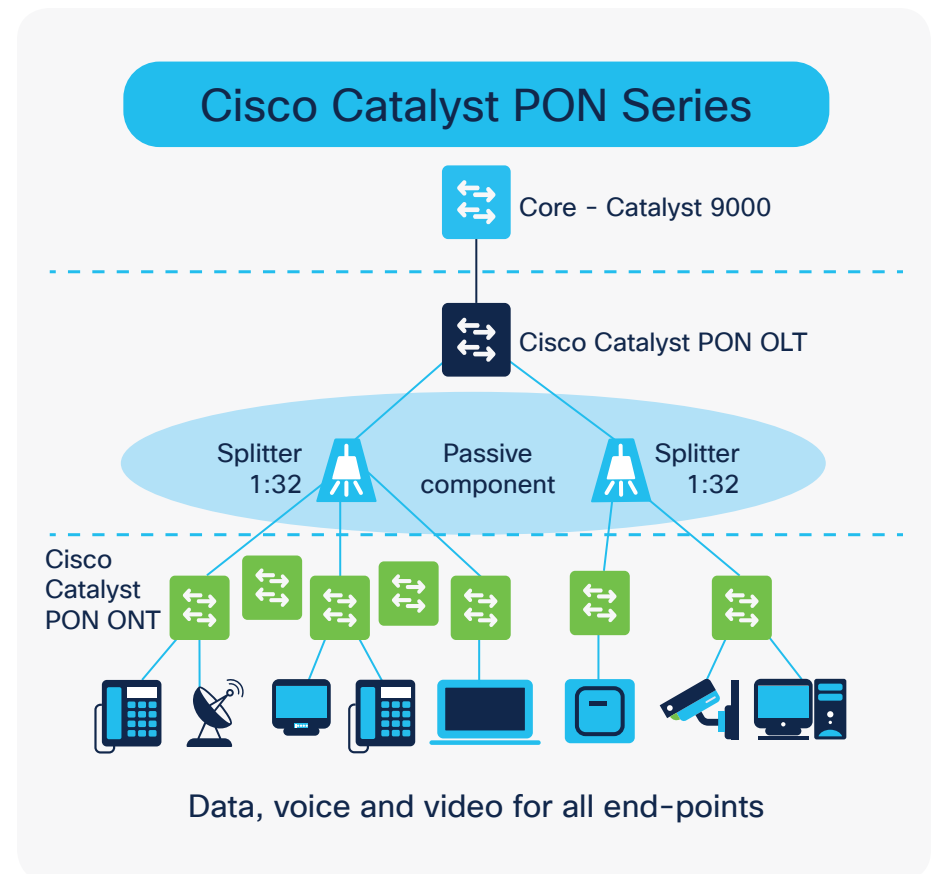‍ılıılı
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The bridge to possible

Cisco Catalyst PON Series

Q **What is the Cisco Catalyst PON Series?**

A   Cisco Catalyst® PON Series switches make refreshing your passive optical networks easy. With enterprise-grade features like power and uplink redundancy, PoE+, and a sensitivity on cost and ease of operations, the Cisco Catalyst PON Series gives you what you need today with the confidence that your investment is protected with future innovations to come.
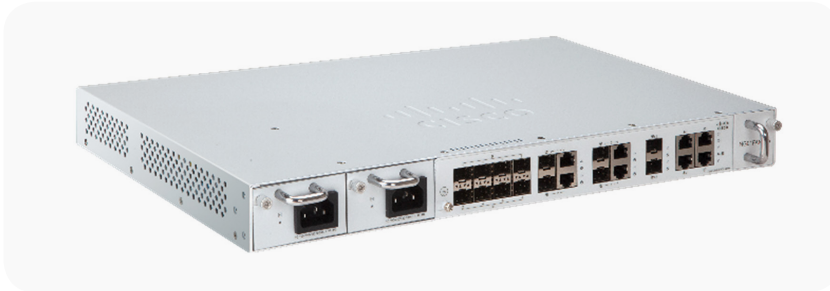
The Cisco Catalyst PON Series provides the switching at the active ends of the PON distribution network, specifically the network-facing Optical Line Terminals (OLTs) and user-facing Optical Network Terminals (ONTs).

The Cisco Catalyst PON Series includes 8- and 16-port OLT options, and five ONT models that include options for data, POTS, CATV, PoE+, and Wi-Fi.

