characteristics correspond to the desired characteristics (e.g., target power) when the optical signal arrives at the processing nodes. See, e.g., **Network Reference** at 1 ("After the GEDFA is set, APC regulates the power on the VOA (DC-TX port) of the OPT-RAMP-C or OPT-RAMP-CE card to match the target Power (COM-TX port) value,

and accounts for the actual DCU loss.”); *see also* **Provisioning Optical Amplifier Cards** (“OPT-AMP-C Card ... Fixed output power mode (mode used during provisioning) ... ASE compensation in Constant Gain and Constant Output Power modes ... OPT-EDFA-17 and OPT-EDFA-24 Cards ... Constant gain mode ... ASE compensation in Constant Gain and Constant Output Power modes”); **Node Reference** at 1 (“The APC dynamically adjusts the tilt reference (TILT REFERENCE) value to meet the target taking into consideration the Raman tilt (TILT RAMAN) that the Raman installation wizard calculates and the EDFA tilt (TILT EDFA) that is calculated by the OPT-RAMP-C or OPT-RAMP-CE card based on its GEDFA value: $TILT\ CTP\ setpoint = TILT\ RAMAN + TILT\ EDFA + TILT\ REFERENCE$ ”).

52. As another example, on information and belief, the 1Finity platforms, such as the Flashwave 7500 deployed in Comcast’s mesh/DWDM network, detect characteristics of the optical signal and compare detected characteristics of the optical signal to the at least one desired characteristic, wherein controlling includes controlling the at least one signal varying device to vary the optical signal until the detected characteristics correspond to the desired characteristics when the optical signal arrives at the processing nodes. **Fujitsu’s Response to State of Utah** at 659; *see also* **Flashwave 7500 Small Systems** at 1; *see also* **Flashwave 7500** at 1; *see also* **Optical Transport Systems/Networks** at 721:



See also id. at 722:



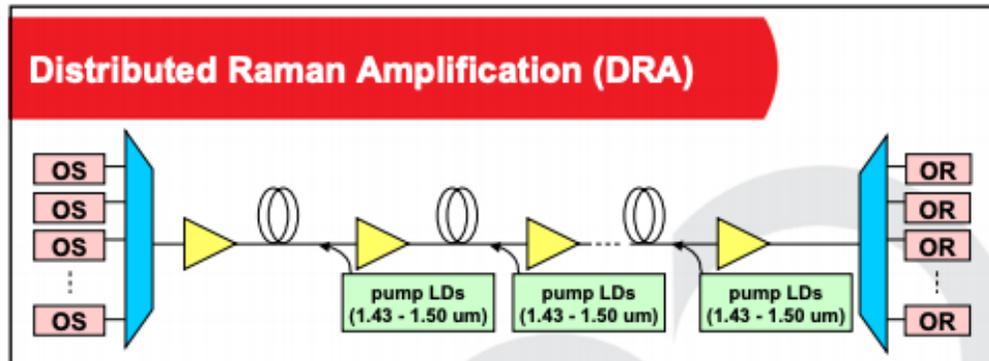
53. On information and belief, the '487 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, also select the at least one desired signal characteristic from the group consisting of signal-to-noise ratio, signal intensity, noise intensity, and combinations thereof. *See, e.g.*, "Cisco ONS 15454 DWDM Troubleshooting Guide, Releases 10.x.x Chapter: General Troubleshooting" ("**General Troubleshooting**") at 1 ("If the optical result indications (power, optical signal-to-noise ratio [OSNR], chromatic dispersion [CD], and so on) are all green, the repair procedure is complete."); *see also* "Cisco ONS 15454 DWDM Reference Manual, Releases 9.2.1 and 9.2.2" ("**Reference Manual**") at 1, *available at* https://www.cisco.com/c/en/us/td/docs/optical/15000r9_2_1/dwdm/reference/guide/454d921_referenceguide/454d921_hwspec.html (last visited Apr. 1, 2020) (showing various desired gain and noise figures for EDFAs and Raman amplifiers).

54. As another example, on information and belief, the 1Finity platforms, such as the Flashwave 7500 deployed in Comcast's mesh/DWDM network, select the at least one desired signal characteristic from the group consisting of signal-to-noise ratio, signal intensity, noise

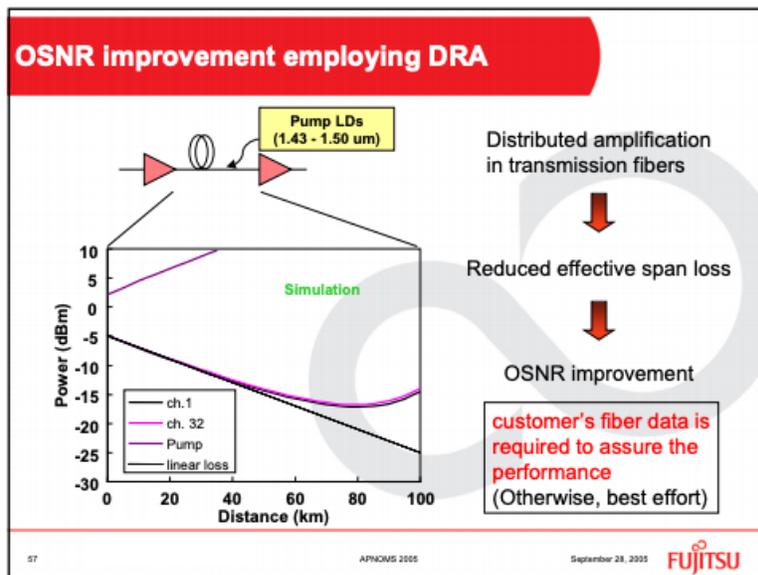
intensity, and combinations thereof to vary the optical signal until the detected characteristics.

See, e.g., **Fujitsu’s Response to State of Utah** at 659; see also **Flashwave 7500 Small Systems**

at 1; see also **Flashwave 7500** at 1; see also **Optical Transport Systems/Networks** at 721:



See also *id.* at 722:



55. Discovery is expected to uncover the full extent of Comcast’s unlawful use of Optic153’s patented technology in the ’487 Patent beyond the ’487 Accused Instrumentalities already identified through public information.

56. On information and belief, Comcast also directly infringed at least Claims 26-28 of the ’487 Patent by testing the ’487 Accused Instrumentalities, including in relation to network

testing and improvement responsive to user/customer feedback, and demonstration at trade shows, sales facilities, customer sites, and training/tutorial videos.

57. Plaintiff has suffered damages as a result of Comcast's infringement of the '487 Patent.

58. Plaintiff reserves the right to modify its infringement theories as discovery progresses in this case. Plaintiff shall not be estopped for purposes of its infringement contentions or its claim constructions by the foregoing discussions on how the '487 Accused Instrumentalities infringe the '487 Patent. Plaintiff intends only that the foregoing discussions satisfy the notice requirements of Rule 8(a)(2) of the Federal Rule of Civil Procedure, and that they should not be construed as Plaintiff's preliminary or final infringement contentions or preliminary or final claim construction positions.

COUNT III - INFRINGEMENT OF U.S. PATENT NO. 6,344,922

59. Plaintiff incorporates and realleges the preceding paragraphs as if fully set forth herein.

60. The '922 Patent is directed to systems and methods for controlling signal variation in an optical fiber, as described and claimed in the '922 Patent.

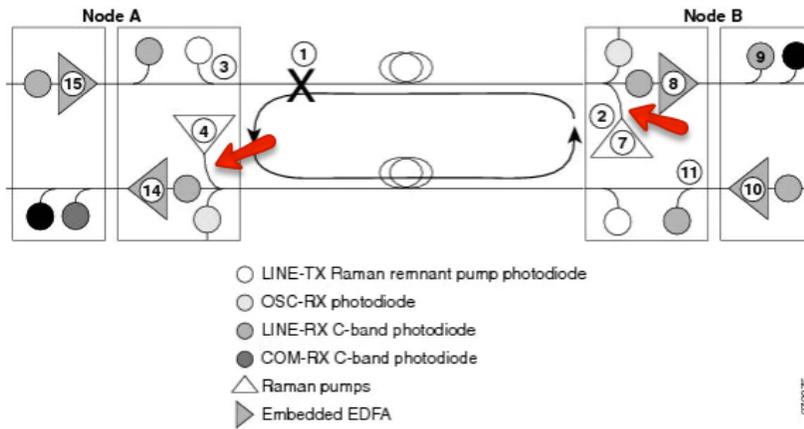
61. Comcast directly infringed at least Claim 32 of the '922 Patent, in this judicial District and elsewhere in the United States, pursuant to 35 U.S.C. § 271(a), literally or under the doctrine of equivalents, by, among other things, by making, using, selling, offering to sell, and/or importing in or into the United States, without authority: products, devices, systems, and/or components of systems that provide two pump sources with at least one being controlled to vary a signal variation profile and Raman gain ("'922 Accused Instrumentalities"). The '922 Accused Instrumentalities include, for example and without limitation, Comcast's optical communications

networks (e.g., Comcast Xfinity, mesh/DWDM networks, and nationwide fiber-optic networks; *see, e.g.*, <https://business.comcast.com/about-us/our-network>) that employ Raman C-Band optical amplifiers (e.g., OPT-RAMP-C, OPT-RAMP-CE, and EDRA-x-xx), counter-propagating (e.g., 15454-M-RAMAN-CTP/RAMAN-CTP card) and co-propagating (e.g., 15454-M-RAMAN-COP/RAMAN-COP card) Raman units, and Raman platforms and systems (e.g., Cisco's ONS15454 multiservice platforms, and/or telecommunications networks and systems (e.g., Comcast's mesh/DWDM networks))that deploy or have deployed such platforms or components.

