Net Optics®

Multimode Fiber: 50µm versus 62.5µm

Net Optics products support both 50µm and 62.5µm multimode fiber. Which one is right for you? This paper addresses that question. But first, what does 50µm and 62.5µm mean, and why does the industry support two types?

What are 50µm fiber and 62.5µm fiber?

The numbers 50µm and 62.5µm refer to the diameters of the glass or plastic core, the part of the fiber that carries the light which encodes your data. The dimensions are sometimes specified as 50/125µm and 62.5/125µm, to include the diameter of the cladding. (The cladding confines the light to the core because it has a lower index of refraction.) Cable construction is shown in the following diagram, indicating the cable core, cladding, and outer jacket diameters.

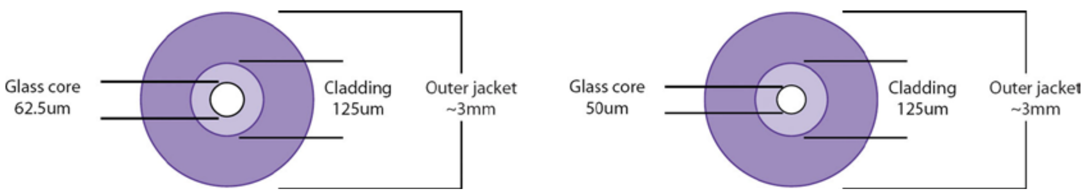
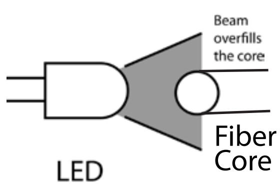


Figure 1: Cross-section of multimode fiber optic cables

Why two standards?

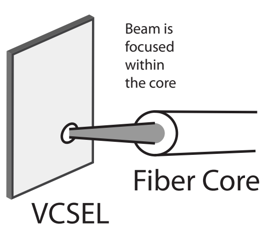
The reasons why two core diameters are supported are largely historical.[1] When optical fiber was introduced for 10 Mbps and then 100 Mbps Ethernet, light-emitting diode (LED) light sources and 62.5µm fiber were used.



LEDs over-fill the fiber core, so larger core diameters mean more light is collected, and thus data can be carried farther.

Figure 2: LED light source over-fills the fiber core

To achieve 1 Gbps performance, new technology was needed. The light source was upgraded to vertical-cavity surface-emitting laser (VCSEL), a laser technology that was economical to produce. VCSELs can switch more rapidly than LEDs, making them better for higher data rates.



VCSELs emit much smaller and more sharply focused beams, coupling more power into the fiber for greater efficiency.

Figure 3: VCSEL light source is focused within the fiber core

With a VCSEL light source, all of the light is coupled into the fiber, so a larger core diameter does not gather more light. In fact, a larger core diameter transmits the light less efficiently because of modal dispersion (see sidebar). Use of 50µm fiber decreased modal dispersion and thereby increased the reach of 1 Gbps fiber cabling, but 62.5µm fiber continued to be supported for backwards compatibility with existing cable plants.

The story continues for 10 Gbps networks, where 10Gbase-SR can span 300 meters on 50µm fiber but only 33 meters on 62.5µm fiber. 10Gbase-LX4 pushes the performance on 62.5µm fiber up to 300 meters but requires expensive, wave-division multiplexing transceivers.

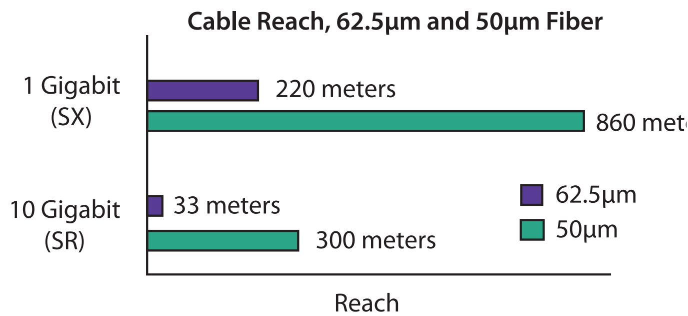


Figure 4: Cable reach is longer for 50µm fiber compared to 62.5µm

Which technology should I choose?