Cisco Catalyst PON Series

Core - Catalyst 9000

Cisco Catalyst PON OLT

Splitter 1:32   Passive component   Splitter 1:32

Cisco Catalyst PON ONT

Data, voice and video for all end-points

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Cisco Catalyst PON Series Optical Line Terminals

Connecting to the core of the network are the standards-based, compact, high-density network optical aggregation devices called Cisco Catalyst PON Series Optical Line Terminals (OLTs). There are two OLT models, 8 port (CGP-OLT-8T) and 16 port (CGP-OLT-16T). Both include redundant power options and redundant 1G (SFP or copper) or 10G (SFP+) uplinks and are managed by the Cisco Catalyst PON Manager network management system.

CGP-OLT-8T

CGP-OLT-16T

Cisco Catalyst PON Series Optical Network Terminals

At the optical edge are the small Cisco Catalyst PON Series Optical Network Terminals (ONTs) that provide access options to connect to high-speed Internet, Wi-Fi, video, POTS, VoIP, CCTV, and CATV.

There are five ONT models providing a wide range of deployment options:

- 1x 1G PoE+ (CGP-ONT-1P)*
- 4x1G PoE+ (CGP-ONT-4P)
- 4x1G PoE+, 2xPOTS (CGP-ONT-4PV)
- 4x1G PoE+, 2xPOTS, 1xCATV (CGP-ONT-4PVC)
- 4x1G, 2xPOTS, 1xCATV, 2.4GHz/5GHz Wi-Fi (CGP-ONT-4TVCW)
  *Available Q3, 2021

CGP-ONT-1P*   CGP-ONT-4PVC   CGP-ONT-4TVCW*
   CGP-ONT-4PV
                     CGP-ONT-4P

All ONTs have fanless operation and are managed by the Cisco Catalyst PON Manager.

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Q **What is passive optical networking?**

A Passive optical networking, like active optical networks, provides Ethernet connectivity from the main data source to Ethernet endpoints using fiber optic cabling. PON was originally developed in the mid-1990s to deliver broadband triple-play services (data, voice, video) to the home and was specifically designed to reduce the amount of fiber runs needed to reach the multiple end-user locations and to eliminate the need to provide power to transmission devices between the central office/headend and the end user – both key issues hindering the deployment FTTx (fiber to the x) services at the time.
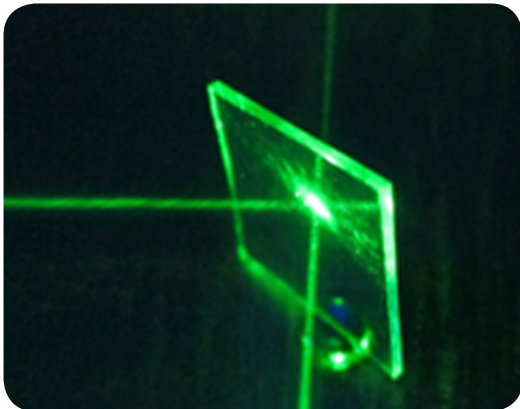
PON solves the "last mile" power distribution issue by using optical beam splitters near the end devices. These optical splitters leverage the behavior of single-mode fiber to physically split a single beam into multiple beams. The use of the splitter also reduces the amount of fibers needed to serve subscribers. The ITU-T G. 984 GPON standard allows a maximum of 320 subscribers per shared fiber, but splitters typically offer ratios of Splitter ration: from 1:2 to 1:64. That same standard also sets the maximum distance of the fiber run end to end to be 20 km.
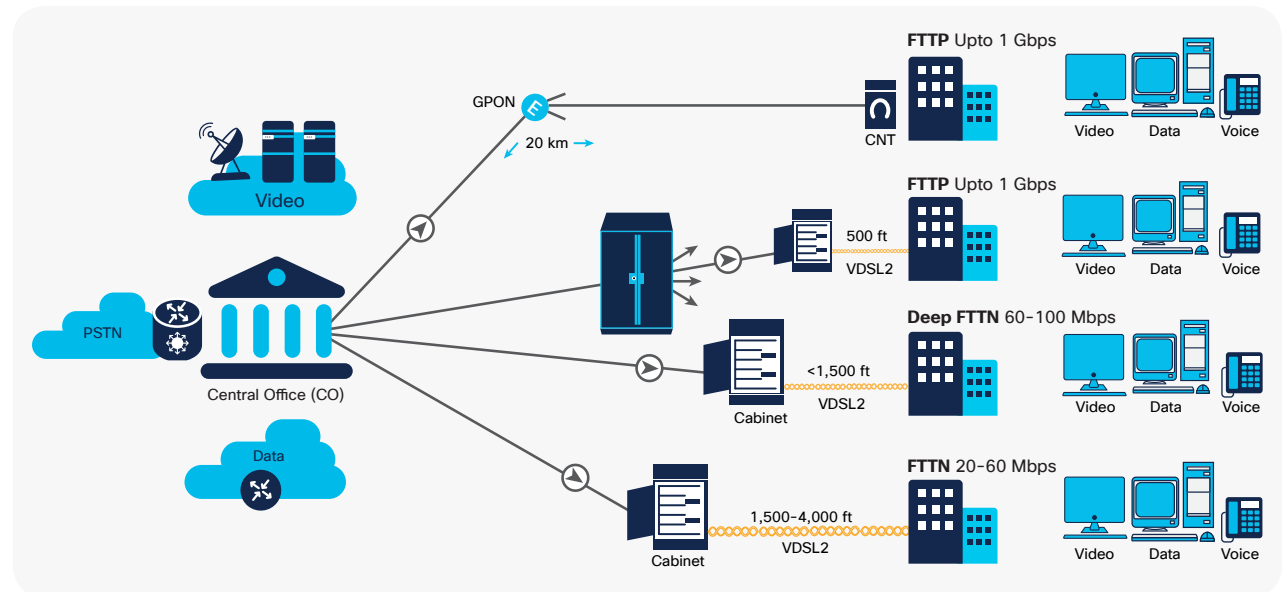
PON also reduces the number of fiber runs by taking advantage of two distinct types of telephony multiplexing concepts: wavelength division and time division.

