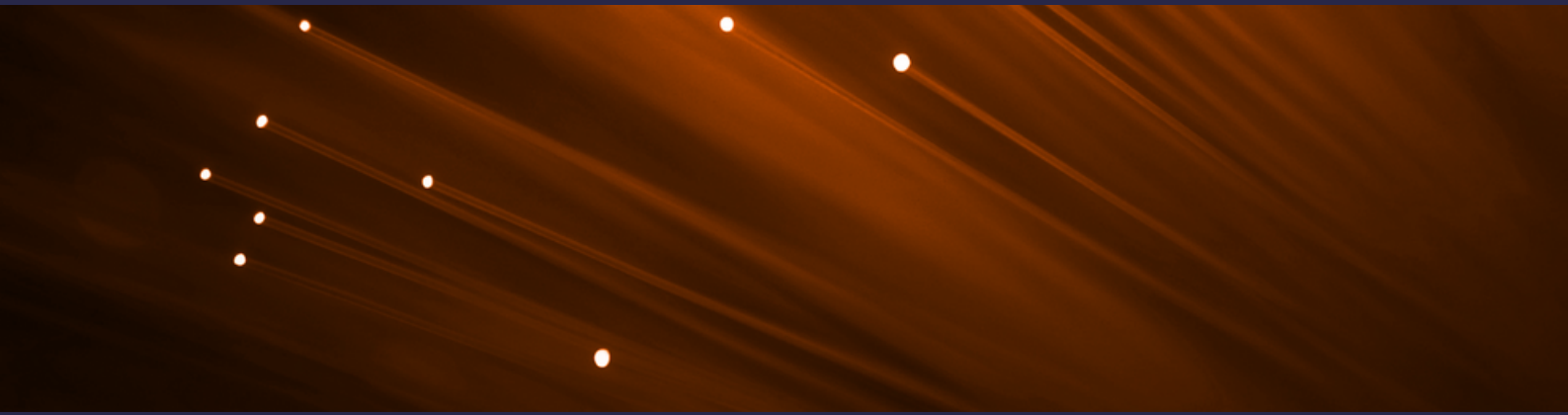
SFP & FIBRE EXPLAINED

- SFP Types & Advantages
- SFP Standards
- Fibre Module Colour Codes
- Fibre Optic Cables
- Fibre Optic Cable Types
- Fibre Connectors



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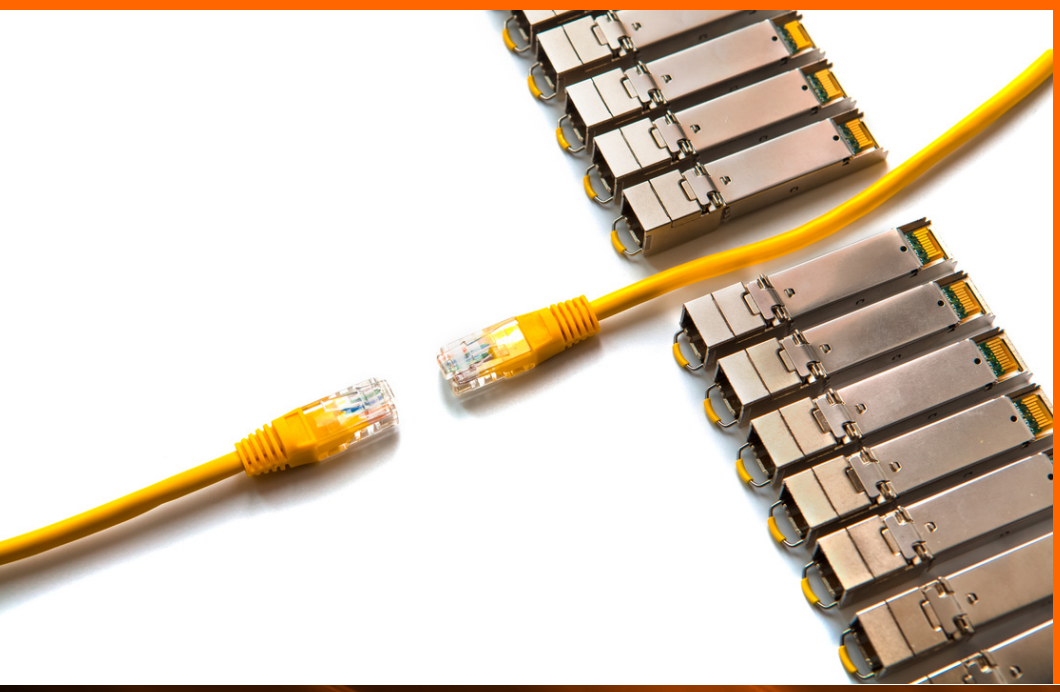
SFP & FIBRE EXPLAINED

