Multiprotocol Label Switching(MPLS)

**Multiprotocol Label Switching** (**MPLS**) is a routing technique in [telecommunications networks](https://en.wikipedia.org/wiki/Telecommunications_network) that directs data from one [node](https://en.wikipedia.org/wiki/Node_(networking)) to the next based on short path labels rather than long network addresses, thus avoiding complex lookups in a [routing table](https://en.wikipedia.org/wiki/Routing_table) and speeding traffic flows. The labels identify virtual links (*paths*) between distant nodes rather than [endpoints](https://en.wikipedia.org/wiki/Communication_endpoint). MPLS can encapsulate packets of various [network protocols](https://en.wikipedia.org/wiki/Network_protocol), hence the "multiprotocol" reference on its name.

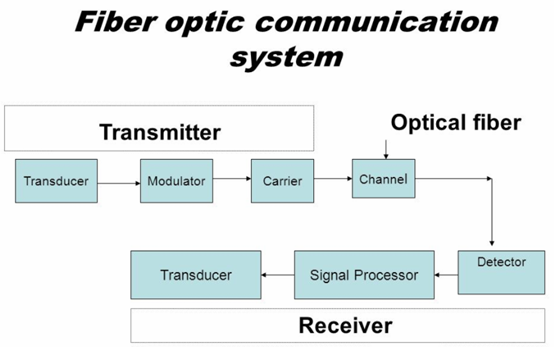
## Role and functioning

MPLS is scalable and protocol-independent. In an MPLS network, data packets are assigned labels. Packet-forwarding decisions are made solely on the contents of this label, without the need to examine the packet itself. This allows one to create end-to-end circuits across any type of transport medium, using any protocol. The primary benefit is to eliminate dependence on a particular [OSI model](https://en.wikipedia.org/wiki/OSI_model) [data link layer](https://en.wikipedia.org/wiki/Data_link_layer) (layer 2) technology, such as [Asynchronous Transfer Mode](https://en.wikipedia.org/wiki/Asynchronous_Transfer_Mode) (ATM), [Frame Relay](https://en.wikipedia.org/wiki/Frame_Relay), [Synchronous Optical Networking](https://en.wikipedia.org/wiki/Synchronous_Optical_Networking) (SONET) or [Ethernet](https://en.wikipedia.org/wiki/Ethernet), and eliminate the need for multiple layer-2 networks to satisfy different types of traffic. Multiprotocol label switching belongs to the family of [packet-switched networks](https://en.wikipedia.org/wiki/Packet_switching).

# Fiber-optic communication

**Fiber-optic communication** is a method of transmitting information from one place to another by sending pulses of [light](https://en.wikipedia.org/wiki/Light) through an [optical fiber](https://en.wikipedia.org/wiki/Optical_fiber). The light forms an [electromagnetic](https://en.wikipedia.org/wiki/Electromagnetic_radiation) [carrier wave](https://en.wikipedia.org/wiki/Carrier_wave) that is [modulated](https://en.wikipedia.org/wiki/Modulation) to carry information Fiber is [preferred over electrical cabling](https://en.wikipedia.org/wiki/Fiber-optic_communication#Comparison_with_electrical_transmission) when high [bandwidth](https://en.wikipedia.org/wiki/Bandwidth_(computing)), long distance, or immunity to [electromagnetic interference](https://en.wikipedia.org/wiki/Electromagnetic_interference) are required.

Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals. Researchers at [Bell Labs](https://en.wikipedia.org/wiki/Bell_Labs) have reached internet speeds of over 100 [petabit](https://en.wikipedia.org/wiki/Petabit" \o "Petabit)×kilometer per second using fiber-optic communication



### Transmitters

[](https://en.wikipedia.org/wiki/File:Finisar_GBIC_SX_2.jpg)

A [GBIC](https://en.wikipedia.org/wiki/GBIC) module (shown here with its cover removed), is an optical and electrical [transceiver](https://en.wikipedia.org/wiki/Transceiver). The electrical connector is at top right and the optical connectors are at bottom left

The most commonly used optical transmitters are semiconductor devices such as [light-emitting diodes](https://en.wikipedia.org/wiki/Light-emitting_diode) (LEDs) and [laser diodes](https://en.wikipedia.org/wiki/Laser_diode). The difference between LEDs and laser diodes is that LEDs produce [incoherent light](https://en.wikipedia.org/wiki/Coherence_(physics)#Spectral_coherence), while laser diodes produce [coherent light](https://en.wikipedia.org/wiki/Coherence_(physics)#Spectral_coherence). For use in optical communications, semiconductor optical transmitters must be designed to be compact, efficient and reliable, while operating in an optimal wavelength range and directly modulated at high frequencies.

In its simplest form, an LED is a forward-biased [p-n junction](https://en.wikipedia.org/wiki/P-n_junction), emitting light through [spontaneous emission](https://en.wikipedia.org/wiki/Spontaneous_emission), a phenomenon referred to as [electroluminescence](https://en.wikipedia.org/wiki/Electroluminescence). The emitted light is incoherent with a relatively wide spectral width of 30–60 nm. LED light transmission is also inefficient, with only about 1% of input power, or about 100 microwatts, eventually converted into [launched power](https://en.wikipedia.org/w/index.php?title=Launched_power&action=edit&redlink=1) which has been coupled into the optical fiber. However, due to their relatively simple design, LEDs are very useful for low-cost applications.

Communications LEDs are most commonly made from [Indium gallium arsenide phosphide](https://en.wikipedia.org/wiki/Indium_gallium_arsenide_phosphide) (InGaAsP) or [gallium arsenide](https://en.wikipedia.org/wiki/Gallium_arsenide) (GaAs). Because InGaAsP LEDs operate at a longer wavelength than GaAs LEDs (1.3 micrometers vs. 0.81–0.87 micrometers), their output spectrum, while equivalent in energy is wider in wavelength terms by a factor of about 1.7. The large spectrum width of LEDs is subject to higher fiber dispersion, considerably limiting their bit rate-distance product (a common measure of usefulness). LEDs are suitable primarily for [local-area-network](https://en.wikipedia.org/wiki/Local_area_network) applications with bit rates of 10–100 Mbit/s and transmission distances of a few kilometers. LEDs have also been developed that use several [quantum wells](https://en.wikipedia.org/wiki/Quantum_well) to emit light at different wavelengths over a broad spectrum and are currently in use for local-area [WDM](https://en.wikipedia.org/wiki/Wavelength-division_multiplexing) (Wavelength-Division Multiplexing) networks.

Today, LEDs have been largely superseded by [VCSEL](https://en.wikipedia.org/wiki/Vertical-cavity_surface-emitting_laser) (Vertical Cavity Surface Emitting Laser) devices, which offer improved speed, power and spectral properties, at a similar cost. Common VCSEL devices couple well to multi mode fiber.

A semiconductor laser emits light through [stimulated emission](https://en.wikipedia.org/wiki/Stimulated_emission) rather than spontaneous emission, which results in high output power (~100 mW) as well as other benefits related to the nature of coherent light. The output of a laser is relatively directional, allowing high coupling efficiency (~50 %) into single-mode fiber. The narrow spectral width also allows for high bit rates since it reduces the effect of [chromatic dispersion](https://en.wikipedia.org/wiki/Dispersion_(optics)). Furthermore, semiconductor lasers can be modulated directly at high frequencies because of short [recombination time](https://en.wikipedia.org/wiki/Carrier_generation_and_recombination).