Wavelength Division Multiplexing (WDM) allows bidirectional traffic across a single fiber by using different wavelengths for each direction of traffic: 1490-nanometer (nm) wavelength for downstream traffic and 1310-nm wavelength for upstream traffic, with 1550 nm reserved for optional overlay services, typically RF (analog) video.
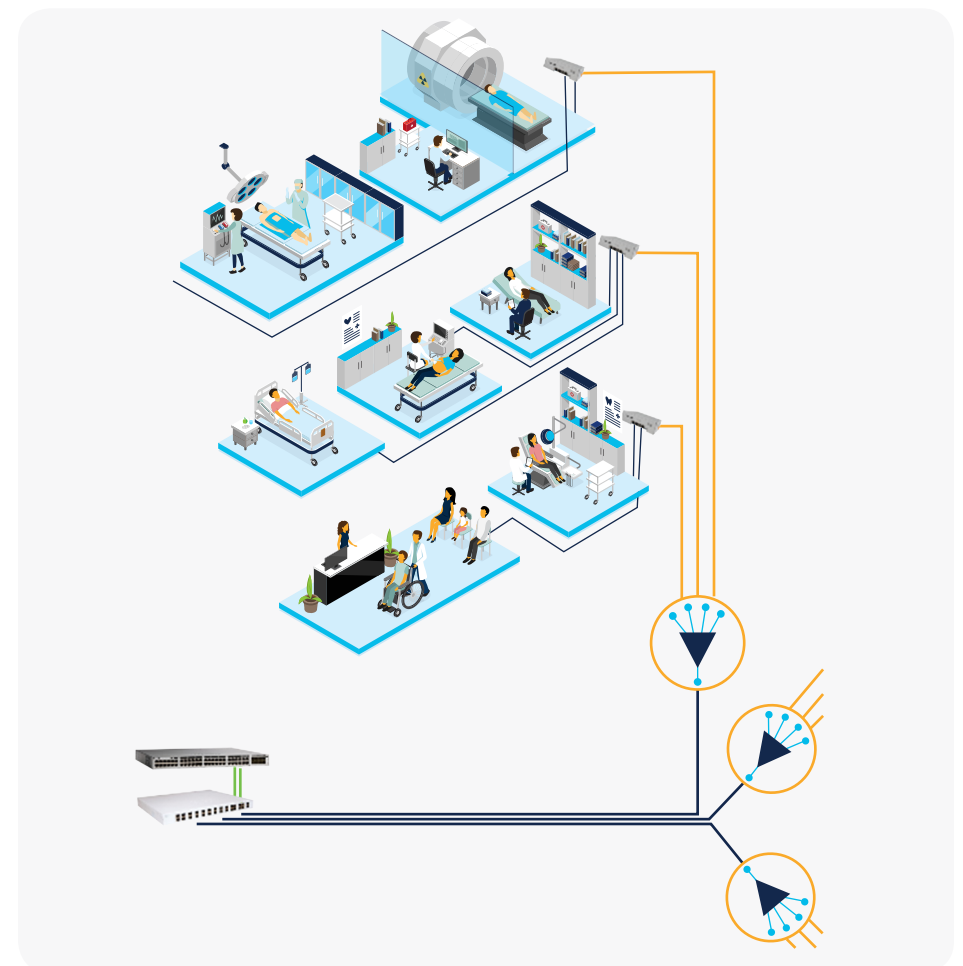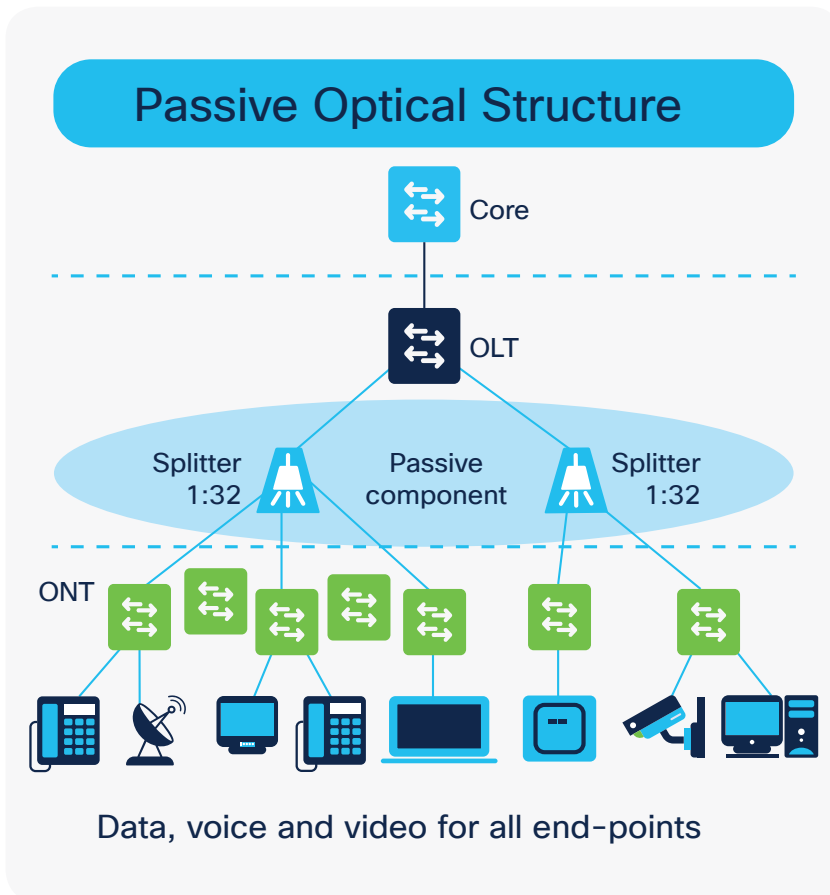
Time-division multiplexing allows multiple end devices to transmit and receive independent signals across a single fiber by reserving time slots in a stream of data. PON uses two specific time-division multiplexing technologies, Time-Division Multiplexing (TDM) for downstream traffic and Time-Division Multiple Access (TDMA) for upstream traffic.