Small form-factor pluggable (SFP) transceivers are a core technology in many networks. They provide vital communication between switches and important network components, and due to their small size, versatile connection options and swappable capabilities are a popular choice. Designed to work with the majority of modern networks, SFP is compact enough to use in tight networking spaces, whilst being powerful enough to provide fast communication between switches and other important networking equipment and reliable enough for mission-critical usage.

If you're looking to expand or adjust an existing network without having to redesign an entire cable infrastructure, SFP is ideal. SFP modules are also a great choice for bridging communications between switches.

When it comes to using SFP modules with fibre optic connections you're spoilt for choice. There is an SFP for all of your needs, as they are made to support single-mode and multi-mode fibre, with wavelength options between 850 nm to 1550 nm, and networking ranges from 500 m to over 100 km... but more on that later!

SFP compatibility can be deceptively tricky, as there is no formal, regulated international standard for these modules. SilverNet has put together this document to help you better understand SFP modules and Fibre, and to help you make an informed decision when the time comes.



Read on to discover the ins and outs of SFP and Fibre...

SFP TYPES & ADVANTAGES

SFP modules play a crucial role in enabling high-speed communication between switches and various network components, including routers and other devices. They are primarily utilised with both copper and fibre optic cables. The compact form factor of SFP modules makes them exceptionally well-suited for deployment in areas that might have limited accessibility.

The functions of SFP modules include:

Connectivity: SFP modules establish a reliable and efficient connection between network devices, allowing seamless data transmission.

Flexibility: These modules support both copper and fibre optic cables, providing flexibility in network design and allowing compatibility with different infrastructure requirements.

High-Speed Communication: SFP modules enable high-speed data transfer, supporting various network speeds such as Fast Ethernet, Gigabit Ethernet, and beyond.

Hot-Swapping: SFP modules are hot-swappable, meaning they can be inserted or removed from a device without disrupting the overall network operation. This feature facilitates ease of maintenance and upgrades.

Distance Extension: By utilising fibre optic cables, SFP modules extend the reach of network connections over longer distances, enabling connectivity in challenging environments.

Compatibility: SFP modules adhere to industry-standard specifications, ensuring compatibility with a wide range of networking equipment from different vendors.

In summary, SFP modules are essential components that facilitate efficient and high-speed communication in network infrastructures. Their small form factor, compatibility, and support for both copper and fibre optic cables make them a versatile choice for enhancing connectivity in diverse networking environments.

SFP STANDARDS

There are several SFP standards that specify the physical and electrical characteristics of these modules. Here are the most common SFP standards and their meanings:

SFP: The original standard for SFP modules, also known as SFP 1.0 or SFP 2.5. It supports data rates up to 4.25 Gbps and can accommodate both single-mode and multimode fibre optic cables.

SFP+: This enhanced version of the SFP standard, also known as SFP 10.0 or SFP 10G, supports data rates up to 10 Gbps. It is commonly used for 10 Gigabit Ethernet connections over both fibre optic and copper cables.

SFP28: This standard builds upon SFP+ and supports data rates up to 25 Gbps. It is often used in high-speed networking applications, such as 25 Gigabit Ethernet.

