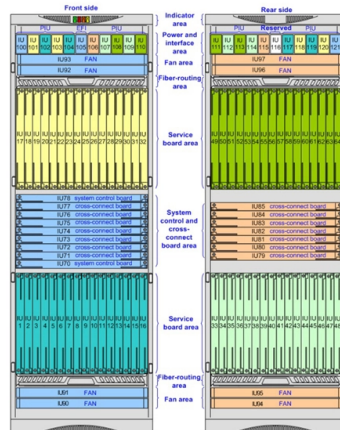


How to connect multiple optical modules in series



Overview

An optical module is a typically hot-pluggable optical transceiver used in high-bandwidth data communications applications.

Key Takeaways

Optical modules are connected in series by linking the transmitter of one module to the receiver of the next via fiber optic cables, ensuring compatible optical power levels and proper interface types. Basic Connection Principle

Optical modules, such as SFP, SFP+, QSFP, or XFP, are hot-pluggable transceivers that convert electrical signals to optical signals and vice versa . To connect them in series:

- Transmitter to Receiver: The transmit (Tx) port of one module is connected to the receive (Rx) port of the next module using a fiber optic cable .
- Fiber Type: The fiber must match the module type—single-mode for long distances or multi-mode for short distances .
- Connector Compatibility: Common connectors include LC for SFP/SFP+ and MPO for QSFP+ modules .

- **Optical Power Matching:** The transmit power of the sending module must fall within the receiver sensitivity range of the receiving module to maintain a low bit error rate ($BER = 10^{-12}$), .

Series Connection Considerations

- **Link Budget:** Each module has a maximum and minimum optical power it can handle. When connecting multiple modules in series, the cumulative loss of fiber, connectors, and splices must not exceed the link budget .
- **Extinction Ratio:** Modules must maintain a sufficient extinction ratio to distinguish between logical 0 and 1 signals, ensuring signal integrity across the series .
- **Distance Limitations:** The optical fiber length between modules must respect the module's maximum transmission distance, which varies by wavelength and fiber type .
- **Digital Diagnostic Monitoring (DDM):** Some modules support DDM to monitor voltage, temperature, transmit/receive power, which helps ensure proper operation when modules are connected in series .

Practical Implementation

In practice, connecting optical modules in series is equivalent to creating a point-to-point optical link between devices. For example:

- **Switch-to-switch connection:** SFP+ modules in two switches are connected via LC fiber, with Tx of switch A to Rx of switch B and vice versa.
- **Cascading devices:** If multiple devices are connected in a chain, each module pair must satisfy optical power and distance requirements to prevent signal degradation. By following these principles, optical modules can be reliably connected in series to form high-speed, low-latency optical links in data centers, telecom networks, or enterprise environments .

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An optical module is a typically hot-pluggable optical transceiver used in high-bandwidth data communications applications. Optical

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