As a passive device, the splitter acts as a distribution point with the single feed of downstream data broadcast to all connected ONT endpoints. The ONT accepts packets assigned to its TDM channel (frame time slot) to filter and discard packets meant for other ONTs.

TDMA is a type of time-division multiplexing that enables multiple transmitters to be connected to one receiver. For PON, TDMA is used to recombine the multiple upstream feeds at the coupler. Splitters and couplers are often the same device.

The ITU-T G.984 Gigabit-capable Passive Optical Networks (GPON) standard permits several choices of bit rate, with 2.5 Gbit/s downstream and 1.25 Gbit/s upstream bandwidth currently the most widely deployed.

While PON was initially focused on fiber connectivity to the home, other use cases have benefited from the simple, cost-effective PON solutions, including hotels, hospitals, and dense residential.
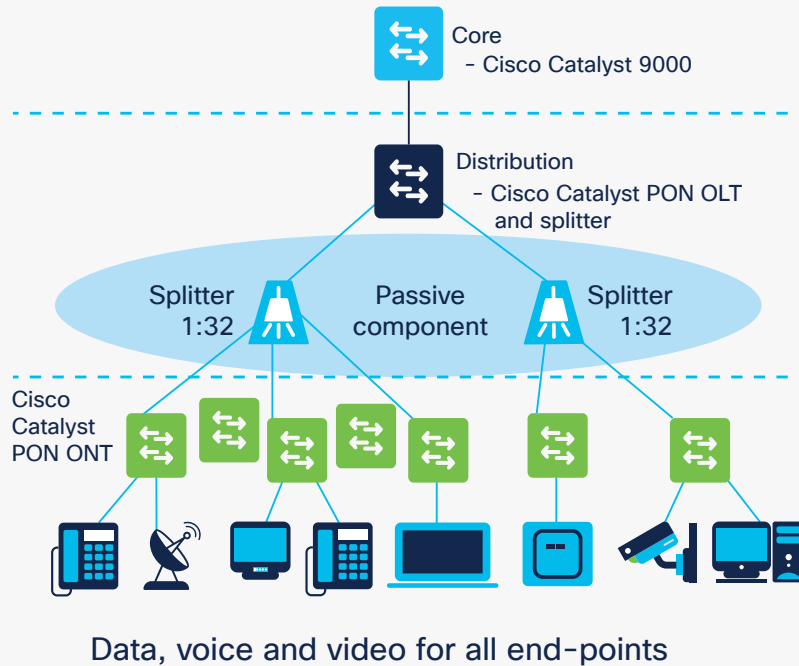