QSFP: Quad Small Form-factor Pluggable modules, or QSFP, provide higher data rates and density compared to SFP modules. They support data rates up to 40 Gbps and are commonly used for 40 Gigabit Ethernet connections.

QSFP+: This enhanced version of QSFP supports data rates up to 40 Gbps or 56 Gbps (with PAM4 modulation). It is often used for 40 Gigabit Ethernet or 56 Gigabit Ethernet connections, as well as InfiniBand and other high-speed networking applications.

QSFP28: This standard builds upon QSFP+ and supports data rates up to 100 Gbps. It is commonly used for 100 Gigabit Ethernet connections and is the prevalent standard for high-speed networking.

These are some of the most common SFP standards used in networking equipment.

Each standard defines the physical form factor, electrical interface, and maximum data rates supported by the SFP module, allowing for flexibility and interchangeability in network deployments.

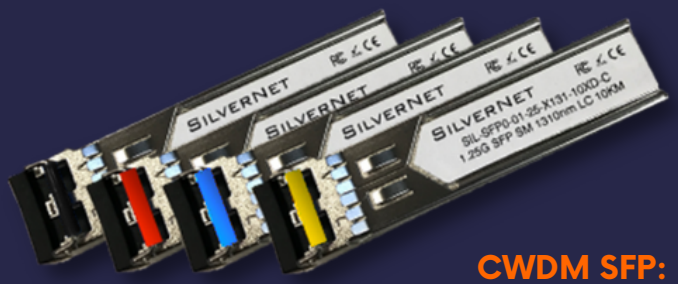
FIBRE MODULE COLOUR CODES

Coarse Wavelength Division Multiplexing (CWDM) can easily run more channels of higher bandwidth traffic over the same fibre. CWDM is an effective method to solve the increasing bandwidth capacity needs and to maximize the utilization of both new and existing fibre. The need to bury more fibre is eliminated as you can push more data over a fibre by just upgrading the SFP modules.

BiDi modules are equipped with WDM couplers/diplexers to combine or separate data transmitted over a single fibre using different wavelengths of the light. BiDi transceivers should be deployed in pairs. A transceiver transmits (TX) on 1310nm on a single fibre. At the remote end that receives (RX) on 1310nm and transmits back on 1490nm on the same fibre where the receiver (RX) frequency is listening on 1490nm.

The latch colour indicates the SFP wavelength. There isn't an IEEE standard as such that covers everything but the whole industry pretty much agrees on an SFP standard that SilverNet follows:

Gigabit SFP:
Multimode (850nm) Black
Singlemode (1310nm) Blue
Singlemode (1550nm) Yellow

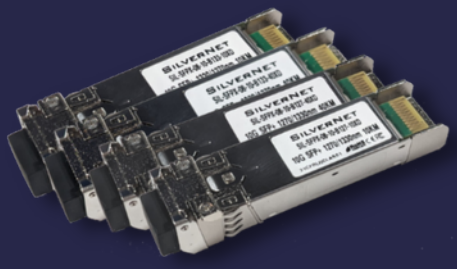


10G SFP+
Multimode 850nm Black
Singlemode 1310nm Blue
Singlemode 1550nm Red

CWDM SFP:
1470nm Grey
1490nm Purple
1510nm Blue
1530nm Green
1550nm Yellow
1570nm Orange
1590nm Red
1610nm Brown

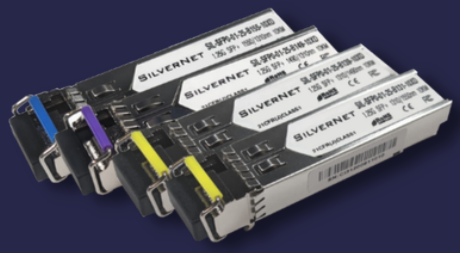
Bidi SFP:

