

What is the principle of passive optical networks



Overview

A passive optical network (PON) uses fiber-optic technology to deliver data from a single source to multiple endpoints.

Key Takeaways

Passive Optical Networks (PONs) deliver high-speed fiber-optic connectivity from a single source to multiple endpoints using unpowered optical splitters, enabling efficient, cost-effective broadband access.

A PON is a point-to-multipoint fiber-optic network that connects an Internet Service Provider (ISP) to multiple end users without requiring powered devices between the central office and the customer premises. Unlike active optical networks, which use electrically powered switches or routers to distribute signals, PONs rely on passive optical splitters to divide and combine optical signals, reducing network complexity, cost, and maintenance requirements.

Key Components

- **Optical Line Terminal (OLT):** Located at the service provider's central office, the OLT generates and manages downstream and upstream optical signals, coordinating data flow to multiple users.
- **Optical Network Units (ONUs) / Optical Network Terminals (ONTs):** These devices are installed near end users to receive downstream signals and transmit upstream data back to the OLT.

- **Optical Distribution Network (ODN):** The physical fiber infrastructure connecting the OLT to ONUs/ONTs, including fiber cables, connectors, and passive splitters . Splitters can operate at ratios such as 1:16, 1:32, or higher, depending on network design.

Operational Principles

- **Downstream Transmission:** The OLT sends a single optical signal that is broadcast to all connected ONUs. Each ONU extracts only the data intended for it, often using encryption to ensure privacy .
- **Upstream Transmission:** Multiple ONUs share the same fiber to send data back to the OLT. A time-division multiple access (TDMA) protocol coordinates transmissions to prevent collisions .
- **Passive Splitters:** These unpowered devices divide the optical signal from the OLT to multiple ONUs and combine upstream signals back to the OLT, maintaining the point-to-multipoint architecture .

Advantages

- **Cost Efficiency:** Reduces the number of fibers and central office equipment compared to point-to-point networks .
- **Energy Savings:** No power is required in the field for signal distribution.
- **Scalability:** Supports high split ratios and can serve many users from a single OLT.
- **High Bandwidth:** Modern PON standards like GPON, XGS-PON, and 10G-PON provide gigabit-level speeds for both upstream and downstream traffic .

Standards and Evolution

- **GPON (G.984):** Offers 2.488 Gbit/s downstream and 1.244 Gbit/s upstream, widely deployed globally .
- **10G-PON (G.987):** Provides 10 Gbit/s downstream and 2.5 Gbit/s upstream, designed to coexist with GPON devices .
- **XGS-PON (G.9807.1):** Delivers symmetrical 10 Gbit/s speeds, supporting high-demand applications . PONs are now a cornerstone of fiber-to-the-home (FTTH) and other high-density deployments, providing efficient, reliable, and scalable broadband access while minimizing infrastructure costs and energy consumption .

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A passive optical network (PON) is a shared, fiber optic access network that uses unpowered optical splitters to

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In a PON access network there are two end-points with active (powered) electronic transmission equipment, connected by passive

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Passive Optical Network

The PON (Passive Optical Network) is a passive optical network that is typically deployed in a point-to-multipoint fashion similar to a

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PON Architecture and Components

Summary Passive optical networking (PON) is a full duplex technology that uses inexpensive optical splitters to divide a

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Consolidated_Version_Passive Optical Networks

After three decades of dynamic research, Passive Optical Network (PON) has been considered as the most promising broadband

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A passive optical network transfers data, voice and video using light signals transmitted through fibre optic cables. In

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