Passive Optical Structure

Core

OLT

Splitter 1:32   Passive component   Splitter 1:32

ONT

Data, voice and video for all end-points

**Q** **What are the basic differences between a passive optical network and an active optical network?**

A The primary differences between a passive and active network lie in the "distribution" part of the network and the protocols used to transport data. Uplinks facing the network and downlinks facing the end user are essentially the same for both types of deployments. The variety of services that can be offered to the end user are also comparable.

One difference is whether the distribution device is passive (nonpowered) or active (powered). Using a passive splitter allows the hardware to be located as close to the endpoints as possible, reducing the length of fiber used. Active switching devices often require closet placement for power and cooling, making active networks more challenging to deploy.
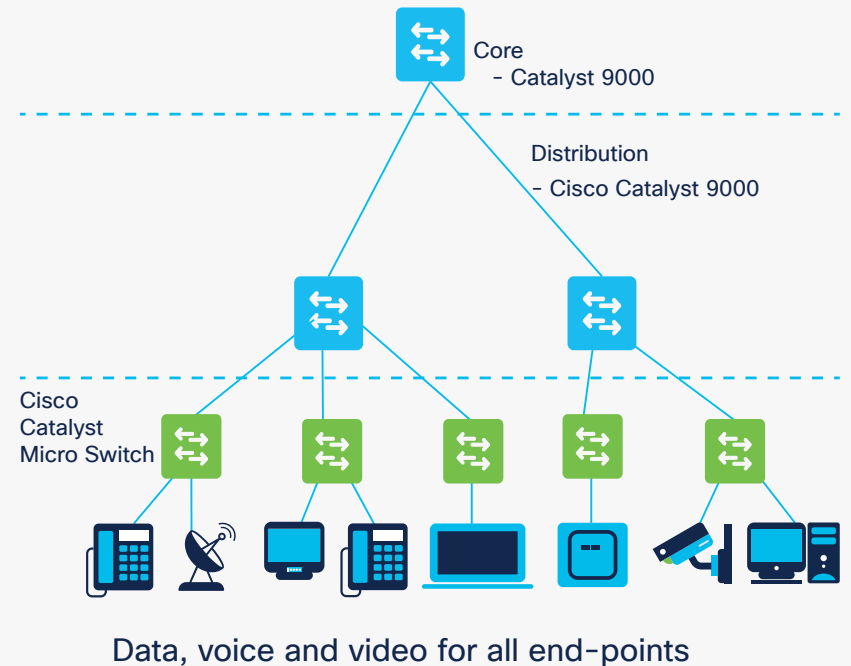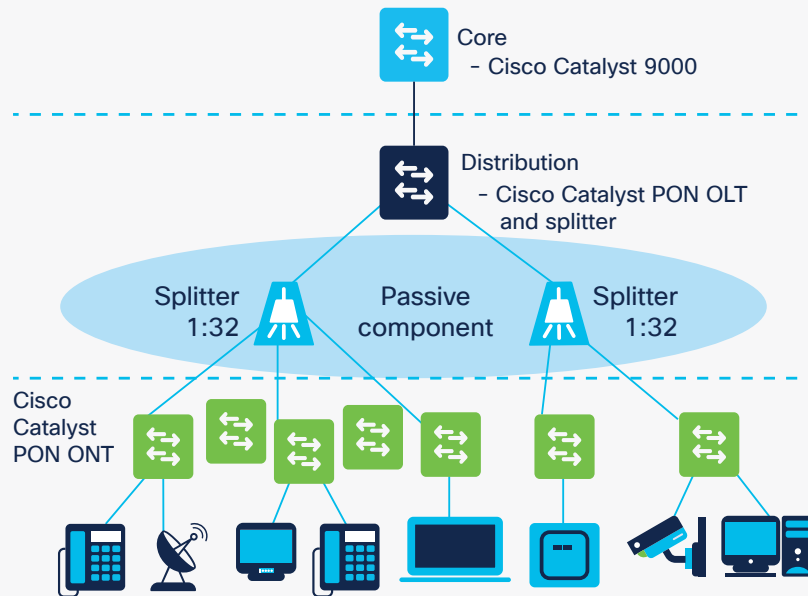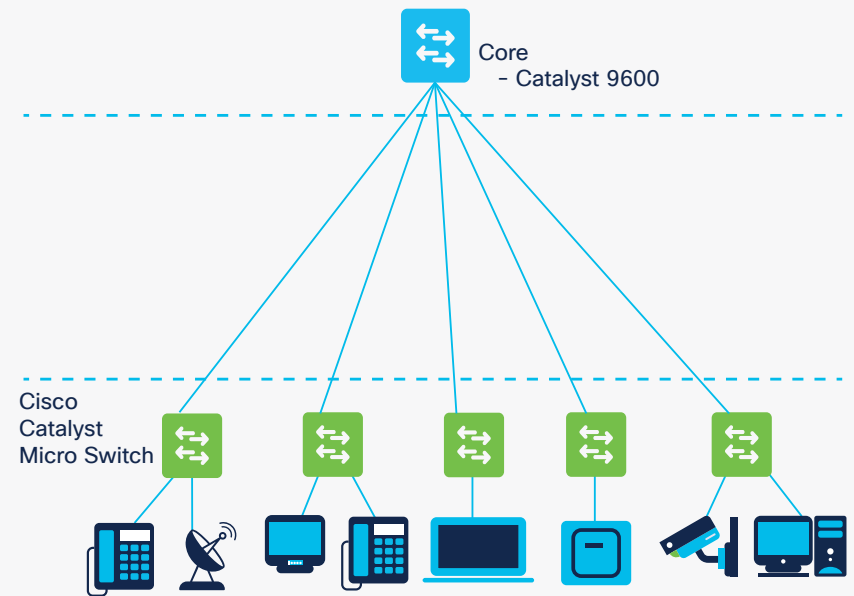
The Catalyst Micro Switch Series offers an active optical option both with and without distribution.