1310/1490nm pairs:
1310nm side Blue
1490nm side Purple



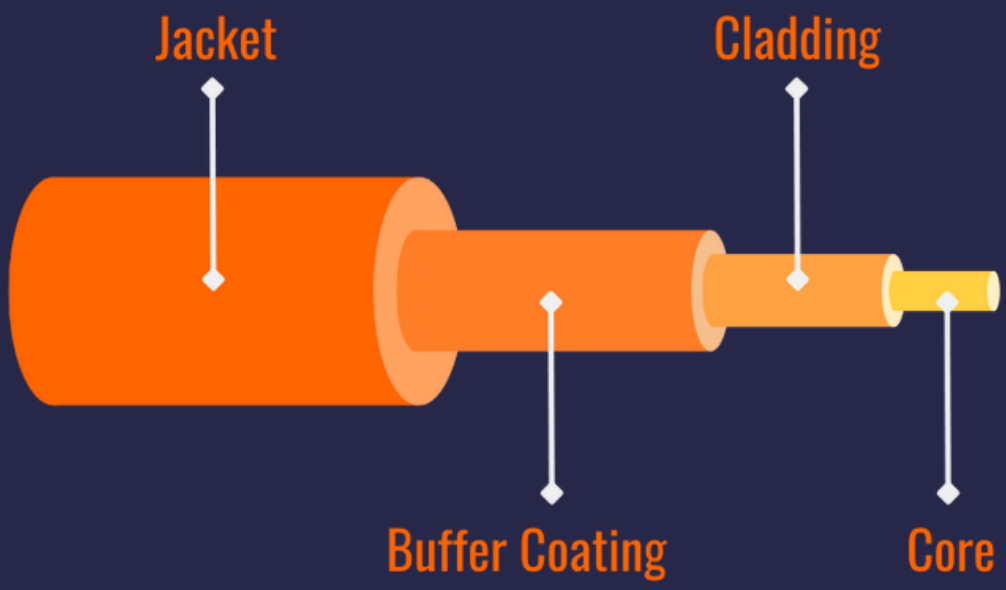
1310/1550nm pairs:
1310nm side Blue
1550nm side Yellow

10G SFP+ Bidi
1270nm Light Blue
1330nm Light Green



FIBRE OPTIC CABLES

Fibre optic cables consist of a core and cladding, each made up of glass or plastic. The core is surrounded by the cladding, which has a lower index of refraction. This difference in refractive indices between the core and cladding creates total internal reflection, enabling data to be transmitted at high speeds.



The core of fibre optic cables is measured in microns (µm). The core size of multimode fibre cables is 50µm and 62.5µm, while single-mode fibre cables are measured in 8-9µm.

Single-Mode Fibre

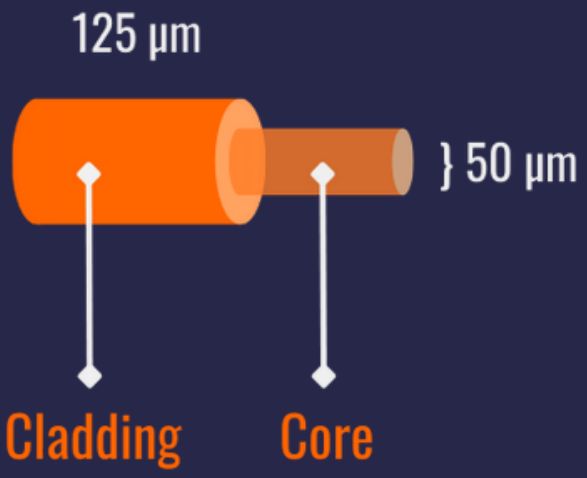
Single-mode fibre (SMF) is made with a very thin core, measuring 8-9µm. The small core size enables the fibre to carry only one light mode or signal. This fibre is used for long-distance data transmission, as it is not affected by fibre bending or fibre stretching.