Laser diodes are often directly [modulated](https://en.wikipedia.org/wiki/Modulation), that is the light output is controlled by a current applied directly to the device. For very high data rates or very long distance *links*, a laser source may be operated [continuous wave](https://en.wikipedia.org/wiki/Continuous_wave#Laser_physics), and the light modulated by an external device, an [optical modulator](https://en.wikipedia.org/wiki/Optical_modulator), such as an [electro-absorption modulator](https://en.wikipedia.org/wiki/Electro-absorption_modulator) or [Mach–Zehnder interferometer](https://en.wikipedia.org/wiki/Mach%E2%80%93Zehnder_interferometer). External modulation increases the achievable link distance by eliminating laser [chirp](https://en.wikipedia.org/wiki/Chirp), which broadens the [linewidth](https://en.wikipedia.org/wiki/Linewidth) of directly modulated lasers, increasing the chromatic dispersion in the fiber. For very high bandwidth efficiency, coherent modulation can be used to vary the phase of the light in addition to the amplitude, enabling the use of [QPSK](https://en.wikipedia.org/wiki/QPSK), [QAM](https://en.wikipedia.org/wiki/QAM), and [OFDM](https://en.wikipedia.org/wiki/OFDM).

A [transceiver](https://en.wikipedia.org/wiki/Transceiver) is a device combining a transmitter and a receiver in a single housing (see picture on right).

Fiber optics have seen recent advances in technology. "Dual-polarization quadrature phase shift keying is a modulation format that effectively sends four times as much information as traditional optical transmissions of the same speed." [[12]](https://en.wikipedia.org/wiki/Fiber-optic_communication#cite_note-12)

### Receivers

The main component of an optical receiver is a [photodetector](https://en.wikipedia.org/wiki/Photodetector) which converts light into electricity using the [photoelectric effect](https://en.wikipedia.org/wiki/Photoelectric_effect). The primary photodetectors for telecommunications are made from [Indium gallium arsenide](https://en.wikipedia.org/wiki/Indium_gallium_arsenide). The photodetector is typically a semiconductor-based [photodiode](https://en.wikipedia.org/wiki/Photodiode). Several types of photodiodes include p-n photodiodes, p-i-n photodiodes, and avalanche photodiodes. [Metal-semiconductor-metal](https://en.wikipedia.org/wiki/Metal-semiconductor-metal) (MSM) photodetectors are also used due to their suitability for [circuit integration](https://en.wikipedia.org/wiki/Integrated_circuit) in [regenerators](https://en.wikipedia.org/wiki/Signal_regeneration) and wavelength-division multiplexers.

Optical-electrical converters are typically coupled with a [transimpedance amplifier](https://en.wikipedia.org/wiki/Transimpedance_amplifier" \o "Transimpedance amplifier) and a [limiting amplifier](https://en.wikipedia.org/w/index.php?title=Limiting_amplifier&action=edit&redlink=1) to produce a digital signal in the electrical domain from the incoming optical signal, which may be attenuated and distorted while passing through the channel. Further signal processing such as [clock recovery](https://en.wikipedia.org/wiki/Clock_recovery) from data (CDR) performed by a [phase-locked loop](https://en.wikipedia.org/wiki/Phase-locked_loop) may also be applied before the data is passed on.

Coherent receivers use a local oscillator laser in combination with a pair of hybrid couplers and four photodetectors per polarization, followed by high speed ADCs and digital signal processing to recover data modulated with QPSK, QAM, or OFDM.

### Fiber cable

[](https://en.wikipedia.org/wiki/File:Fiber_optic3.jpg)

A cable reel trailer with conduit that can carry optical fiber

[](https://en.wikipedia.org/wiki/File:Fibre-optic_cable_in_a_Telstra_pit.jpg)

Multi-mode optical fiber in an underground service pit

An [optical fiber cable](https://en.wikipedia.org/wiki/Optical_fiber_cable) consists of a core, [cladding](https://en.wikipedia.org/wiki/Cladding_(fiber_optics)), and a buffer (a protective outer coating), in which the cladding guides the light along the core by using the method of [total internal reflection](https://en.wikipedia.org/wiki/Total_internal_reflection). The core and the cladding (which has a lower-[refractive-index](https://en.wikipedia.org/wiki/Refractive_index)) are usually made of high-quality [silica](https://en.wikipedia.org/wiki/Silicon_dioxide) glass, although they can both be made of plastic as well. Connecting two optical fibers is done by [fusion splicing](https://en.wikipedia.org/wiki/Fusion_splicing) or [mechanical splicing](https://en.wikipedia.org/wiki/Mechanical_splice) and requires special skills and interconnection technology due to the microscopic precision required to align the fiber cores.[[16]](https://en.wikipedia.org/wiki/Fiber-optic_communication#cite_note-16)