| Cisco Catalyst PON Series |
| Core – Cisco Catalyst 9000 |
| Distribution – Cisco Catalyst PON OLT and splitter |
| Splitter 1:32 | Passive component | Splitter 1:32 |
| Cisco Catalyst PON ONT |
| Data, voice and video for all end-points |

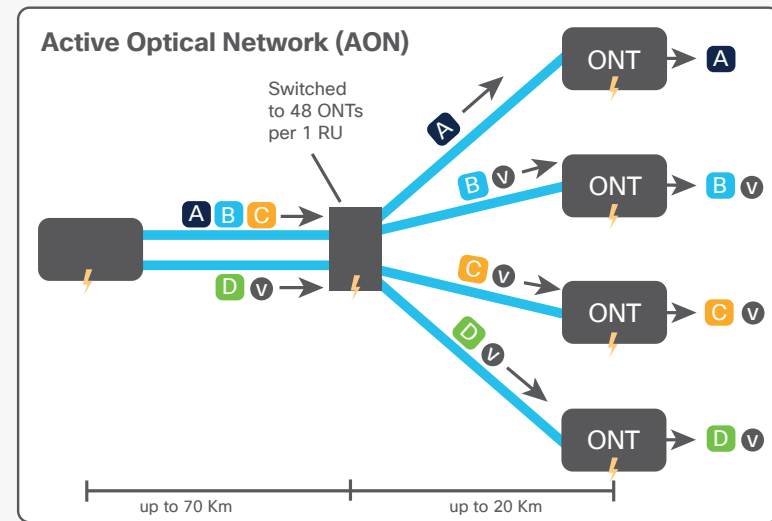| Cisco Catalyst Micro Switch Series |
| Core – Catalyst 9600 |
| Cisco Catalyst Micro Switch |
| Data, voice and video for all end-points |

A significant downside to passive components like splitters and couplers is that little intelligence can be applied to the distribution process. The point-to-multipoint topology used by PON allows multiple ONTs to share a single connection, but offers little visibility and is inefficient, exacerbating any congestion at the ONT.

Just like copper-based Ethernet, active optical networks use a point-to-point distribution topology, with distribution switches optimizing bandwidth by directing packets to addressed endpoints only. This topology also offers full visibility end to end.

Possive Optical Network (PON)

OLT

Split to 32 ONTs.

Split to 32 ONTs.