Multi-mode Fibre

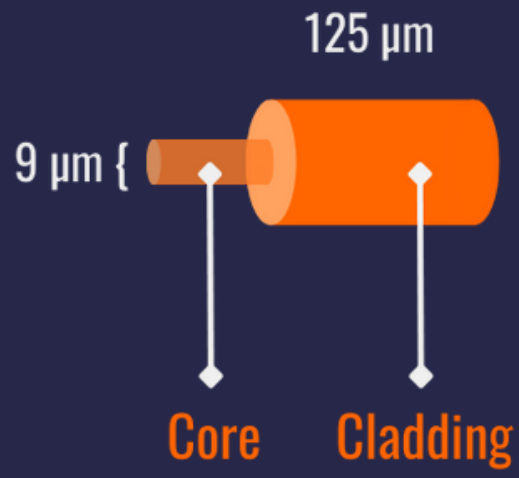
Made with a larger core, Multi-mode fibre (MMF) typically measures 50µm to 62.5µm. MMF is commonly used for fibre-to-the-home (FTTH) networks and fibre-to-the-node (FTTN) networks, as it can carry multiple light modes, allowing it to carry data at high speeds over short distances.

FIBRE OPTIC CABLES

Multimode Fibre



Single-mode Fibre



Fibre optics carry different frequencies of light or wavelengths. When measuring Fibre optic wavelengths we use nanometers, with MMF wavelengths measuring 850nm and 1300nm, and SMF wavelengths measuring 1310nm and 1550nm.

The wavelength is like a colour of light, and fibre optic cables are typically made to transmit one of two colours: 850nm or 1310nm. These two colours are part of the near-infrared spectrum and are invisible to the human eye.

When thinking about fibre optic cables the two most commonly used are 850nm for MMF data transmission, and 1310nm for SMF due to its high bandwidth and long distance capabilities.

850nm fibre optic cable has a lower attenuation rate, meaning it can carry data with less signal loss. Another, less common option is the 1300nm fibre optic cable, it has a higher bandwidth than the 850nm fibre making it better suited for high-speed data transmission.

FIBRE OPTIC CABLE TYPES

Single Mode Fibre (SMF) Types

OS1: Supports speeds up to 10G and distances up to about 10km (6 miles). Strong, tight-buffered fibre coating making them more resilient and crush resistant.Typically used in local or indoor applications such as fibre to the desktop (FTTD), fibre to the home (FTTH), and fibre to the node (FTTN).

OS2: Supports speeds up to 100G and distances up to about 200km (124 miles). The loose-tube fibre design makes them incredible flexible and easy to install in ducts and conduits. Typically used in long-haul or outdoor applications such as fibre optic backbone and fibre optic backhaul lines.

FIBRE OPTIC CABLE TYPES

Multi Mode Fibre (MMF) Types

OM1: Core diameter of 62.5 microns (µm) and can support data rates up to 1Gbps at distances at an 850nm wavelength and distances of 300 meters. Most commonly used in local area networks and private networks. Identified by its orange jacket.

OM2: Core diameter of 50 µm which allows it to support data rates up to 1Gbps at 850nm wavelength and distances of 600 meters. An enhancement of OM1, it can support up to twice the distance. Identified by its orange jacket.

OM3: Core diameter 50 µm, which allows it to support data rates up to 10Gbps at 850nm wavelength and distances of up to 300 meters. Also known as laser-optimized multimode cables and commonly used in larger private networks. It uses fewer modes of light which results in increasing speeds. Identified by its aqua jacket.

OM4: Can support data rates up to 10Gbps at an 850nm wavelength and distances at 550 meters, and 10GBASE-SR, 10GBASE-SW, and 10GBASE-LW applications. Also known as laser-optimized multimode cables and commonly used in high-speed networks such as financial centres, data centres, corporate campuses, or similar. Identified by its aqua jacket.