Two main types of optical fiber used in optic communications include [multi-mode optical fibers](https://en.wikipedia.org/wiki/Multi-mode_optical_fiber) and [single-mode optical fibers](https://en.wikipedia.org/wiki/Single-mode_optical_fiber). A multi-mode optical fiber has a larger core (≥ 50 [micrometers](https://en.wikipedia.org/wiki/Micrometre" \o "Micrometre)), allowing less precise, cheaper transmitters and receivers to connect to it as well as cheaper connectors. However, a multi-mode fiber introduces [multimode distortion](https://en.wikipedia.org/wiki/Multimode_distortion), which often limits the bandwidth and length of the link. Furthermore, because of its higher [dopant](https://en.wikipedia.org/wiki/Dopant) content, multi-mode fibers are usually expensive and exhibit higher attenuation. The core of a single-mode fiber is smaller (<10 micrometers) and requires more expensive components and interconnection methods, but allows much longer, higher-performance links. Both single- and multi-mode fiber is offered in different grades.

# Network switch

[](https://en.wikipedia.org/wiki/File:2550T-PWR-Front.jpg)

a 50-port Ethernet switch

A **network switch** (also called **switching hub**, **bridging hub**, officially **MAC bridge**[[1]](https://en.wikipedia.org/wiki/Network_switch#cite_note-1)) is a [computer networking device](https://en.wikipedia.org/wiki/Computer_networking_device) that connects devices on a [computer network](https://en.wikipedia.org/wiki/Computer_network) by using [packet switching](https://en.wikipedia.org/wiki/Packet_switching) to receive, process, and forward data to the destination device.

A network switch is a multiport [network bridge](https://en.wikipedia.org/wiki/Network_bridge) that uses [hardware addresses](https://en.wikipedia.org/wiki/Hardware_address) to process and forward data at the [data link layer](https://en.wikipedia.org/wiki/Data_link_layer) (layer 2) of the [OSI model](https://en.wikipedia.org/wiki/OSI_model). Some switches can also process data at the [network layer](https://en.wikipedia.org/wiki/Network_layer) (layer 3) by additionally incorporating [routing](https://en.wikipedia.org/wiki/Routing) functionality. Such switches are commonly known as layer-3 switches or [multilayer switches](https://en.wikipedia.org/wiki/Multilayer_switch).[[2]](https://en.wikipedia.org/wiki/Network_switch#cite_note-layer3-2)

Switches for [Ethernet](https://en.wikipedia.org/wiki/Ethernet) are the most common form of network switch. The first Ethernet switch was introduced by [Kalpana](https://en.wikipedia.org/wiki/Kalpana_(company)" \o "Kalpana (company)) in 1990.[[3]](https://en.wikipedia.org/wiki/Network_switch#cite_note-3) Switches also exist for other types of networks including [Fibre Channel](https://en.wikipedia.org/wiki/Fibre_Channel), [Asynchronous Transfer Mode](https://en.wikipedia.org/wiki/Asynchronous_Transfer_Mode), and [InfiniBand](https://en.wikipedia.org/wiki/InfiniBand).

Unlike less advanced [repeater hubs](https://en.wikipedia.org/wiki/Repeater_hub), which broadcast the same data out of each of its ports and let the devices decide what data they need, a network switch forwards data only to the devices that need to receive it.

**Types of Network switches:**

## Unmanaged Switch

Unmanaged network switches are frequently used in home networks, small companies and businesses. It permits devices on the network to connect with each other, such as computer to computer or printer to computer in one location. An unmanaged switch does not necessarily need to be configured or watched. It is simple and easy to set up. If you want to add more Ethernet ports, you can use these plug and play types of switches in networking.