ONT → A
ONT → B V
ONT → C V
ONT → D V

up to 20 Km

Active Optical Network (AON)

Switched to 48 ONTs per 1 RU

ONT → A
ONT → B V
ONT → C V
ONT → D V

up to 70 Km   up to 20 Km
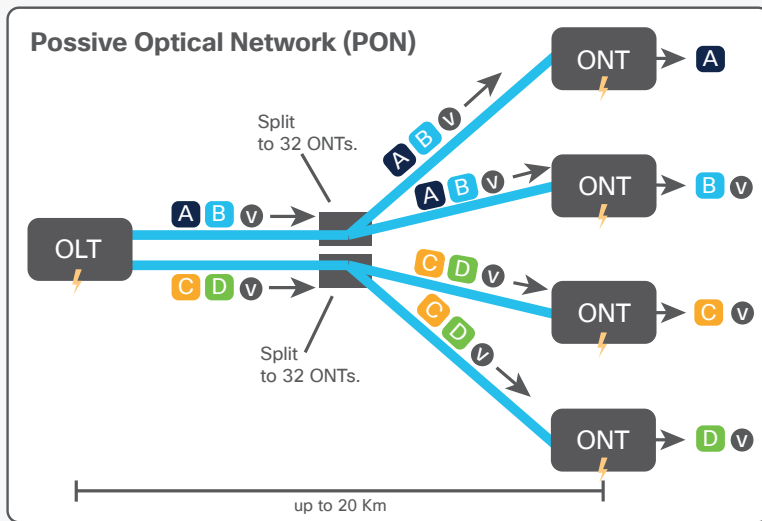
Key: A - Data or voice for a single customer   V - Video for multiple customers.

Q **Are there certain types of properties or construction styles that are more conducive to deploying a GPON?**

A   While PON was originally designed for service providers and FTTx deployments, Gigabit PON (GPON) has also gained favor at large hotels and resorts, metro high-rise buildings, large government and education campuses, and healthcare facilities that require higher density of Ethernet ports and triple-play services and/or where there is a large distance between main data center and the Ethernet endpoint connectivity, such as a sprawling resort property. When confronted with lack of IT space and distributed electrical, GPON networks are an ideal choice.

Q **What services can be delivered on a GPON network?**

A   GPON networks can deploy any residential IP service – Internet access, multicast video, traditional telephony (POTS), VoIP, IP and Ethernet Virtual Private Network (VPN) services and emulated TDM services (for example, T1/E1) can be provided for businesses.

Q **How many 1G endpoints can the Cisco Catalyst PON Series support?**

A   Remembering that the fiber link to the OLT is a shared resource, the number of endpoints depends on your acceptable degree of oversubscription.

For instance, a guideline that allows 1:32 ratio on a 2.5G GPON downlink connection is an effective 12.8:1 oversubscription (32x 1G/2.5G).

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Q **How does GPON enable service oversubscription?**

A A key benefit of GPON is the inherent cost advantages for point-to-multipoint access networks. Congestion issues are remediated with techniques like dynamic bandwidth allocation, which frees up unused bandwidth to offer users more bandwidth as needed.

Statistical multiplexing across a large number of subscribers (maximum of 320) also means that high-bandwidth users are typically not disruptive to the access network.

Q **What Cisco Catalyst PON equipment goes into the office, hotel room, residence, or business?**

A Optical Network Terminals (ONTs) are installed at the or near the end-user locations. ONTs terminate the fiber from the splitter, which is also typically also nearby. Residential ONTs, for example, have traditionally been installed on the outside or inside the home. Hotel ONTs may be in each room or serve a number of rooms.

Cisco ONT Wi-Fi model can be used for desktop mounted and it also has bottom mount holes for wall. (optimized for hospitality or building)

OLTs are typically in a data closet or central office/headend, often a fair distance from the end user.

Q **What is the physical reach of the Cisco Catalyst PON Series?**

A The recommended distance between a Cisco Catalyst PON OLT and a Cisco Catalyst ONT is 20 km.

Q **What are the GPON standards?**

A The ITU-T G.984 family of standards defines Gigabit Passive Optical Networks (GPONs). The first version was ratified in 2003 and subsequently amended to support coexistence with future WDM PON technology and reach extensions.

Q **What is an ONT?**

A ONT is an optical-to-electrical media converter. It accepts the network-side GPON transmission and offers various service connections (for example, RJ-45 Ethernet with PoE, RJ-11 POTS, Fconnector RF video, Wi-Fi). The Cisco Catalyst PON Series offers models that provide 4 ports of 1G data connectivity with PoE, POTS, CATV and Wi-Fi.

