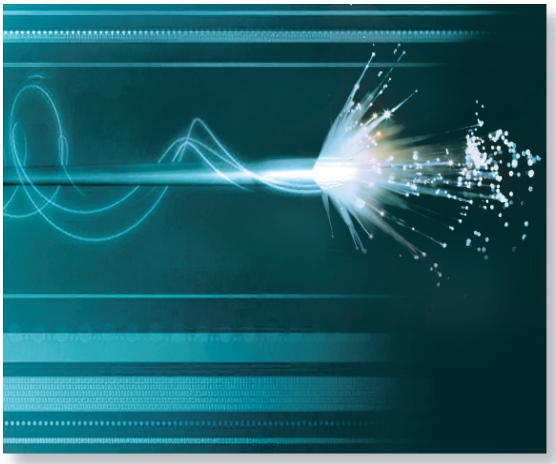
Why choose multimode fiber?

Total lifecycle costs may be lower and network flexibility greater than with single-mode fiber.

The primary factor affecting the design of premises and local area networks is the overall cost of the components. The geometrical properties and fiber core construction of single-mode and multimode fiber differ greatly, such that each fiber type has different optical-performance attributes that lend themselves to different communications network applications.

When comparing the relative fiber core geometries of multimode and single-mode fiber, the core of multimode fiber is more than five times greater in diameter than that of a single-mode fiber. The large core of multimode fiber has distinct advantages: it enables low loss connection and facilitates simple fiber-to-fiber or fiber-to-transceiver alignment and, consequently, is best suited to premises and LAN applications.



The use of low-cost 850-nm VCSELs in conjunction with multimode fiber can reduce the cost of premise network installations.

Apart from switch electronics, the optical transceivers are the most expensive part of a premises network installation. The switch electronics are independent of fiber type and, therefore, changes in transceiver cost will have the greatest effect on the overall network costs.

There are four main types of optical transmitters that can be used in communications networks. These light sources differ greatly in cost, optical characteristics and performance.

Distributed feedback (DFB) and Fabry-Perot (FP) lasers are expensive relative to light-emitting diodes (LEDs) and vertical-cavity, surface-emitting lasers (VCSELs), but the high-power and highly focused source beam allows efficient coupling of high power levels into the small core of single-mode fiber. LEDs and VCSELs offer an inexpensive solution for short-reach applications, like premises networks, but are unsuitable for single-mode fiber.

VCSELs have a low numerical aperture, but can have a large active area (~15 µm) and have relatively low-source power, so that the coupling efficiency into a 9-µm single-mode fiber core is low. LEDs have low launch power and, with a large numerical aperture, are also unsuitable for coupling into single-mode fibers.

To benefit from the cost advantages of VCSELs and LEDs, multimode fiber should be used, as the large core of multimode fiber facilitates highly efficient coupling of LED and VCSEL power. Recently, the use of LEDs in premises networks has decreased due to their bandwidth limitation and 850-nm VCSELs have become the choice for short-reach premises applications.

The cost of a premises network when installed using multimode fiber with 850-nm VCSELs is lower than the cost of a network that has been installed using either single-mode or multimode fiber with 1,300-nm lasers.

The OM-3 (300-meter data rate) multimode fiber-optic cable (MMF) solution features an OM-3-standardized, 300-meter 10-Gigabit Ethernet laser-optimized multimode fiber and 10GBASE-SR 850-nm VCSEL transceivers. An OM-3+, laser-optimized multimode fiber enables increased link distance over the OM-3 standard, up to 550 meters, and also uses 10GBASE-SR 850-nm VCSELs.

OM-1 conventional (FDDI grade) multimode fiber requires mode-conditioning patch cords and uses 10GBASE-LX4 wideband wavelength division multiplexer (WWDM) 1,300-nm DFB laser transceivers. The single-mode solution uses single-mode fiber-interconnect hardware and patch cords, with 10GBASE-LR 1,310-nm FP laser transceivers.

Although the increased manufacturing costs associated with multimode fiber result in the initial cost of multimode fiber being higher than that of single–mode fiber, with transceivers be-

For more information from Corning Optical Fiber: www.corning.com/opticalfiber ing a dominant cost, the use of low-cost 850-nm VCSELs in conjunction with multimode fiber can reduce the cost of premise network installations. The lower-cost advantage of multimode fiber requires the correct selection of fiber type and transceiver compatibility, taking account of current and long-term data rate requirements.

Cheaper legacy-grade (OM-1) multimode fiber cabling can stretch to 10 Gbps but requires more expensive 1,300-nm DFB lasers and mode-conditioning patch cords, or the use of additional electronics (10GBASE-LX4 or 10GBASE LRM). OM-3 multimode fiber can support future higher data rates of up to 40 Gbps and engineered solutions (using OM-3+ fiber) can enable extended system reach to 550 meters. Lower-cost connectors assist the low multimode fiber-installation cost, with the deployment enabled by the greater offset and alignment tolerances of multimode fiber.

By facilitating lower transceiver and connection costs, the maintenance and upgrade costs of a multimode fiber premises network will be lower than an equivalent single-mode network. Over the lifetime of a network, this will yield operational cost savings in addition to the lower first-installed costs.

Network cable overlays are expensive and should be avoided in order to maintain low operating costs. Despite the availability of 10-Gbps systems, many customers today require only 10 Mbps. Such customers still require the flexibility to upgrade the data rate up to 10 Gbps, if necessary, without incurring the expense of a new cable overlay, and so the system should facilitate a broad operating date range.

The standardized 1,310-nm FP and DFB laser transmitters, required for transmission over single-mode fiber, are restricted by their inherent composition to a lower data rate boundary of 1,000 Mbps. By contrast, low-cost 850-nm VCSELs that are suitable only for transmission over multimode fiber have a broad data-rate operating range–from 10 Mbps up to 10 Gbps. Therefore, the combination of multimode fiber and 850-nm VCSELs constitutes a low-cost solution that facilitates the current needs of a low data rate network, while also future proofing that network by providing a clear migration path from 10 Mbps to 10 Gbps on the same fiber. ❑