Passive Optical Network Topology

Overview

The standard specifies transmission convergence layer, physical layer requirements, management protocols, and service encapsulation for high-speed fiber access networks. GPON puts requirements on the optical medium and the hardware used to access it, and defines the manner in which Ethernet frames are converted to an optical signal, as well as the parameters of that signal.

Key Takeaways

A Passive Optical Network uses a point-to-multipoint topology where a single optical fiber from the service provider is split via passive splitters to serve multiple end users.Overview of PON Topology

A Passive Optical Network (PON) is a fiber-optic network that connects a service provider to multiple end users using unpowered (passive) components between the central office and customer premises . The topology is point-to-multipoint (P2MP), meaning a single optical fiber from the Optical Line Terminal (OLT) at the provider's central office is split into multiple branches using passive optical splitters, allowing one fiber to serve many endpoints . This reduces the amount of fiber and central office equipment compared to point-to-point architectures.

Key Components
• Optical Line Terminal (OLT): Located at the service provider's hub, the OLT manages data transmission, allocates bandwidth, and coordinates upstream and downstream communication with multiple end users .

• Optical Network Units (ONUs) / Optical Network Terminals (ONTs): These devices are located near the end users and convert optical signals into electrical signals for user devices. They also aggregate upstream data to send back to the OLT .

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• Passive Optical Splitters: These unpowered devices divide the optical signal from the OLT into multiple fibers to reach several ONUs/ONTs. Splitters do not require electricity and can last for decades with minimal maintenance .
Signal Flow and Bandwidth Sharing

In a PON, downstream signals from the OLT are broadcast to all connected ONUs/ONTs, while upstream signals from users are combined using Time-Division Multiple Access (TDMA) to prevent collisions . Bandwidth is shared among users, and encryption is often used to maintain data privacy . Some PONs also use Wavelength Division Multiplexing (WDM) to separate upstream and downstream data streams by wavelength .

Advantages of PON Topology
• Cost Efficiency: Fewer fibers and central office ports are needed compared to point-to-point networks .

• Reliability: Passive components are less prone to failure and do not require power or cooling .

• Scalability: A single OLT port can serve multiple users, making it suitable for residential, commercial, and high-density deployments .

• Signal Integrity: Fiber-optic transmission is immune to electromagnetic interference, ensuring high-quality data delivery .
Applications

PON topology is widely used in Fiber-to-the-Home (FTTH), Fiber-to-the-Premises (FTTP), and other last-mile broadband deployments, providing high-speed internet, voice, and video services efficiently . It is particularly advantageous in areas where minimizing infrastructure costs and maximizing coverage are priorities. In summary, the point-to-multipoint PON topology leverages passive splitters to efficiently distribute optical signals from a single OLT to multiple ONUs/ONTs, offering a cost-effective, reliable, and scalable solution for modern fiber-optic access networks .

Article Content

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Passive optical networking (PON) provides Ethernet connectivity from a main data source to endpoints, using a technique called

GPON

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PONs are assembled from passive devices, such as optical fibers, connectors and power splitters, with active elements

Passive Optical Network (PON) design and managing 101

The correct PON network design not only considers a thoughtful equipment placement, but also ensures optimal signal

Passive Optical Network Architecture

PON architecture, or Passive Optical Network architecture, is defined as a passive optical network deployed in a point-to-multipoint

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Demystify passive optical network (PON) architecture. Learn about components, topology,

The 5x5 Gaussian coarse AWG , displayed in Fig

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