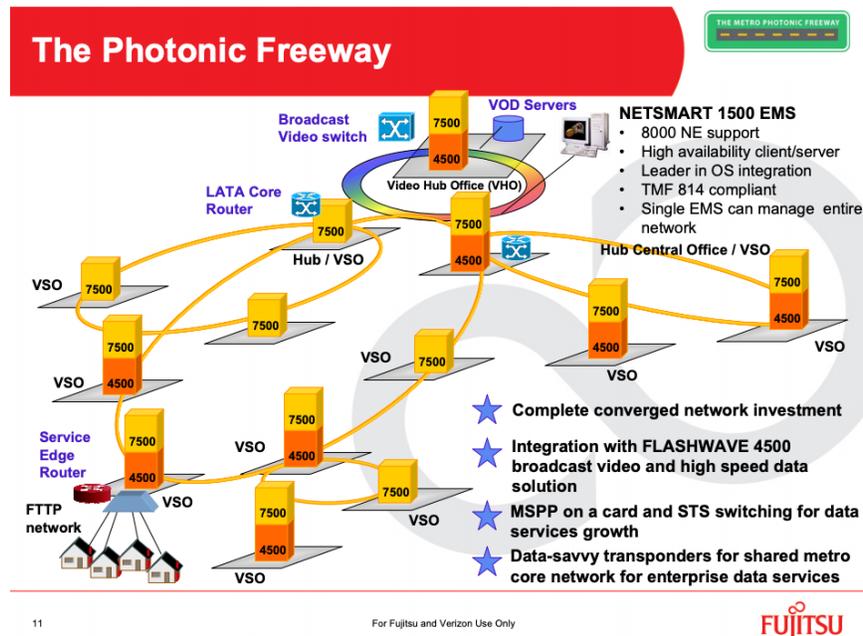
62. By way of example, the representative instrumentality, Comcast's mesh/DWDM networks, has deployed at least Cisco's ONS 15454 multiservice platforms in as early as 2008. The ONS 15454 multiservice transport platform includes Raman amplifiers such as, without limitations, OPT-RAMP-C, OPT-RAMP-CE, RAMAN-CTP, RAMAN-COP, and EDRA-x-xx.

63. More specifically, the '922 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, provide a computerized method of controlling signal variation in an optical fiber comprising providing an optical fiber suitable for transmitting optical signals (e.g., optical fiber(s) connected between optical nodes, optical terminal units, and optical network units) in at least one signal wavelength range (e.g., 1529.0 nm to 1562.5 nm) and facilitating Raman gain in the at least one signal wavelength range. *See, e.g.*, **Network Reference** at Fig. 30 (annotated):

Figure 30. Nodes Using OPT-RAMP-C or OPT-RAMP-CE Cards



See also Flashwave 7500 ROADM at 11:



64. Also, the '922 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, couple a first pump source (e.g., any one or combination of P1/PD11, P2/PD12, P3/PD13, and P4/PD14) to the fiber to provide pump energy in a first set of Raman wavelengths including a plurality of pump wavelengths (e.g., any one or combination of $\lambda P1$, $\lambda P2$, $\lambda P3$, and $\lambda P4$) having sufficient pump energy to produce Raman gain in the optical signal according to a signal variation profile in the signal wavelength range and a

second pump source (e.g., any one or combination of P1/PD11, P2/PD12, P3/PD13, and P4/PD14) configured to provide pump energy in at least a second set of Raman wavelengths (e.g., any one or combination of $\lambda P1$, $\lambda P2$, $\lambda P3$, and $\lambda P4$) to provide Raman gain in the first set of Raman wavelengths in said optical fiber. *See, e.g., Node Reference* at 1 (“The Raman pump is equipped with two different Raman pumps transmitting powers (P1 and P2) at two different wavelengths Lambda1 and Lambda2. During installation, the two pumps alternatively turn ON and OFF at two different power values. Lambda1 and Lambda2 signals are used as probes at the end of spans to measure Raman gain efficiency of the two Raman pumps separately.”); *see also id.* at Table 12:

Table 12. Example of Raman Power Measurements

Input	P1	P2	Probe Signal Power Received at Node B
Lambda1=1530.33 nm at Node A	Plow = 100 mW	Pmin = 8 mW	S1low
	Phigh = 250 mW	Pmin = 8 mW	S1high
Lambda2=1560.61 nm at Node A	Pmin = 8 mW	Plow = 100 mW	S2low
	Pmin = 8 mW	Phigh = 250 mW	S2low

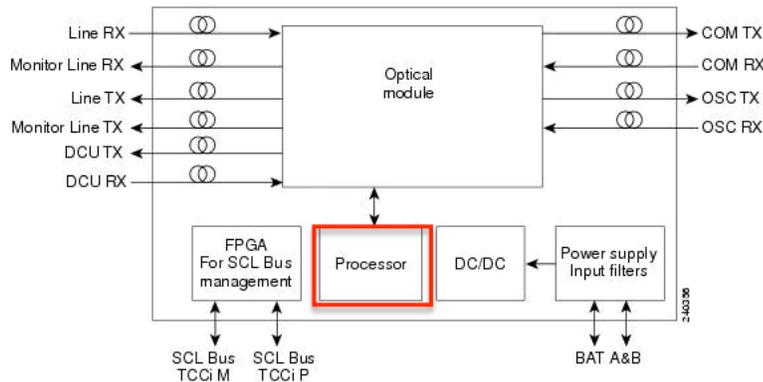
65. Further, the '922 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, monitor characteristics of the optical signals in a signal wavelength range passing through the optical fiber and controls the pump energy supplied by the at least one of the first and second pump sources in at least one of the pump wavelengths to vary the signal variation profile (e.g., from 8.5dB to 13.5dB) and Raman gain to provide Raman amplification, attenuation, and lossless transmission over the signal wavelength range in the optical fiber. *See, e.g., Network Reference* at 1 (“Amplifiers monitor the changes to the input power and change the output power proportionately according to the calculated gain

setpoint ... After the GEDFA is set, APC regulates the power on the VOA (DC-TX port) of the OPT-RAMP-C or OPT-RAMP-CE card to match the target Power (COM-TX port) value, and accounts for the actual DCU loss. ... The APC adjusts the VOA attenuation of the OPT-RAMP-C or OPT-RAMP-CE card if the Total Power (LINE-TX port) does not match the expected value that is equal to the maximum power multiplied by the number of active channels. The VOA attenuation value on the OPT-RAMP-C or OPT-RAMP-CE cards is set to 15 dB. This value ensures that the system turns up in any circumstance.”); *see also* **Raman C-Band Datasheet at 1** (“The OPT-RAMP-C also provides an embedded fast Gain Control for transient suppression to respond quickly to network changes without impairments and degradation of existing wavelengths. In addition to this, the unit features an embedded Gain Flattening Filter (GFF) for the compensation of the ripple generated by the cascaded Raman and EDFA stages. The amplifier integrates a software-controllable variable optical attenuator (VOA) to provide gain tilt control capabilities and to optimize and control the per-channel power at the input of the mid-access loss for dispersion compensation units (DCUs). ... A dedicated software application has been incorporated in Cisco Transport Controller to allow a fully automatic and simple configuration and tuning of the optical Raman amplifiers along a DWDM link. This software application, called Raman Tuning Wizard, can take advantage of tunable Transponder or Muxponder units to evaluate the physical characteristics of the span’s fiber, determine the optimal mix of Raman pump wavelengths, and define the contribution of Raman versus EDFA for the overall optical amplification of the unit.”); *see also* **Node Reference at 1** (“Automatic Raman Pump Calculation The Raman gain depends on the characteristics of the span (fiber type and span loss). To obtain optimum Raman gain, a correct mix of pump powers must be provisioned. Tuning of the four Raman pumps is crucial before traffic is provisioned. The tuning

procedure is called Automatic Raman Power Calculation (ARPC). This procedure assesses the Raman gain on a C-band signal using pre-defined Raman pump values. ARPC applies to the RAMAN-CTP and EDRA cards.”); *see also* **Release 9.6x Optical Amplifier Cards** at Fig. 5-20 (showing a processor to monitor characteristics of the optical signals in a signal wavelength range passing through the optical fiber and control the pump energy) (annotated):

Figure 5-20 shows a simplified block diagram of the OPT-RAMP-C and OPT-RAMP-CE card features.

Figure 5-20 OPT-RAMP-C and OPT-RAMP-CE Block Diagram



66. Discovery is expected to uncover the full extent of Comcast’s unlawful use of Optic153’s patented technology in the ’922 Patent beyond the ’922 Accused Instrumentalities already identified through public information.

67. On information and belief, Comcast also directly infringed at least Claim 32 of the ’922 Patent by testing the ’922 Accused Instrumentalities, including in relation to network testing and improvement responsive to user/customer feedback, and demonstration at trade shows, sales facilities, customer sites, and training/tutorial videos.

68. Plaintiff has suffered damages as a result of Comcast’s infringement of the ’922 Patent.

69. Plaintiff reserves the right to modify its infringement theories as discovery progresses in this case. Plaintiff shall not be estopped for purposes of its infringement

contentions or its claim constructions by the foregoing discussions on how the '922 Accused Instrumentalities infringe the '922 Patent. Plaintiff intends only that the foregoing discussions satisfy the notice requirements of Rule 8(a)(2) of the Federal Rule of Civil Procedure, and that they should not be construed as Plaintiff's preliminary or final infringement contentions or preliminary or final claim construction positions.

