Selection of Optical Module Distance

Overview

How to Choose SFP Module for Compatibility, Speed, and DistanceLearn how to choose the right SFP module based on compatibility, speed, fiber type, waveleng.

Key Takeaways

Selecting the right optical module for long-distance transmission depends on fiber type, wavelength, optical power budget, and link distance requirements.

Fiber Type Considerations

For long-distance links, single-mode fiber (SMF) is essential because it allows light to travel in a single path, minimizing modal dispersion and enabling stable transmission over tens of kilometers. Multimode fiber (MMF) is limited to short distances due to higher modal dispersion and attenuation, making it unsuitable for metro or long-haul networks.

Wavelength Selection

Optical modules operate at different wavelengths, typically 850 nm, 1310 nm, and 1550 nm. For long-distance transmission: 1310 nm is suitable for moderate distances (up to ~40 km) with standard SMF. 1550 nm is preferred for longer distances (40–120 km) due to lower fiber attenuation and reduced chromatic dispersion.

It is also compatible with DWDM systems for high-capacity links.

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Module Reach Classes

Optical modules are classified by reach: LR (Long Reach): ~10 kmER (Extended Reach): ~40 kmZR (Ultra Long Reach): 80 km or moreDWDM-enhanced modules: 100–120 km Each class defines the optical power budget and dispersion tolerance, not just transmit power.

Optical Power Budget

The optical budget is critical for reliable transmission and is calculated as: Optical Budget = Tx Power (min) − Rx Sensitivity (min) A safety margin of 3–5 dB is recommended to account for aging, environmental variations, and connector/splice losses. Exceeding the budget can cause link failure even if the distance is within specification.

Additional Considerations

Transmitter and receiver sensitivity: High-power transmitters and sensitive receivers extend reach. Dispersion: Chromatic dispersion can limit distance; 1550 nm modules are less affected. Connector and splice loss: Each connection adds attenuation; plan for total link loss.

Digital Optical Monitoring (DOM/DDM): Provides real-time telemetry for optical power, temperature, and bias current, helping maintain link stability. Compatibility: Ensure modules are compatible with existing network equipment to avoid receiver overload or instability.

Practical Selection Tips

Determine the link distance and fiber type. Choose the appropriate wavelength (1310 nm for medium, 1550 nm for long distances). Select a module with a sufficient optical budget including safety margin.

Consider future scalability for higher data rates or DWDM integration. Verify vendor compatibility and availability to ensure stable operations. By carefully evaluating these factors, network engineers can select optical modules that provide reliable, cost-effective, and scalable long-distance fiber links.

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Article Content

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Optical module are SFP28 modules used for fiber optic connections. Based on transmission distance and wavelength technology, the main types include SR (Short Range), LR (Long Range), ER

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The StarryLink optical module is a core component developed by Huawei for data center networks. It delivers ultra-long-distance transmission, exceptional reliability, and enhanced security,

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