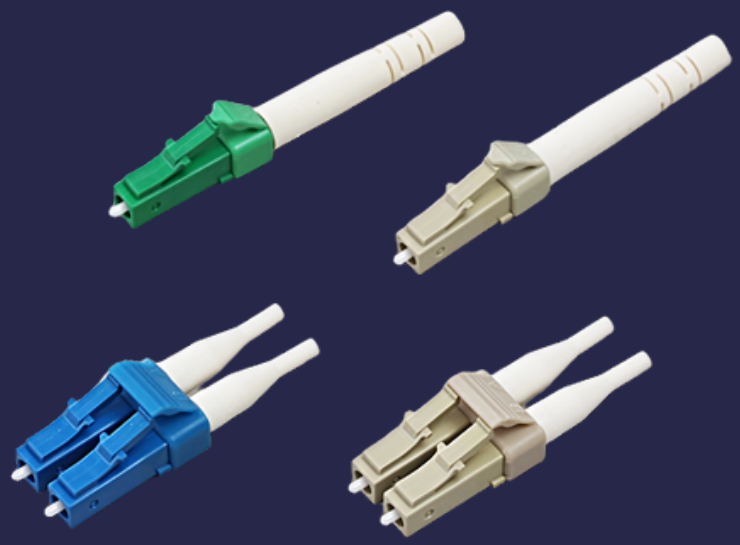
OM5: Uses a wide range of wavelengths between 850nm and 953nm, allowing it to support 40GBASE-SR4, 100GBASE-SR10, and 100GBASE-SW4 fibre applications. A newer type, it is designed to support Short Wavelength Division Multiplexing (SWDM). OM5 is fully compatible with both OM3 and OM4 cabling, meaning it can adapt to a wide range of wavelengths between 850nm and 953nm. Identified by its lime green jacket.

FIBRE CONNECTORS

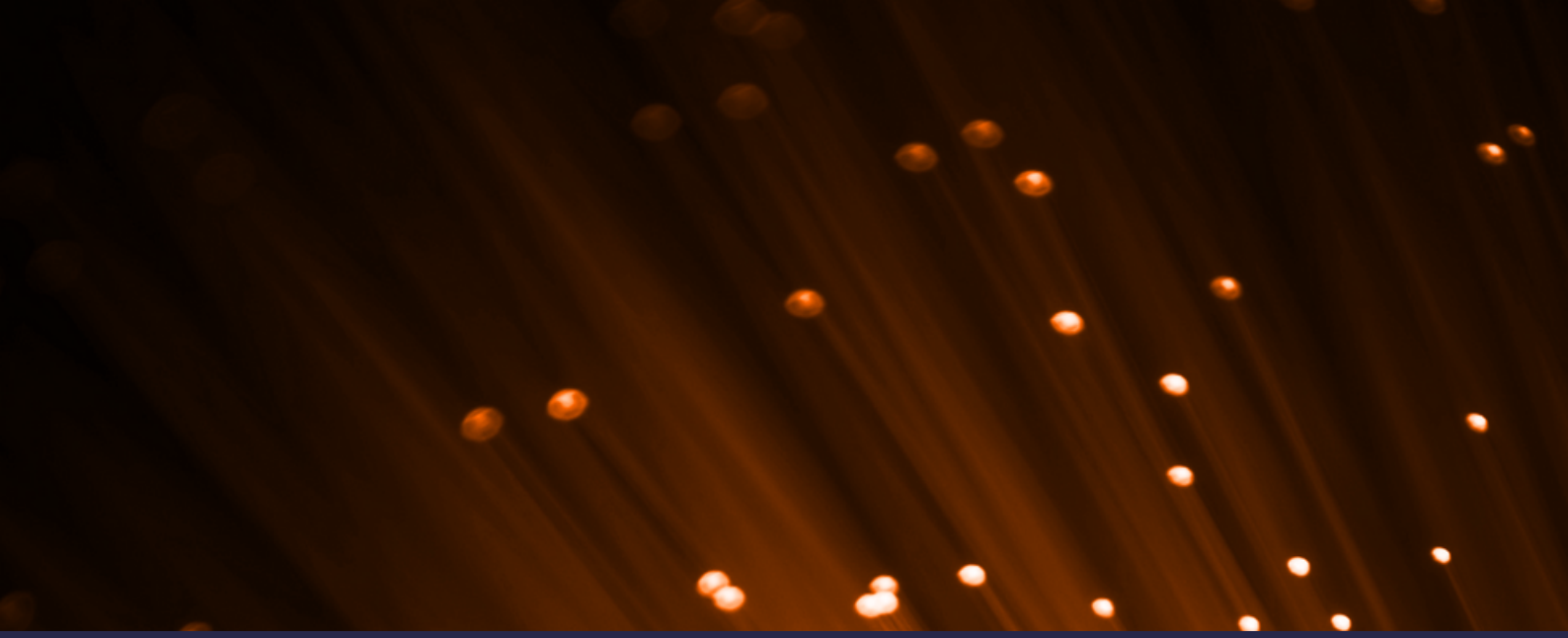
A Fibre Connector (also known as fibre optic connector or optical fibre connector) is a precise coupling device that joins fibre optic cables quickly, enabling fast connection and disconnection than splicing. The connector mechanically orients the fibre cores, allowing light to pass and travel through the cable without interruption.