COUNT IV - INFRINGEMENT OF U.S. PATENT NO. 6,356,383

70. Plaintiff incorporates and realleges the preceding paragraphs as if fully set forth herein.

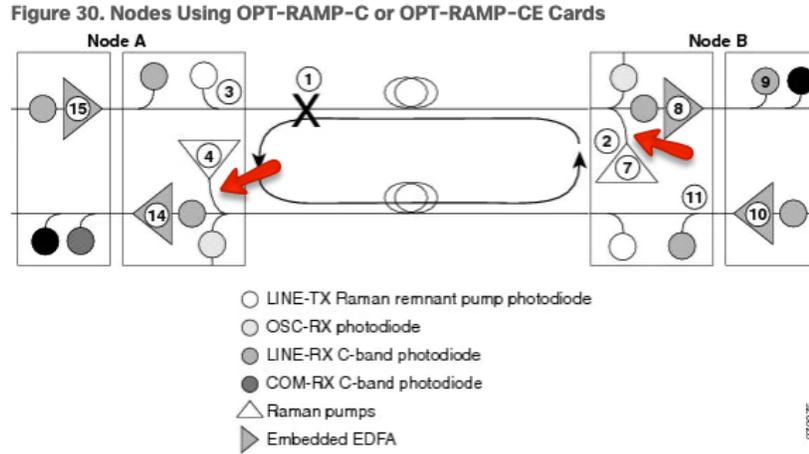
71. The '383 Patent is directed to systems and methods for amplifying optical signals, as described and claimed in the '383 Patent.

72. Comcast directly infringed at least Claims 1-2 of the '383 Patent, in this judicial District and elsewhere in the United States, pursuant to 35 U.S.C. § 271(a), literally or under the doctrine of equivalents, by, among other things, by making, using, selling, offering to sell, and/or importing in or into the United States, without authority: products, devices, systems, and/or components of systems that counter-propagate and co-propagate optical energy to produce a desired Raman amplification ("'383 Accused Instrumentalities"). The '383 Accused Instrumentalities include, for example and without limitation, Comcast's optical communications networks (e.g., Comcast Xfinity, mesh/DWDM networks, and nationwide fiber-optic networks; *see, e.g.,* <https://business.comcast.com/about-us/our-network>) that employ counter-propagating (e.g., 15454-M-RAMAN-CTP/RAMAN-CTP card) and co-propagating (e.g., 15454-M-RAMAN-COP/RAMAN-COP card) Raman units, Raman platforms and systems (e.g., Cisco's ONS15454 multiservice platforms, and/or other telecommunications networks and systems that deploy or have deployed such platforms or components).



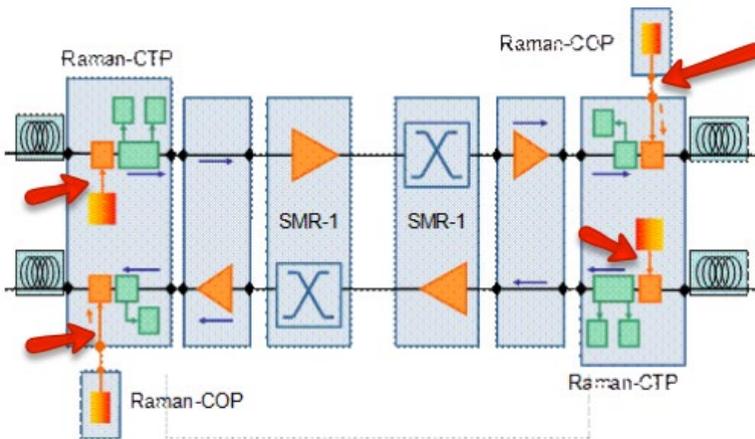
See, e.g., “High Power Counter-Propagating and Co-Propagating Raman units for the Cisco ONS 15454 Multiservice Transport Platform (MSTP)” (“**15454 MSTP Datasheet**”) at 1, available at https://www.cisco.com/c/en/us/products/collateral/optical-networking/ons-15454-series-multiservice-provisioning-platforms/data_sheet_c78-658538.html (last visited Apr. 1, 2020).

74. More specifically, the '383 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, perform a method of amplifying optical signals comprising transmitting optical signals in a transmission media (e.g., optical fiber(s) connected between optical nodes, optical terminal units, and optical network units) configured to transmit and provide Raman amplification of the optical signals. See, e.g., **Network Reference** at Fig. 30 (annotated):



See also **15454 MSTP Datasheet** at 1 (“The high power counter-propagating unit injects counter-propagating optical power to generate a Raman effect in the span fiber and thus amplifies the signals propagating in the same fiber. Similarly, the co-propagating Raman unit injects co-propagating optical power that also amplifies the signal through a Raman effect in fiber. The signal thus receives amplification from the optical power injected by both these units present on opposite ends of the span”); see also *id.* at Fig. 5 (annotated):

Figure 5. Equalization Stage with Single-Module ROADM 1 (SMR-1) and Counter- and Co-Propagating Raman Amplifiers



75. Also, the '383 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, counter-propagate optical energy in the transmission media in a first pump wavelength range (e.g., 1428 nm to 1457 nm or ζP1 and ζP2

via Pumps 1-4) to produce Raman amplification of the optical signals, wherein the Raman amplification has a corresponding noise figure profile over an optical signal wavelength range (e.g., 1500 to 1567 nm); and, co-propagate optical energy with the optical signals in a second pump wavelength range (e.g., 1428 nm to 1457 nm or λ_{P1} and λ_{P2} via Pumps 1-4) to vary the noise figure profile of the Raman amplification produced by said counter-propagating optical energy over at least a portion of the optical signal wavelength range. wherein said co-propagating includes co-propagating optical energy in the second pump wavelength range that overlaps with shorter wavelengths in the first wavelength range (e.g., 1428 nm). *See also*

Provisioning Optical Amplifier Cards at 1 (annotated):

RAMAN-CTP and RAMAN-COP Cards Power Monitoring

Physical photodiodes P1 through P10 monitor the power for the RAMAN-CTP card.

Table 2 RAMAN-CTP Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	DFB in-fiber Output Power	LINE-TX
P2	DWDM RX Input Power	LINE-RX
P3	Pump 1 in-fiber Output Power	LINE-RX
P4	Pump 2 in-fiber Output Power	LINE-RX
P5	Total Pump in-fiber Output Power	LINE-RX
P6	Back-Reflected Pump Power	LINE-RX
P7	DWDM TX Input Power	COM-RX
P8	Total Co-Pump in-fiber Output Power	LINE-TX
P9	DFB Input Power	LINE-RX
P10	ASE Input Power	LINE-RX

Physical photodiodes P3 through P6 monitor the power for the RAMAN-COP card.

Table 3 RAMAN-CTP Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P3	Pump 1 in-fiber Output Power	RAMAN-TX
P4	Pump 2 in-fiber Output Power	RAMAN-TX
P5	Total Pump in-fiber Output Power	RAMAN-TX
P6	Back-Reflected Pump Power	RAMAN-TX

See also 15454 MSTP Datasheet at Figs. 2-3:

Table 5. Optical Amplifier Specifications

Specification	Counter-Propagating Unit	Co-Propagating Unit
Pump wavelength	1428 nm (pumps 1 and 2) 1457 nm (pumps 3 and 4)	1428 nm (pumps 1 and 2) 1457 nm (pumps 3 and 4)
Raman pump unit class	1 M	1 M
Operating range Raman pump power	100 to 1000 mW	200 to 1000 mW
Maximum output power: pump laser 1+ 2 (1428 nm)	500 mW	550 mW
Maximum output power: pump laser 1+ 2 (1457 nm)	500 mW	500 mW
Pump-power set resolution	0.1 mW (maximum)	0.1 mW (maximum)
Pump-power precision	+ or - 2%	+ or - 2%
Optical power-settling time	0.1 to 1 sec	0.1 to 1 sec
Maximum optical output power - LINE Rx port	1200 mW (maximum)	1200 mW (maximum)
C-band signal wavelength range	1500 to 1567 nm (96 channels)	C-band wavelengths do not propagate through this card.

See also “Practical Aspects of Raman Amplifier” (“**Practical Aspects of Raman Amplifier**”) at 1, available at <https://www.cisco.com/c/en/us/support/docs/optical-networking/ons-15454-m6-multiservice-transport-platform-mstp/212834-practical-aspects-of-raman-amplifier.html> (last visited Apr. 1, 2020) (“Noise Sources Noise created in a DRA span consists: Amplified Spontaneous Emissions (ASE) Double Rayleigh Scattering (DRS) Pump Laser Noise ASE noise is due to photon generation by spontaneous Raman scattering. DRS noise occurs when twice reflected signal power due to Rayleigh scattering is amplified and interferes with the original signal as crosstalk noise. ... Counter pump DRA configuration results in better OSNR performance for signal gains of 15 dB and greater. ... For fibers with low DRS noise, the Raman noise figure due to ASE is much better than the EDFA noise figure. Typically, the Raman noise figure is -2 to 0 dB, which is about 6 dB better than the EDFA noise figure.”).

76. Further, the '383 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, transmit optical signals in a signal wavelength range from 1530-1570 nm; counter-propagate optical energy in the first pump wavelength range from 1410 to 1480 nm (e.g., from 1428 nm to 1457 nm); and co-propagate

optical energy in the second pump wavelength range from 1410 to 1430 nm (e.g., from 1428 nm to 1457 nm). *See, e.g., 15454 MSTP Datasheet* at Table 5:

Table 5. Optical Amplifier Specifications

Specification	Counter-Propagating Unit	Co-Propagating Unit
Pump wavelength	1428 nm (pumps 1 and 2) 1457 nm (pumps 3 and 4)	1428 nm (pumps 1 and 2) 1457 nm (pumps 3 and 4)
Raman pump unit class	1 M	1 M
Operating range Raman pump power	100 to 1000 mW	200 to 1000 mW
Maximum output power: pump laser 1+ 2 (1428 nm)	500 mW	550 mW
Maximum output power: pump laser 1+ 2 (1457 nm)	500 mW	500 mW
Pump-power set resolution	0.1 mW (maximum)	0.1 mW (maximum)
Pump-power precision	+ or - 2%	+ or - 2%
Optical power-settling time	0.1 to 1 sec	0.1 to 1 sec
Maximum optical output power - LINE Rx port	1200 mW (maximum)	1200 mW (maximum)
C-band signal wavelength range	1500 to 1567 nm (96 channels)	C-band wavelengths do not propagate through this card.