## Managed Switch

Compared to unmanaged switches, the advantage of managed switches is that they can be customized to enhance the functionality of a certain network. They offer some features like QoS (Quality of Service), Simple Network Management Protocol (SNMP) and so on. These types of switches in networking can support a range of advanced features designed to be controlled by a professional administrator. In addition, there is smart switch, a type of [managed switch](https://www.fs.com/products/35252.html). It has some features that managed switch has, but are more limited. Smart network switch is usually used for the networking devices such as VLANs.

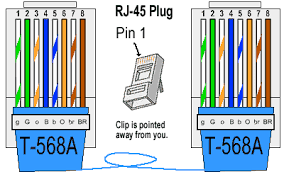
## PoE Switch

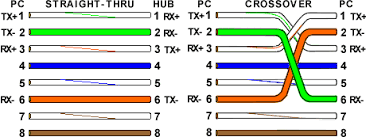
PoE Gigabit Ethernet switch is a network switch that utilizes Power over Ethernet technology. When connected with multiple other network devices, PoE switches can support power and data transmission over one [network cable](https://www.fs.com/c/cat5e-cat6-cat7-904) at the same time. This greatly simplifies the cabling process. These types of switches in networking provide greater flexibility and you will never have to worry about power outlet when deploying network devices.

**Ethernet Cable**

**Category 6 cable**, commonly referred to as **Cat 6**, is a standardized [twisted pair](https://en.wikipedia.org/wiki/Twisted_pair) cable for [Ethernet](https://en.wikipedia.org/wiki/Ethernet) and other network [physical layers](https://en.wikipedia.org/wiki/Physical_layer) that is [backward compatible](https://en.wikipedia.org/wiki/Backward_compatible) with the [Category 5/5e](https://en.wikipedia.org/wiki/Category_5_cable) and [Category 3 cable](https://en.wikipedia.org/wiki/Category_3_cable) standards.

Compared with Cat 5 and Cat 5e, Cat 6 features more stringent specifications for [crosstalk](https://en.wikipedia.org/wiki/Crosstalk) and system noise. The cable standard also specifies performance of up to 250 MHz compared to 100 MHz for Cat 5 and Cat 5e.





# Cisco UCS C240 M4 Rack Server

The Cisco UCS C240 M4 Rack Server is an enterprise-class server designed to deliver exceptional performance, expandability, and efficiency for storage and I/O-intensive infrastructure workloads. This includes big data analytics, virtualization, and graphics-rich and bare-metal applications.



## Features and Capabilities

### Performance for Data-Intensive Applications

The UCS C240 M4 Rack Server delivers outstanding levels of expandability and performance for standalone or UCS-managed environments in a two rack-unit (2RU) form factor. It provides:

* Dual Intel® Xeon® E5-2600 v3 or v4 processors for improved performance suitable for nearly all two-socket applications
* Next-generation double-data-rate 4 (DDR4) memory, 12-Gbps SAS throughput, and NVMe PCIe SSD support
* Innovative Cisco UCS virtual interface card (VIC) support in PCIe or modular LAN-on-motherboard (mLOM) form factor
* Graphics-rich experiences to more virtual users with support for the latest NVIDIA graphics processing units (GPUs)

The UCS C240 M4 server also offers maximum reliability, availability, and serviceability (RAS) features, including:

* Tool-free CPU insertion
* Easy-to-use latching lid
* Hot-swappable and hot-pluggable components
* Redundant Cisco Flexible Flash SD cards

The Cisco UCS C240 M4 server can be deployed standalone or as part of the Cisco Unified Computing System (UCS). Cisco UCS unifies computing, networking, management, virtualization, and storage access into a single integrated architecture that can enable end-to-end server visibility, management, and control in both bare-metal and virtualized environments. With Cisco UCS-managed deployment, UCS C240 M4 takes advantage of our standards-based unified computing innovations to significantly reduce customers’ TCO and increase business agility.

