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How to calculate the speed of a 10G optical module



Overview

Fiber Optic Speed: 10G-800G Limits & Components | PHILISUNSee how fast fiber optic networks can be, what limits real speed, and which cables, transceivers.

Key Takeaways

A 10G optical module operates at a line rate of 10.3125 Gbps, which is the standard data rate for 10 Gigabit Ethernet SFP+ transceivers.Understanding 10G Optical Module Speed

The speed of a 10G optical module is defined by its line rate, which is the raw data transmission rate over the fiber. For standard 10G SFP+ modules, this line rate is 10.3125 Gbps, slightly higher than 10 Gbps to accommodate encoding overhead used in Ethernet protocols (such as 64b/66b encoding) that ensures reliable data transmission and error detection .

Factors Affecting Effective Speed
• Encoding Overhead: Ethernet uses encoding schemes like 64b/66b, which introduces a small overhead. While the line rate is 10.3125 Gbps, the effective payload throughput is slightly lower, around 10 Gbps .

• Fiber Type and Distance: Short-range (SR) modules over multimode fiber (OM3/OM4) typically support 300–400 meters, while long-range (LR) modules over single-mode fiber can reach up to 10 km . Signal attenuation and dispersion over longer distances can affect effective throughput.

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• Wavelength: SR modules operate at 850 nm, LR modules at 1310 nm, and extended reach modules (ER, ZR) may use 1550 nm. Wavelength affects both distance and signal integrity, indirectly influencing the achievable speed .

• Module Compatibility: Ensure the module is designed for 10GbE operation. Some SFP+ modules are dual-rate (1G/10G), but using a module at a mismatched port or protocol can reduce speed or prevent operation .
Practical Calculation

To determine the effective speed of a 10G module in your network:

• Identify the module type (SR, LR, LRM, ER, ZR) and its line rate (10.3125 Gbps for standard 10G SFP+).

• Account for encoding overhead: Effective throughput ≈ 10 Gbps.

• Consider fiber type and distance: Longer distances or legacy multimode fiber may require LRM modules, which can slightly reduce performance due to modal dispersion .

• Verify switch or NIC compatibility: Ensure the port supports 10G SFP+; otherwise, the module may operate at a lower speed or fail to link .
Summary

A 10G optical module is engineered to transmit at 10.3125 Gbps line rate, with effective throughput around 10 Gbps after encoding overhead. The actual performance depends on fiber type, distance, wavelength, and hardware compatibility. For short-range intra-data center links, SR modules over OM3/OM4 fiber are common, while LR modules over single-mode fiber are used for longer distances up to 10 km . Proper selection ensures the module achieves its intended 10G speed reliably.

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