77. Discovery is expected to uncover the full extent of Comcast's unlawful use of Optic153's patented technology in the '383 Patent beyond the '383 Accused Instrumentalities already identified through public information.

78. On information and belief, Comcast also directly infringed at least Claims 1-2 of the '383 Patent by testing the '383 Accused Instrumentalities, including in relation to network testing and improvement responsive to user/customer feedback, and demonstration at trade shows, sales facilities, customer sites, and training/tutorial videos.

79. Plaintiff has suffered damages as a result of Comcast's infringement of the '383 Patent.

80. Plaintiff reserves the right to modify its infringement theories as discovery progresses in this case. Plaintiff shall not be estopped for purposes of its infringement contentions or its claim constructions by the foregoing discussions on how the '383 Accused Instrumentalities infringe the '383 Patent. Plaintiff intends only that the foregoing discussions

satisfy the notice requirements of Rule 8(a)(2) of the Federal Rule of Civil Procedure, and that they should not be construed as Plaintiff's preliminary or final infringement contentions or preliminary or final claim construction positions.

COUNT V - INFRINGEMENT OF U.S. PATENT NO. 6,587,261

81. Plaintiff incorporates and realleges the preceding paragraphs as if fully set forth herein.

82. The '261 Patent is directed to systems and methods for amplifying optical signals, as described and claimed in the '261 Patent.

83. Comcast directly infringed at least Claims 1 and 10 of the '261 Patent, in this judicial District and elsewhere in the United States, pursuant to 35 U.S.C. § 271(a), literally or under the doctrine of equivalents, by, among other things, by making, using, selling, offering to sell, and/or importing in or into the United States, without authority: products, devices, systems, and/or components of systems that supply optical energy in a plurality of pump wavelengths based on a characterized amplifier performance to control amplification signal wavelengths in an optical signal ("'261 Accused Instrumentalities"). The '261 Accused Instrumentalities include, for example and without limitation, Comcast's optical communications networks and systems (e.g., Comcast Xfinity, mesh/DWDM networks, and nationwide fiber-optic networks; *see, e.g.*, <https://business.comcast.com/about-us/our-network>) that employ Cisco's ONS 15454 Series platform, NCS 2000 Series network platform, and GS7000 Optical Hub, and Fujitsu's 1Finity platforms including Flashwave 7500, and/or other telecommunications networks and systems that deploy or have deployed such platforms or components.

84. By way of example, the representative instrumentality, Comcast's mesh/DWDM networks, has deployed at least Cisco's ONS 15454 Multiservice platform in as early as 2008.

See, e.g., DWDM Technology at 1. The ONS 15454 Multiservice platform includes erbium doped fiber amplifiers (e.g., OPT-AMP-xx-x, OPT-EDFA-xx, SMRX-X, and Enhanced C-Band 96-Channel EDFA Amplifiers) and Raman amplifiers (e.g., OPT-RAMP-C, OPT-RAMP-CE, and EDRA-x-xx). *See, e.g., Enhanced C-Band for 15454 MSTP Data Sheet* at 1; *see also Provisioning Optical Amplifier Cards* at 1.

85. As another example, Comcast's mesh/DWDM networks has deployed Fujitsu's Flashwave 7500 since as early as 2008. *See, e.g., Fujitsu Adds Mid-Range ROADM* at 1 ("Its flagship Flashwave 7500 system has been deployed in 220 nodes across five MSOs, including Comcast Corp. and Cox Communications Inc., largely to handle VOD traffic"). The Flashwave 7500 employs EDFA and Raman amplifiers. *See Fujitsu's Response to State of Utah* at 659; *see also Flashwave 7500 Small Systems Data Sheet* at 1.

86. More specifically, the '261 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, perform a method of amplifying optical signals comprising providing an optical amplifier (e.g., EDFA or Raman amplifiers) in an optical transmission fiber including an amplifying fiber configured to receive power as optical energy in a plurality of pump wavelengths. *See, e.g., Release 9.6x Optical Amplifier Cards* at 1 (listing all suitable concentrated optical amplifiers including OPT-EDFA-xx, EDRAx-xx, OPT-AMP-C, OPT-AMP-17C, OPT-RAMP-C, OPT-RAMP-CE, RAMAN-CTP, and RAMAN-COP):

Table 5-1 Optical Amplifier Cards for the ONS 15454

Card	Port Description	For Additional Information
OPT-PRE	The OPT-PRE amplifier has five optical ports (three sets) located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-PRE Amplifier Card" section.
OPT-BST	The OPT-BST amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-BST and OPT-BST-E Amplifier Card" section.
OPT-BST-E	The OPT-BST-E amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-BST and OPT-BST-E Amplifier Card" section.
OPT-BST-L	The OPT-BST-L L-band amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-BST-L Amplifier Card" section.
OPT-AMP-L	The OPT-AMP-L L-band preamplifier has five sets of optical ports located on the faceplate. It is a two-slot card that operates in Slots 1 to 6 and 12 to 17.	See the "OPT-AMP-L Card" section.
OPT-AMP-17-C	The OPT-AMP-17-C C-band low-gain preamplifier/booster amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-AMP-17-C Card" section.
OPT-AMP-C	The OPT-AMP-C C-band high-gain, high-power preamplifier/booster amplifier has five sets of optical ports located on the faceplate. It operates as a preamplifier when equipped and provisioned in Slots 2 to 6 and 11 to 16 or as a booster amplifier when equipped and provisioned in Slot 1 and 17.	See the "OPT-AMP-C Card" section.
OPT-RAMP-C	The OPT-RAMP-C C-band amplifier has five sets of optical ports located on the faceplate and operates in Slots 1 to 5 and 12 to 16.	See the "OPT-RAMP-C and OPT-RAMP-CE Cards" section.
OPT-RAMP-CE	The OPT-RAMP-CE C-band amplifier has five sets of optical ports located on the faceplate and operates in Slots 1 to 5 and 12 to 16.	See the "OPT-RAMP-C and OPT-RAMP-CE Cards" section.
RAMAN-CTP	The RAMAN-CTP amplifier is a single-slot card and has six optical ports located on the faceplate. The RAMAN-CTP and RAMAN-COP units must be installed in adjacent slots (Slots 2 and 3, 4 and 5, or 6 and 7) in the ONS 15454 M6 chassis and Slots 2 and 3 in the ONS 15454 M2 chassis.	See the "RAMAN-CTP and RAMAN-COP Cards" section. 
RAMAN-COP	The RAMAN-COP amplifier has one optical port located on the faceplate. It is a single-slot card and works in conjunction with the RAMAN-CTP amplifier.	See the "RAMAN-CTP and RAMAN-COP Cards" section.
OPT-EDFA-17	The OPT-EDFA-17 amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-EDFA-17 and OPT-EDFA-24 Cards" section.
OPT-EDFA-24	The OPT-EDFA-24 amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-EDFA-17 and OPT-EDFA-24 Cards" section.

See also **Raman C-Band Datasheet** at 1 ("A Raman amplifier uses intrinsic properties of silica fibers to obtain signal amplification. This means that transmission fibers can be used as a medium for amplification, and hence that the intrinsic attenuation of data signals transmitted

over the fiber can be combated within the fiber. An amplifier working on the basis of this principle is commonly known as a distributed Raman amplifier (DRA) or simply Raman amplifier. The OPT-RAMP-C unit not only embeds efficient next-generation pump lasers to generate counter-propagating Raman effect in the span fiber but also a low-noise Erbium Doped Fiber Amplifier (EDFA) to optimize the overall Noise Figure of the Node.”).

87. As another example, on information and belief, the 1Finity platforms, such as the Flashwave 7500 deployed in Comcast’s mesh/DWDM network, provide an optical amplifier (e.g., EDFA or Raman amplifiers) in an optical transmission fiber including an amplifying fiber (e.g., the amplifying fiber connected to either the EDFA or Raman amplifiers) configured to receive power as optical energy in a plurality of pump wavelengths.

88. Also, the ’261 Accused Instrumentalities, including the representative instrumentality, Comcast’s mesh/DWDM networks, characterize the amplifier performance for optical signals passing through the transmission fiber and amplifying fiber as a function of the optical energy provided in the plurality of pump wavelengths. *See, e.g., Network Reference* at 1 (“Amplifiers monitor the changes to the input power and change the output power proportionately according to the calculated gain setpoint.”); *see also id. Provisioning Optical Amplifier Cards* at Table 11 (monitoring input and output power of EDFA):

OPT-EDFA-17 and OPT-EDFA-24 Cards Power Monitoring

Physical photodiodes PD1 through PD6 monitor the power for the OPT-EDFA-17 and OPT-EDFA-24 cards.

Table 11 OPT-EDFA-17 and OPT-EDFA-24 Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	EDFA Input Power	COM-RX
P2	EDFA Output Power	LINE-TX
P3	EDFA Output Power	LINE-TX
P4	OSC ADD Input Power	OSC-RX
P5	OSC DROP Output Power	LINE-RX
P6	COM-TX Output Power	LINE-RX

See also id. at Table 6 (monitoring input and output power of EDRA):

EDRA-1-xx and EDRA-2-xx Cards Power Monitoring

The following table lists the physical photodiodes that monitor the power for the EDRA-1-xx and EDRA-2-xx cards.

