

## Optical modules and fiber optic network cards



### Overview

Fiber optic technology continues to evolve, pushing the boundaries of data transmission capabilities.

### Key Takeaways

Fiber optic network cards typically use SFP, SFP+, SFP28, QSFP, or QSFP28 optical modules to connect to fiber cables.

Optical modules are hot-pluggable transceivers that convert electrical signals from a network card into optical signals for transmission over fiber, and vice versa . They serve as the critical interface between the NIC and the fiber optic cable, enabling high-speed data communication over varying distances.

Common Types of Optical Modules

- SFP (Small Form-factor Pluggable): Supports speeds up to 1 Gbit/s and is widely used for short- to medium-range fiber connections .
- SFP+ (Enhanced SFP): Designed for 10 Gbit/s Ethernet, commonly used in data centers and enterprise networks .
- SFP28: Supports 25 Gbit/s, suitable for modern high-speed aggregation and server connections .
- QSFP (Quad SFP): Four-lane module, typically used for 40 Gbit/s connections.

- QSFP28: Supports 100 Gbit/s, often used in leaf-spine data center architectures .
- QSFP56: Supports 200 Gbit/s, used in high-performance computing and hyperscale networks .

#### Fiber Types and Distance

- Single-mode fiber (SMF, OS2): Used for long-distance connections, often several kilometers .
- Multimode fiber (MMF, OM3/OM4): Used for short-distance connections, typically under 500 meters .
- Direct Attach Copper (DAC) and Active Optical Cables (AOC): Alternative modules for very short distances (3–30 meters), offering low latency and cost efficiency .

#### Key Features

Modern optical modules often include Digital Diagnostics Monitoring (DDM), which allows real-time monitoring of temperature, voltage, and optical power to ensure reliability and prevent link failures . Modules may use different laser types, such as VCSEL for short-range or DFB for long-range transmission, depending on the application.

#### Compatibility

Fiber NICs are designed with pluggable cages that accept these optical modules. Choosing the correct module depends on the NIC speed, fiber type, and distance requirements. For example, a 10G NIC typically uses SFP+ modules, while a 25G NIC uses SFP28 modules . QSFP28 modules are used for 100G NICs, and QSFP56 for 200G NICs . In summary, SFP, SFP+, SFP28, QSFP, and QSFP28 optical modules are the standard choices for fiber optic network cards, with selection guided by speed, distance, and fiber type requirements .

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Key Takeaway 1: Always verify compatibility between modules, patch cords, and network equipment to avoid signal

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