**Q** **Are there any restrictions to ONT placement?**

A ONTs can be positioned in a room, inside a wall, or in an outlet similar to a traditional network. Because ONTs are fanless, they can also be mounted under furniture, inside a closet, within a flush wall enclosure, or inside a pull-down zone box in a hallway.

Q **What type of fiber cabling do I use with GPON?**

A Single-mode fiber is used for GPON.

Q **How does the Cisco Catalyst PON Series centrally manage or monitor the performance of the GPON once it is installed?**

A Cisco Catalyst PON Series switches are managed through the Cisco Catalyst PON Manager NMS tool. The Cisco Catalyst PON Manager is a powerful network management software that enables centralized and single-point PON network operation and management by configuring and monitoring end-to-end devices including OLT and ONT. You can automatically configure and provision devices and service, monitor health and diagnose of the PON network as well as manage upstream and downstream ports resources.

Network Manager — Cisco Catalyst PON Manager — OLT — Splitter — ONT — ONT
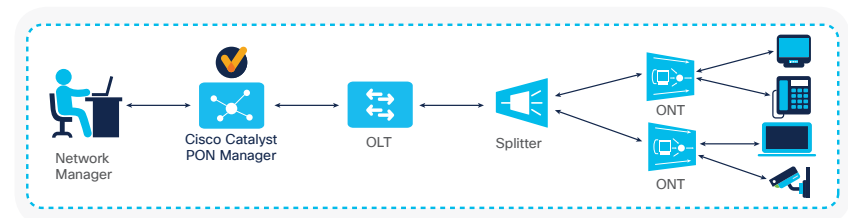
Q **Is port security required for every deployment on every ONT? If port security is not enabled, can end users attach rogue devices to the network?**

A ONT ports are disabled by default. The activation of an ONT port is initiated through the Cisco Catalyst PON Manager and controlled by the OLT back at the main data center. Network Access Control (NAC) and IEEE 802.1x mechanisms provide an additional layer of security on ONT ports.

Q **How much total bandwidth does the Cisco Catalyst PON topology offer downstream and upstream?**

A Cisco Catalyst PON offers a total of 2.5 Gbps downstream and 1.2 Gbps upstream. Each ONT sees all of the PON bandwidth, but the amount of bandwidth utilized by each ONT is provisioned by the system operator. ONTs can be provisioned up to 1 Gbps. Future versions will allow greater bandwidth.

Q **Can every room/office/location be provisioned for a Gigabit per second of bandwidth?**

A Yes. Cisco Catalyst PON can be oversubscribed on a provisioned basis when the bandwidth profile is set to best effort.

Q **How is bandwidth dynamically managed on a Cisco Catalyst PON topology?**

A Dynamic bandwidth allocation is utilized to assign upstream bandwidth as needed to ONTs. Status-reporting algorithms allow a master controller to rapidly assign time slots in the upstream based on ONT bandwidth requests. In addition, P bits are utilized in both the downstream and upstream to prioritize traffic on the PON network.

Q **What are optical splitters?**

A An optical splitter is an integrated waveguide optical beam splitter that takes the input of a single optical signal and outputs duplicate signals to multiple light paths. Splitter range is typically from 1:2 to 1:64. Also there are splitters with redundancy – 2:8, 2:16, 2:32. We do not recommend specific splitter ratio but most popular one is 1:16 or 1:32.

Q **What does a split ratio mean?**

A A 1:32 split ratio means a single fiber feed is shared by 32 ONTs, while a 1:64 ratio split is a fiber shared by 64 ONTs. The higher the split ratio, the more devices are sharing 2.5/1.2 Gbps bandwidth. Splitting ratios range typically from 1:2 to 1:64, and there are also redundant splitters with ratios such as 2:8, 2:16 or 2:32. While Cisco does not recommend any specific ratio, the most popular are 1:16 and 1:32.

Q **Are VLANs supported on GPON?**

A Yes. Cisco Catalyst PON Series switches support single or double (Encapsulating IEEE 802.1Q VLAN tags within 802.1Q - QnQ) tagging.

Q **Can a VLAN per room or multiple VLANs per room be supported over GPON?**

A VLANs are supported in the same ways that a traditional switched network supports VLANs.

Q **Does GPON support different classes of service, such as prioritized service for voice or IPTV (quality of service - QoS)?**

A GPON supports different classes of services in the same way that an Ethernet switch does.

Q **Can ONTs provide Power over Ethernet (PoE)?**

A Yes. Four Cisco Catalyst PON Series ONT models (CGP-ONT-1P, CGP-ONT-4P, CGP-ONT-4PV, CGP-ONT-4PVC) can provide up to 30W PoE+ per port, and up to 60W total power.