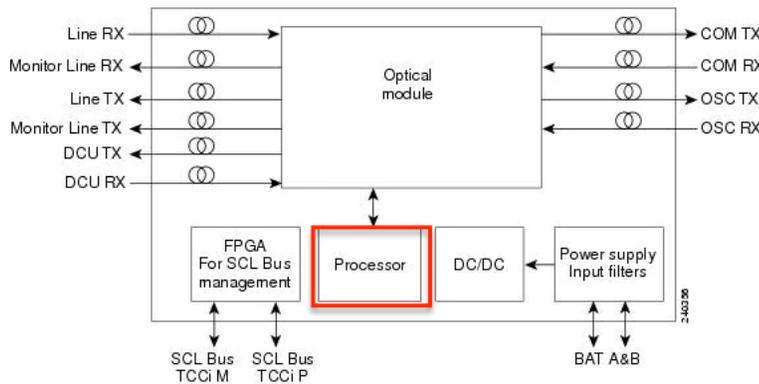
Table 6. EDRA-1-xx and EDRA-2-xx Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
PD1	Remnant Pump Input power	LINE-TX
PD2	OSC Add Input Power	OSC-RX
PD3	EDFA1 Input Power	LINE-RX
PD4	EDFA1 Output Power	COM-TX
PD5	EDFA2 Input Power	COM-RX
PD6	EDFA2/LINE-TX Output Power	LINE-TX
PD7	OSC Drop Output Power	LINE-TX
PD11	Pump λ 1 in-fibre Output Power	LINE-RX
PD12	Pump λ 2 in-fibre Output Power	LINE-RX
PD13	Pump λ 3 in-fibre Output Power	LINE-RX
PD14	Pump λ 4 in-fibre Output Power	LINE-RX
PD15	Total Pump in-fibre Output Power	LINE-RX
PD16	Back-Reflected Pump Power	LINE-RX
PD17	OTDR2-L Input Power	OTDR2-L-RX

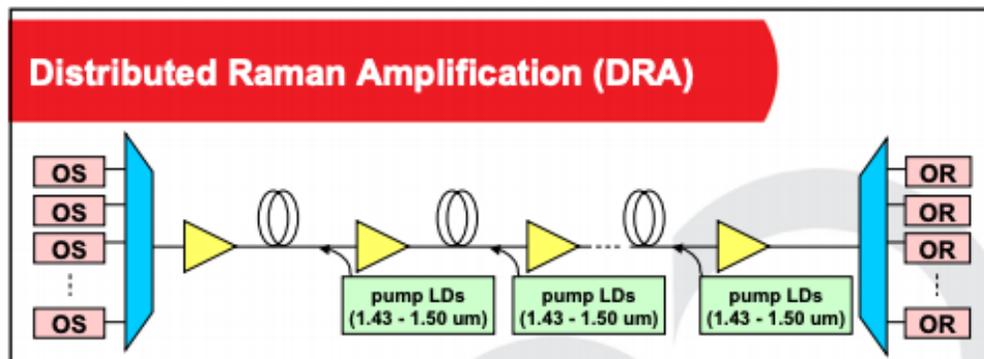
See also **Optical Amplifier Cards** at Fig. 5-20 (showing a processor to characterize the amplifier performance for optical signals passing through the transmission fiber and amplifying fiber) (annotated):

Figure 5-20 shows a simplified block diagram of the OPT-RAMP-C and OPT-RAMP-CE card features.

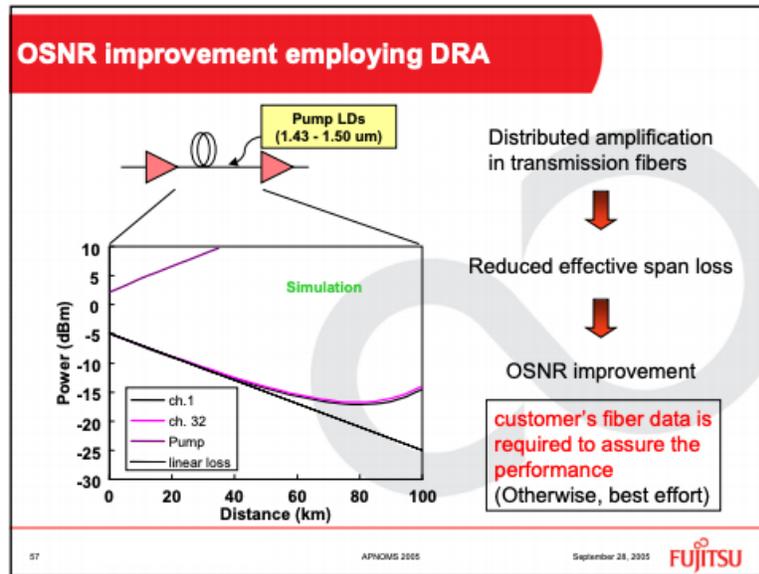
Figure 5-20 OPT-RAMP-C and OPT-RAMP-CE Block Diagram



89. As another example, on information and belief, the IFinity platforms, such as the Flashwave 7500 deployed in Comcast’s mesh/DWDM network, characterize the amplifier performance for optical signals passing through the transmission fiber and amplifying fiber as a function of the optical energy provided in the plurality of pump wavelengths. See also **Fujitsu’s Response to State of Utah** at 659 (showing the use and control of Raman amplifiers in Flashwave 7500); see also **Flashwave 7500 Small Systems** at 1 (showing the use and control of EDFA); see also **Flashwave 7500 at 1**; see also **Optical Transport Systems/Networks** at 721 (showing both transmission and amplifying fibers):



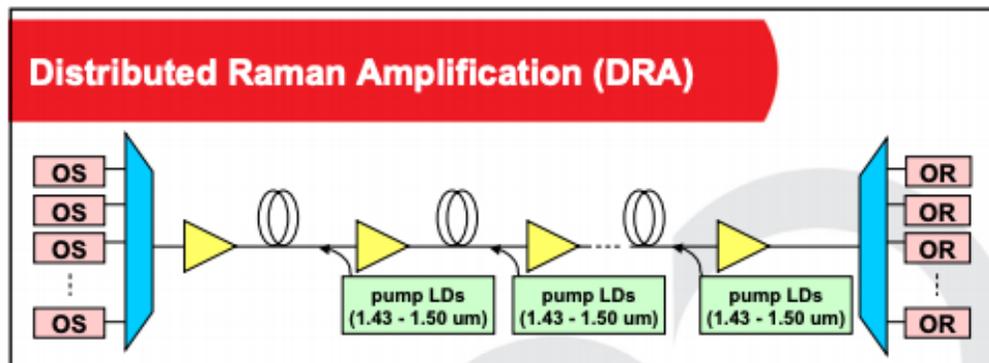
See also *id.* at 722:



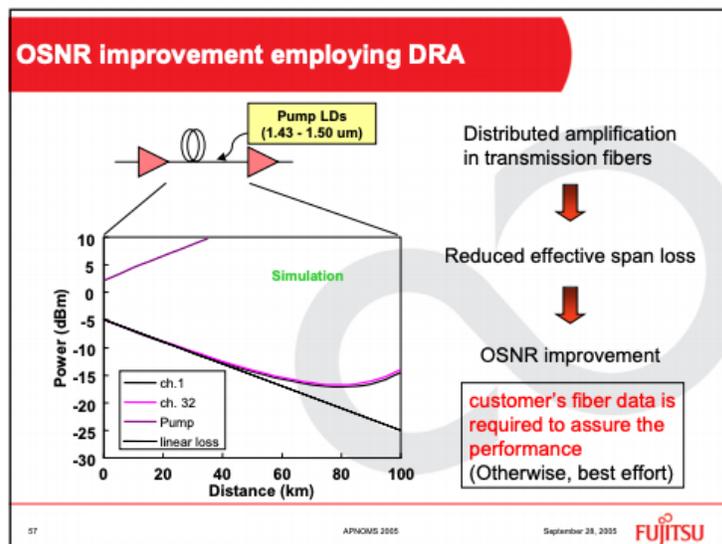
90. Further, the '261 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, supply optical energy in the plurality of pump wavelengths in an amount based on the characterized amplifier performance (e.g., to reach target power) to control the amplification of a plurality of signal wavelengths included in the optical signal. See, e.g., **Network Reference** at 1 ("After the GEDFA is set, APC regulates the power on the VOA (DC-TX port) of the OPT-RAMP-C or OPT-RAMP-CE card to match the target Power (COM-TX port) value, and accounts for the actual DCU loss."); see also **Provisioning Optical Amplifier Cards** at 1 ("OPT-AMP-C Card ... Fixed output power mode (mode used during provisioning) ... ASE compensation in Constant Gain and Constant Output Power modes ... OPT-EDFA-17 and OPT-EDFA-24 Cards ... Constant gain mode ... ASE compensation in Constant Gain and Constant Output Power modes"); **Node Reference** at 1 ("The APC dynamically adjusts the tilt reference (TILT REFERENCE) value to meet the target taking into consideration the Raman tilt (TILT RAMAN) that the Raman installation wizard calculates and the EDFA tilt (TILT EDFA) that is calculated by the OPT-RAMP-C or OPT-

RAMP-CE card based on its GEDFA value: TILT CTP setpoint = TILT RAMAN + TILT EDFA + TILT REFERENCE”).