## Specifications at a Glance

| **Item** | **Specification** |
| --- | --- |
| Chassis | Two rack-unit (2RU) server |
| Processors | Either 1 or 2 Intel® Xeon® processor E5-2600 v3 or v4 product family CPUs |
| Chipset | Intel C610 series |
| Memory | Up to 24 double-data-rate 4 (DDR4) dual in-line memory (DIMMs) of up to 2400 MHz speeds |
| PCIe slots | Up to 6 PCI Express (PCIe) Generation 3 slots (four full-height and full-length;  four NCSI-capable and VIC-ready; two GPU-ready) |
| Hard drives | Up to 24 small-form factor (SFF) drives or 12 large form-factor (LFF) drives, plus two optional internal  SATA boot drives, and NVMe drive support |
| Embedded NIC | Two 1-Gbps Intel i350-based Gigabit Ethernet ports |
| mLOM | mLOM slot can flexibly accommodate 1-Gbps, 10-Gbps, or 40-Gbps adapters |
| RAID controller | Cisco 12 Gb SAS modular RAID controller for internal drives Cisco 9300-8E 12 Gb SAS HBA for external drives Embedded software RAID (entry RAID solution) for up to four SATA drives |

IP camera

An **Internet Protocol camera**, or **IP camera**, is a type of [digital video camera](https://en.wikipedia.org/wiki/Digital_video_camera) that receives control data and sends image data via the [Internet](https://en.wikipedia.org/wiki/Internet). They are commonly used for [surveillance](https://en.wikipedia.org/wiki/Surveillance). Unlike analog [closed-circuit television](https://en.wikipedia.org/wiki/Closed-circuit_television) (CCTV) cameras, they require no local recording device, but only a [local area network](https://en.wikipedia.org/wiki/Local_area_network). Most IP cameras are [webcams](https://en.wikipedia.org/wiki/Webcam), but the term *IP camera* or **netcam** usually applies only to those used for surveillance that can be directly accessed over a network connection.

Some IP cameras require support of a central [network video recorder](https://en.wikipedia.org/wiki/Network_video_recorder)(NVR) to handle the recording, video and alarm management. Others are able to operate in a decentralized manner with no NVR needed, as the camera is able to record directly to any local or remote storage media.



IP cameras differ from previous generation analog cameras that transmitted video signals as a voltage, whereas IP cameras send images digitally using the transmission and security features of the [TCP/IP](https://en.wikipedia.org/wiki/Internet_protocol_suite) protocol. Advantages to this approach include:

* Two-way audio via a single network cable allows users to listen to and speak to the subject of the video (e.g., a clerk assisting a customer through step-by-step instructions)
* Use of a [Wi-Fi](https://en.wikipedia.org/wiki/Wi-Fi) or [wireless network](https://en.wikipedia.org/wiki/Wireless_network)[[11]](https://en.wikipedia.org/wiki/IP_camera#cite_note-11)
* [Distributed artificial intelligence](https://en.wikipedia.org/wiki/Distributed_artificial_intelligence) (DAI)—as the camera can contain video analytics that analyze images[[12]](https://en.wikipedia.org/wiki/IP_camera#cite_note-12)
* Secure data transmission through encryption and authentication methods such as [WPA](https://en.wikipedia.org/wiki/Wi-Fi_Protected_Access) or [WPA2](https://en.wikipedia.org/wiki/WPA2), [TKIP](https://en.wikipedia.org/wiki/Temporal_Key_Integrity_Protocol) or [AES](https://en.wikipedia.org/wiki/Advanced_Encryption_Standard)
* Remote accessibility that lets users view live video from any device with sufficient access privileges[[13]](https://en.wikipedia.org/wiki/IP_camera#cite_note-13)
* [Power over Ethernet](https://en.wikipedia.org/wiki/Power_over_Ethernet) (PoE) to supply power through the ethernet cable and operate without a dedicated power supply
* Better image Resolution, typically four times the resolution of an analog camera