The fibre optic connector allows light signals instead of electrical signals which requires the connector to be much more precise. They have long lifetimes, are low insert loss, high return loss, and have best insertion repeatability.

Although there are over 100 fibre connectors, only a few types are particularly common and widely used in the industry. At SilverNet we tend to use the LC Connector, but other types you may want to read more about include the SC, FC, ST or MPO connectors.



LC stands for "Lucent Connector" and it has a 1.25mm ferrule – half the size of the SC connector which preceded it. High efficiency cabling with LC fibre optic connectors is preferred by many, and so this connector is most often used, and most successful of the connectors. Ideal for high-density applications, this small form-factor connector is popular in datacoms. Additionally, modern optical transceivers and active networking components feature LC connectors, expanding massive deployments and applications.



If you have any further questions about SFP Modules and Fibre Optics, or would like advice or information about any SilverNet products, contact our experts today:

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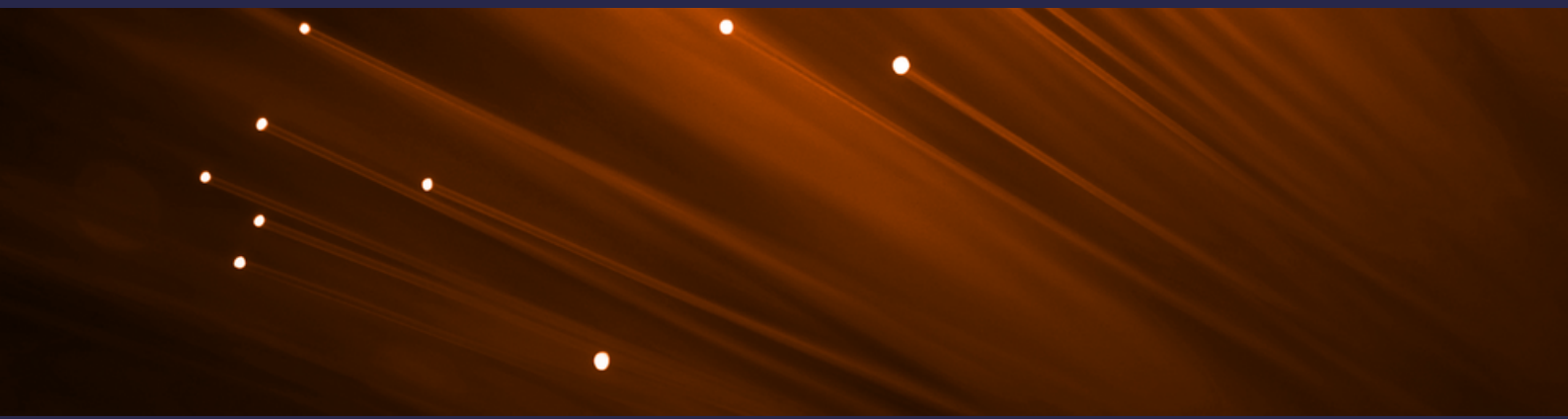

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