91. As another example, on information and belief, the IFinity platforms, such as the Flashwave 7500 deployed in Comcast’s in mesh/DWDM network, supply optical energy in the plurality of pump wavelengths in an amount based on the characterized amplifier performance to control the amplification of a plurality of signal wavelengths included in the optical signal. *See Fujitsu’s Response to State of Utah* at 659 (showing the use and control of Raman amplifiers in Flashwave 7500); *see also Flashwave 7500 Small Systems* at 1 (showing the use and control of EDFA); *see also Flashwave 7500 at 1*; *see also Optical Transport Systems/Networks* at 721:



See also id. at 722:



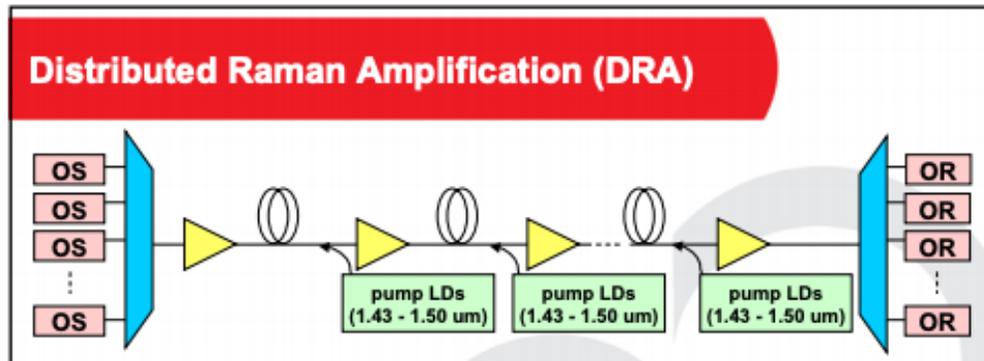
92. Further, the '261 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, perform a method of calibrating optical amplifier performance comprising installing an optical amplifier (e.g., EDFA or Raman amplifiers) in an optical transmission fiber. *See, e.g., Release 9.6x Optical Amplifier Cards at 1* (listing optical amplifiers including OPT-EDFA-xx, EDRAx-xx, OPT-AMP-C, OPT-AMP-17C, OPT-RAMP-C, OPT-RAMP-CE, RAMAN-CTP, and RAMAN-COP):

Table 5-1 Optical Amplifier Cards for the ONS 15454

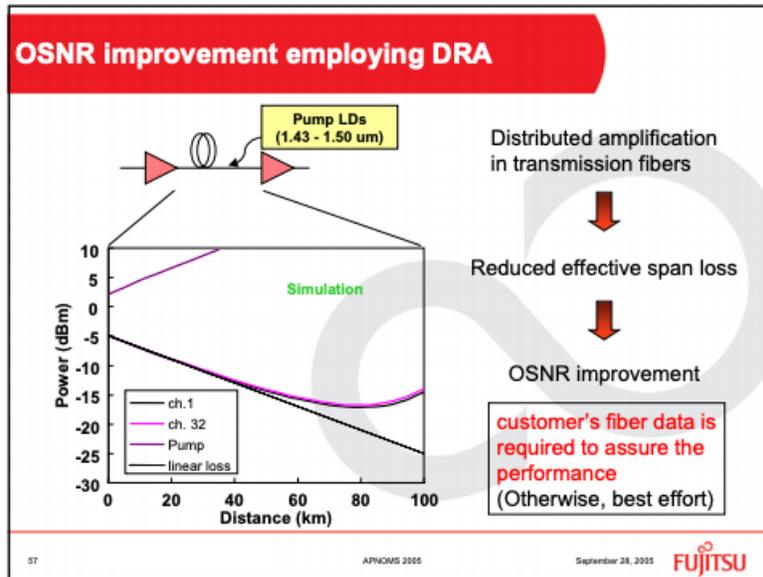
Card	Port Description	For Additional Information
OPT-PRE	The OPT-PRE amplifier has five optical ports (three sets) located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-PRE Amplifier Card" section.
OPT-BST	The OPT-BST amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-BST and OPT-BST-E Amplifier Card" section.
OPT-BST-E	The OPT-BST-E amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-BST and OPT-BST-E Amplifier Card" section.
OPT-BST-L	The OPT-BST-L L-band amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-BST-L Amplifier Card" section.
OPT-AMP-L	The OPT-AMP-L L-band preamplifier has five sets of optical ports located on the faceplate. It is a two-slot card that operates in Slots 1 to 6 and 12 to 17.	See the "OPT-AMP-L Card" section.
OPT-AMP-17-C	The OPT-AMP-17-C C-band low-gain preamplifier/booster amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-AMP-17-C Card" section.
OPT-AMP-C	The OPT-AMP-C C-band high-gain, high-power preamplifier/booster amplifier has five sets of optical ports located on the faceplate. It operates as a preamplifier when equipped and provisioned in Slots 2 to 6 and 11 to 16 or as a booster amplifier when equipped and provisioned in Slot 1 and 17.	See the "OPT-AMP-C Card" section.
OPT-RAMP-C	The OPT-RAMP-C C-band amplifier has five sets of optical ports located on the faceplate and operates in Slots 1 to 5 and 12 to 16.	See the "OPT-RAMP-C and OPT-RAMP-CE Cards" section.
OPT-RAMP-CE	The OPT-RAMP-CE C-band amplifier has five sets of optical ports located on the faceplate and operates in Slots 1 to 5 and 12 to 16.	See the "OPT-RAMP-C and OPT-RAMP-CE Cards" section.
RAMAN-CTP	The RAMAN-CTP amplifier is a single-slot card and has six optical ports located on the faceplate. The RAMAN-CTP and RAMAN-COP units must be installed in adjacent slots (Slots 2 and 3, 4 and 5, or 6 and 7) in the ONS 15454 M6 chassis and Slots 2 and 3 in the ONS 15454 M2 chassis.	See the "RAMAN-CTP and RAMAN-COP Cards" section. 

RAMAN-COP	The RAMAN-COP amplifier has one optical port located on the faceplate. It is a single-slot card and works in conjunction with the RAMAN-CTP amplifier.	See the "RAMAN-CTP and RAMAN-COP Cards" section.
OPT-EDFA-17	The OPT-EDFA-17 amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-EDFA-17 and OPT-EDFA-24 Cards" section
OPT-EDFA-24	The OPT-EDFA-24 amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "OPT-EDFA-17 and OPT-EDFA-24 Cards" section

93. As another example, on information and belief, the IFinity platforms, such as the Flashwave 7500 deployed in Comcast’s mesh/DWDM network, perform a method of calibrating optical amplifier performance comprising installing an optical amplifier (e.g., EDFA or Raman amplifiers) in an optical transmission fiber. See **Fujitsu’s Response to State of Utah** at 659; see also **Flashwave 7500 Small Systems** at 1; see also **Flashwave 7500 at 1**; see also **Optical Transport Systems/Networks** at 721:



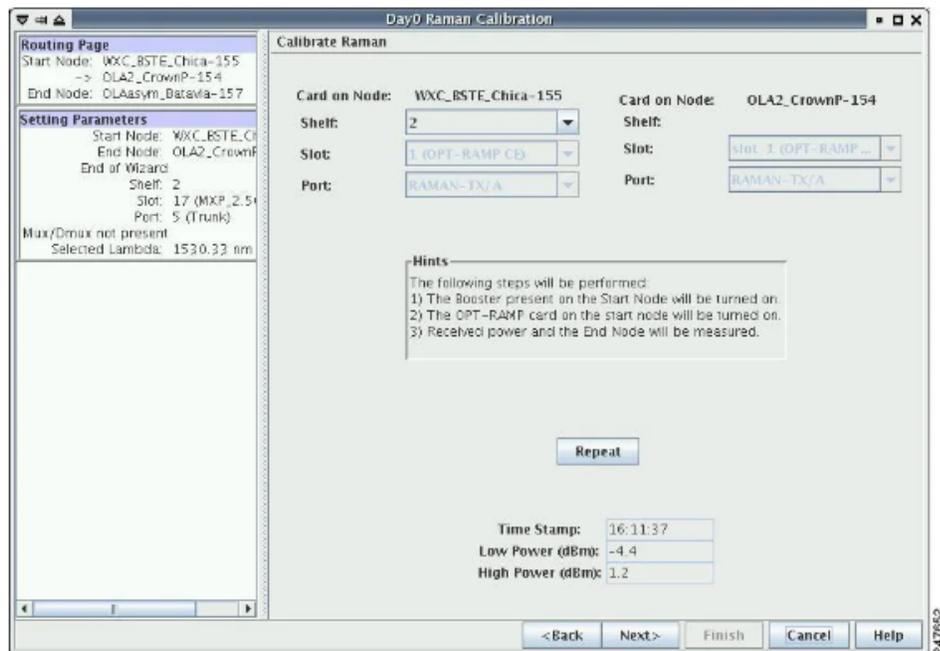
See also *id.* at 722:



94. Further, the '261 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, transmit test power through the transmission fiber and the optical amplifier and varying the power supplied to the optical amplifier. *See, e.g.*, "Cisco ONS 15454 DWDM Network Configuration Guide, Release 10.x.x, Chapter: Turning Up a Network," at Steps 8 and 9 of "DLP-G468 Configure the Raman Pump Using the Installation Wizard" ("**Turning Up a Network**"), *available at* https://www.cisco.com/c/en/us/td/docs/optical/15000r10_0/dwdm/network_config/guide/b_ons_network_configuration/b_ons_network_configuration_chapter_010001.html (last visited Apr. 1, 2020) (turning on amplifiers and calibrating Raman amplification using a software installation wizard):

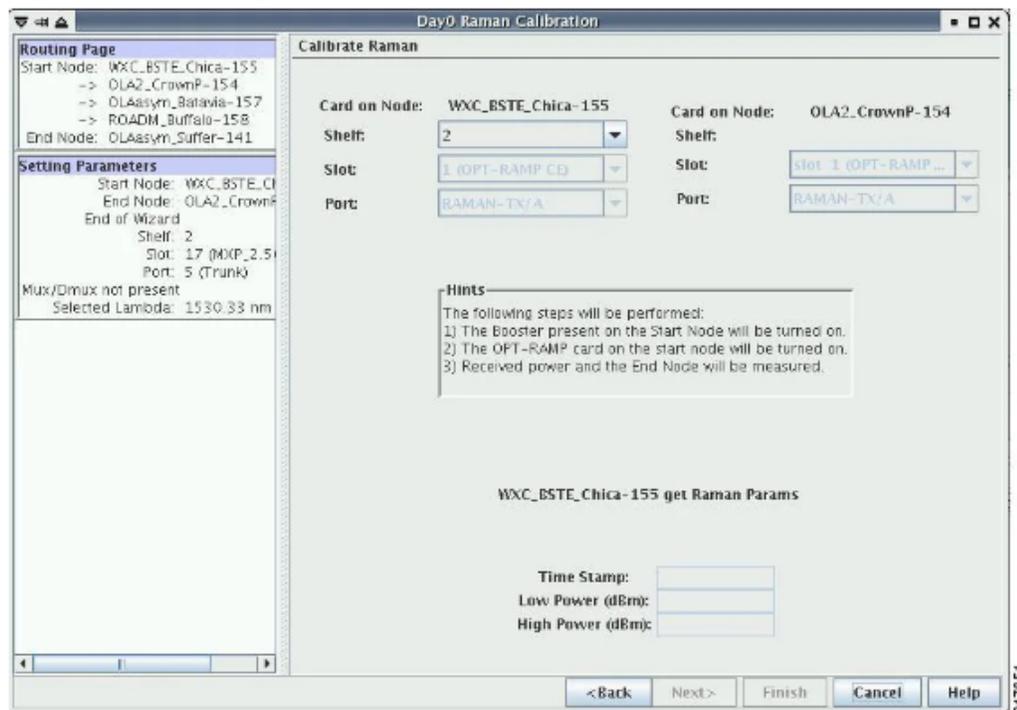
Step 8 Click **Next**. The Calibrate Raman Page is displayed (Figure 16-10).

Figure 10. Calibrating Raman Amplification



Step 9 As soon as the Raman calibrations are complete, the Next button is enabled. Click **Next**.

Figure 11. Calibrating Raman Amplification

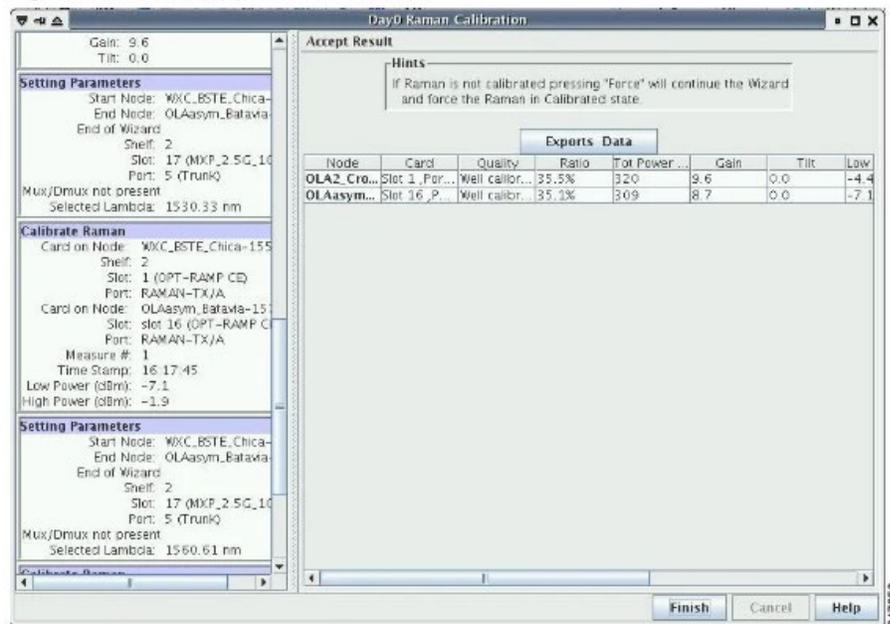


95. As another example, on information and belief, the 1Finity platforms, such as the Flashwave 7500 deployed in Comcast’s mesh/DWDM networks, transmit test power through the transmission fiber and the optical amplifier and vary the power supplied to the optical amplifier (e.g., as part of the system calibration and configuration). *See Fujitsu’s Response to State of Utah* at 659; *see also Flashwave 7500 Small Systems* at 1; *see also Flashwave 7500* at 1.

96. The ’261 Accused Instrumentalities, including the representative instrumentality, Comcast’s mesh/DWDM networks, measure the test power transmitted through the optical amplifier as a function of the power supplied to the optical amplifier; and, calculate amplifier performance parameters based on the measured test powers to characterize the amplification of a plurality of signal wavelengths as a function of the power supplied to the amplifier. *See, e.g., Turning Up a Network* at 1 (at Steps 12 and 13) of “DLP-G468 Configure the Raman Pump Using the Installation Wizard” (measuring test power and calculating Raman gain):

Step 12 Click Next. The Accept Results page is displayed (Figure 16-12).

Figure 12. Raman Amplification Results



The calculated Raman power and Raman gain are displayed. (Figure 16-12.)

See also id. at Step 13 (“The wizard compares the calculated Raman gain value with the expected results. Your action depends on the Raman gain values: Expected gain (Gt) – 0.5 dB <= (gain) <= (expected gain) + 0.5 dB—If the Raman gain is within this range, it means that the setup procedure was successful. Go to Step 14. (Expected gain) - 3.0 dB <= (gain) <= (expected gain) – 0.5 dB—If the Raman gain is within this range, it means that the values are slightly outside the range. The wizard recommends that you verify the span length and cabling, and repeat the installation wizard procedure.”).

97. As another example, on information and belief, the 1Finity platforms, such as the Flashwave 7500 deployed in Comcast’s mesh/DWDM networks, measure the test power transmitted through the optical amplifier as a function of the power supplied to the optical amplifier; and, calculate amplifier performance parameters based on the measured test powers to characterize the amplification of a plurality of signal wavelengths as a function of the power supplied to the amplifier (e.g., as part of the system calibration and configuration). *See Fujitsu’s Response to State of Utah* at 659; *see also Flashwave 7500 Small Systems* at 1; *see also Flashwave 7500* at 1.

98. Discovery is expected to uncover the full extent of Comcast’s unlawful use of Optic153’s patented technology in the ’261 Patent beyond the ’261 Accused Instrumentalities already identified through public information.

99. On information and belief, Comcast also directly infringed at least Claims 1 and 10 of the ’261 Patent by testing the ’261 Accused Instrumentalities, including in relation to network testing and improvement responsive to user/customer feedback, and demonstration at trade shows, sales facilities, customer sites, and training/tutorial videos.

100. Plaintiff has suffered damages as a result of Comcast's infringement of the '261 Patent.

101. Plaintiff reserves the right to modify its infringement theories as discovery progresses in this case. Plaintiff shall not be estopped for purposes of its infringement contentions or its claim constructions by the foregoing discussions on how the '261 Accused Instrumentalities infringe the '261 Patent. Plaintiff intends only that the foregoing discussions satisfy the notice requirements of Rule 8(a)(2) of the Federal Rule of Civil Procedure, and that they should not be construed as Plaintiff's preliminary or final infringement contentions or preliminary or final claim construction positions.

COUNT VI - INFRINGEMENT OF U.S. PATENT NO. 6,771,413

102. Plaintiff incorporates and realleges the preceding paragraphs as if fully set forth herein.

103. The '413 Patent is directed to systems and methods for transmitting optical signals, as described and claimed in the '413 Patent.

104. Comcast directly infringed at least Claims 1 and 10 of the '413 Patent, in this judicial District and elsewhere in the United States, pursuant to 35 U.S.C. § 271(a), literally or under the doctrine of equivalents, by, among other things, by making, using, selling, offering to sell, and/or importing in or into the United States, without authority: products, devices, systems, and/or components of systems that counter pump and co-pump optical energy to produce Raman amplification in an optical fiber ("'413 Accused Instrumentalities"). The '413 Accused Instrumentalities include, for example and without limitation, Comcast's optical communications networks (e.g., Comcast Xfinity, mesh/DWDM networks, and nationwide fiber-optic networks; *see, e.g.*, <https://business.comcast.com/about-us/our-network>) that employ counter-propagating

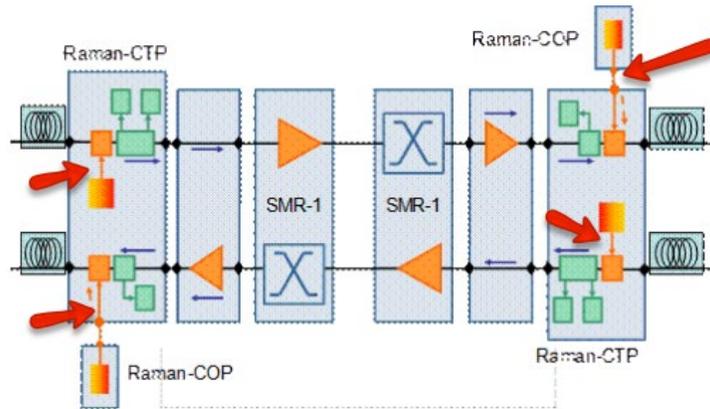


See **15454 MSTP Datasheet** at 1.

106. More specifically, the '413 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, perform a method of transmitting optical signals comprising transmitting optical signals, in an optical signal wavelength range (e.g., 1500 to 1567 nm), via a transmission media (e.g., an optical fiber) and amplifying the optical signals a plurality of times at a plurality of separate locations (e.g., where the counter-propagating and co-propagating amplifiers are located along the transmission) to produce a composite optical signal gain profile, wherein amplifying includes counter pumping optical energy in the transmission media in a first pump wavelength range (e.g., 1428 nm to 1457 nm or ζ P1 and ζ P2 via Pumps 1-4) and co-pumping optical energy in the transmission media in a

second pump wavelength range (e.g., 1428 nm to 1457 nm or $\lambda P1$ and $\lambda P2$ via Pumps 1-4) to produce Raman amplification of the optical signals. See **15454 MSTP Datasheet** at 1 (“The high power counter-propagating unit injects counter-propagating optical power to generate a Raman effect in the span fiber and thus amplifies the signals propagating in the same fiber. Similarly, the co-propagating Raman unit injects co-propagating optical power that also amplifies the signal through a Raman effect in fiber. The signal thus receives amplification from the optical power injected by both these units present on opposite ends of the span”); see also *id.* at Fig. 5 (annotated):

Figure 5. Equalization Stage with Single-Module ROADM 1 (SMR-1) and Counter- and Co-Propagating Raman Amplifiers



See also *id.* at Figs. 2 and 3:

Figure 2. Functional Block Diagram for the Cisco ONS 15454 MSTP High-Power Counter-Propagating Raman Amplifier

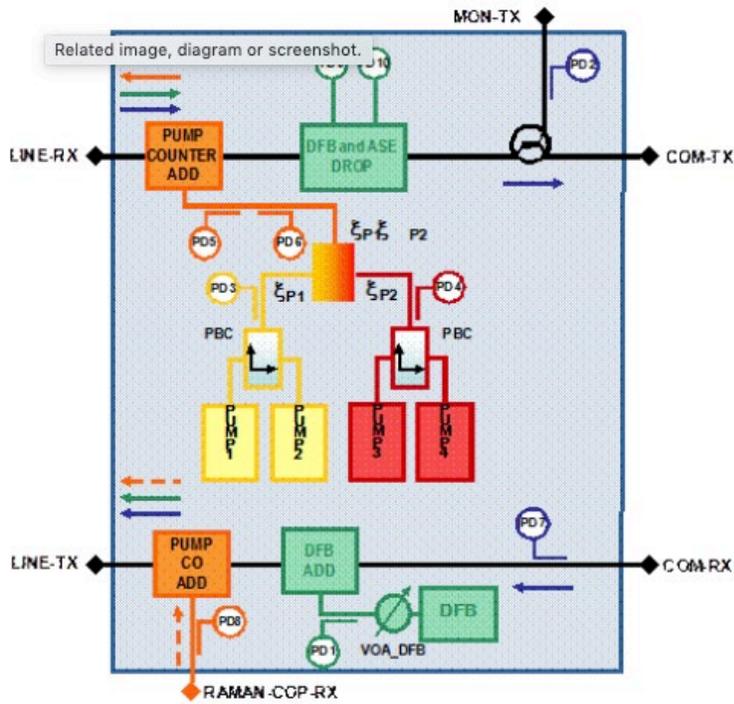
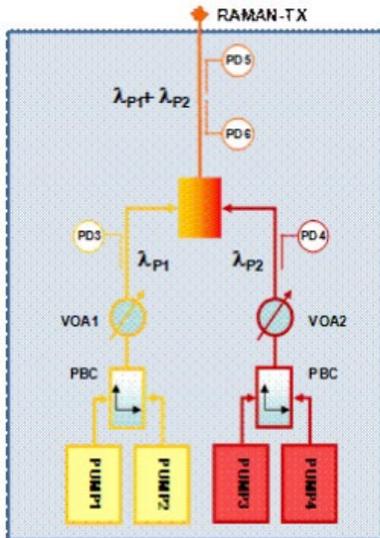
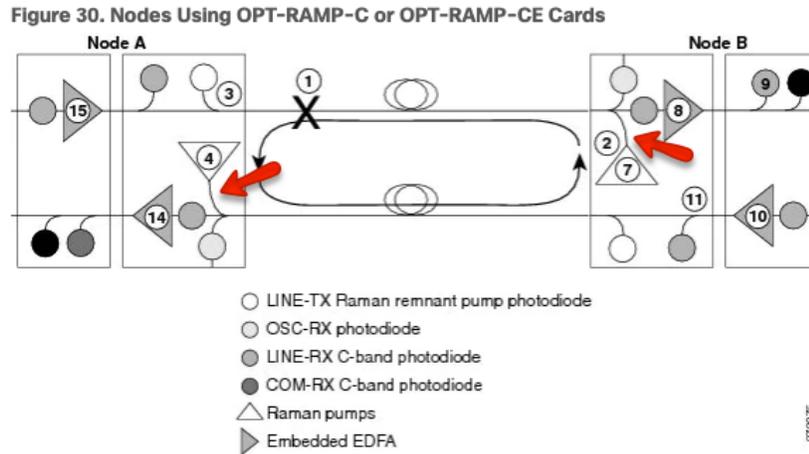


Figure 3. Functional Block Diagram for the Cisco ONS 15454 MSTP High-Power Co-Propagating Raman Amplifier



See also **Network Reference** at Fig. 30 (annotated):



107. Also, the '413 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, counter pump to produce a counter pumping noise figure profile (e.g., as created by ζ P1 and ζ P2 via Pumps 1-4) over the optical signal wavelength range corresponding to the Raman amplification and co-pump to vary the counter pumping noise figure profile over at least a portion of the optical signal wavelength range (e.g., as created by λ P1 and λ P2 via Pumps 1-4). *See also Practical Aspects of Raman Amplifier* at 1 ("Noise Sources Noise created in a DRA span consists: Amplified Spontaneous Emissions (ASE) Double Rayleigh Scattering (DRS) Pump Laser Noise ASE noise is due to photon generation by spontaneous Raman scattering. DRS noise occurs when twice reflected signal power due to Rayleigh scattering is amplified and interferes with the original signal as crosstalk noise. ... Counter pump DRA configuration results in better OSNR performance for signal gains of 15 dB and greater. ... For fibers with low DRS noise, the Raman noise figure due to ASE is much better than the EDFA noise figure. Typically, the Raman noise figure is -2 to 0 dB, which is about 6 dB better than the EDFA noise figure."); *see also Provisioning Optical Amplifier Cards* at 1 (annotated):

RAMAN-CTP and RAMAN-COP Cards Power Monitoring

Physical photodiodes P1 through P10 monitor the power for the RAMAN-CTP card.

Table 2 RAMAN-CTP Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	DFB in-fiber Output Power	LINE-TX
P2	DWDM RX Input Power	LINE-RX
P3	Pump 1 in-fiber Output Power	LINE-RX
P4	Pump 2 in-fiber Output Power	LINE-RX
P5	Total Pump in-fiber Output Power	LINE-RX
P6	Back-Reflected Pump Power	LINE-RX
P7	DWDM TX Input Power	COM-RX
P8	Total Co-Pump in-fiber Output Power	LINE-TX
P9	DFB Input Power	LINE-RX
P10	ASE Input Power	LINE-RX

Physical photodiodes P3 through P6 monitor the power for the RAMAN-COP card.

Table 3 RAMAN-CTP Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P3	Pump 1 in-fiber Output Power	RAMAN-TX
P4	Pump 2 in-fiber Output Power	RAMAN-TX
P5	Total Pump in-fiber Output Power	RAMAN-TX
P6	Back-Reflected Pump Power	RAMAN-TX

108. Also, the '413 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, filter the composite optical signal gain profile produced by amplifying the optical signal a plurality of times (e.g., through a series of amplifiers) to produce a desired gain profile for the optical signals. *See also 15454 MSTP Datasheet* at 1 ("To equalize the Raman gain ripple, the high-power Raman amplifiers must be equipped in nodes with equalization ability: either a dynamic gain-equalizer (DGE) node or a reconfigurable optical add/drop multiplexing (ROADM) node. Multiple options are possible and are detailed in Figures 4 through 6.").

109. On information and belief, the '413 Accused Instrumentalities, including the representative instrumentality, Comcast's mesh/DWDM networks, produce a desired gain profile

that is a flat gain profile (e.g., a constant gain). *See, e.g., Practical Aspects of Raman Amplifier* at 1:

$$G_{R.on/off} = 10 \log \left(\frac{P_s(\text{pump.on,signal.on}) - P_{\text{noise}}(\text{pump.on,signal.off})}{P_s(\text{pump.off,signal.on})} \right)$$

See also Provisioning Optical Amplifier Cards at 1 (“The features of the OPT-RAMP-C and OPT-RAMP-CE card include: ... Gain Flattening Filter (GFF) for Raman plus EDFA ripple compensation”).

110. Discovery is expected to uncover the full extent of Comcast’s unlawful use of Optic153’s patented technology in the ’413 Patent beyond the ’413 Accused Instrumentalities already identified through public information.

111. On information and belief, Comcast also directly infringed at least Claims 1 and 10 of the ’413 Patent by using the ’413 Accused Instrumentalities, including in relation to product testing and improvement responsive to user/customer feedback, and demonstration at trade shows, sales facilities, customer sites, and training/tutorial videos.

112. Plaintiff has suffered damages as a result of Comcast’s infringement of the ’413 Patent.

113. Plaintiff reserves the right to modify its infringement theories as discovery progresses in this case. Plaintiff shall not be estopped for purposes of its infringement contentions or its claim constructions by the foregoing discussions on how the ’413 Accused Instrumentalities infringe the ’413 Patent. Plaintiff intends only that the foregoing discussions satisfy the notice requirements of Rule 8(a)(2) of the Federal Rule of Civil Procedure, and that they should not be construed as Plaintiff’s preliminary or final infringement contentions or

preliminary or final claim construction positions.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff demands judgment for itself and against Defendant Comcast as follows:

- A. A judgment that Defendant has infringed one or more claims of each of the Asserted Patents;
- B. A judgment awarding Plaintiff all damages adequate to compensate for Defendant's infringement, and in no event less than a reasonable royalty for Defendant's acts of infringement, including all pre-judgment and post-judgment interest at the maximum rate allowed by law;
- C. A judgment and order finding that this is an exceptional case within the meaning of 35 U.S.C. § 285 and awarding Plaintiff its reasonable attorneys' fees; and
- D. A judgment awarding Plaintiff such other relief as the Court may deem just and equitable.

DEMAND FOR JURY TRIAL

Pursuant to Rule 38(b) of the Federal Rules of Civil Procedure, Plaintiff demands a trial by jury of this action.

Dated: June 2, 2020

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/s/ Alex Chan

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