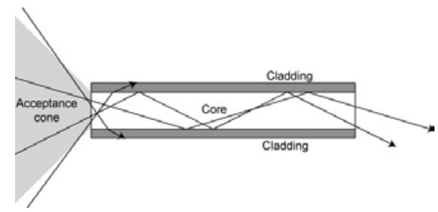
Given its superior technical characteristics for high-speed links, 50µm fiber is the clear choice for new multimode fiber links in most circumstances. Standards organizations including IEEE, INCITS, InfiniBand, OIF, TIA, IEC and ITU-T all specify laser-optimized 50µm fiber for new high-speed network installations.[2] OM3-grade, high-bandwidth 50/125-micron fiber cable increases the flexibility of network designs and achieves data transfer rates up to 10 Gbps at the lowest available cost.[3] Multimode 50µm fiber is the medium of the future, with 62.5µm fiber being supported chiefly for legacy purposes. However, the majority of the fiber deployed in the world today is 62.5µm, so backward compatibility is an important concern.

Assuming you already have 62.5µm fiber in your plant, should you stick with 62.5µm, or migrate to 50µm? As a first consideration, industry standards and leading media and equipment manufacturers recommend that you should not mix different types of fiber in a single link. If you have a 62.5µm run in the wall, that link should use all 62.5µm patch cables and equipment, including 62.5µm Net Optics Taps. However, extensive testing by Corning[4] has shown that the signal loss from joining dissimilar fiber segments, when necessary, is small.

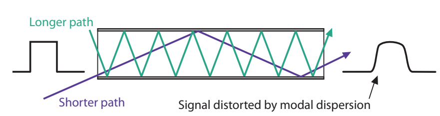
On the other hand, there are no technical drawbacks to using different fiber types in separate network links, as long as the

Modal Dispersion

Modal dispersion occurs because of how light travels down a multimode fiber optic cable.



Depending on the angle that the light enters the cable, it is reflected differently at the cladding boundary, resulting in longer or shorter paths along the cable. These different-length paths are the “modes” that “multimode” refers to. Even though the light always travels at the same speed along its path within the cable, it moves down the length of the cable at different speeds because of the different path lengths. Thus a light pulse that starts out with sharp edges at the launch end of the cable is spread out or dispersed at the receiving end of the cable, distorting the signal and making it more difficult to recover accurately. This modal dispersion is what limits the distance a fiber optic cable can transmit data successfully at a given data rate.



The bottom line on modal dispersion is that a 50µm fiber has a higher bandwidth capability than a 62.5µm fiber, because it limits the modes that light can use to travel down the cable, producing less modal dispersion. Therefore, 50µm fiber optic cables have significantly longer reach than 62.5µm cables.

If a smaller cable diameter is better, why not shrink it further still? It is because of the tradeoff between modal dispersion and coupling enough energy into the cable. If the diameter is decreased below 10µm, only a single mode can travel down the fiber, and modal dispersion is eliminated. However, this singlemode fiber requires a different, more expensive laser technology to launch enough energy into the tiny fiber, resulting in increased overall system costs and relegating its use primarily to long-haul applications such as cross-campus, metro-loop, and inter-city links.

ports at both ends of the link are compatible with the cable. Moreover, there is little if any cost difference between 62.5µm and a 50µm products in today's market. Therefore, installing 50µm fiber for new network links is a good investment for future growth, even if your current plant has mostly 62.5µm fiber.

With the demand for network capacity increasing daily, upgrades must be planned with an eye to the future. Installing 50µm multimode fiber today brings immediate benefits of longer cable reach and improved light loss budget margins, and prepares the network for future upgrades. If you haven't started already, it's time to begin phasing out 62.5µm fiber and moving into the world 50µm for higher performance and better returns on your network investments.

References

[1] Corning Cable Systems LLC, "Migration to 50/125 µm in the Local Area Network"
http://www.corningcablesystems.com/web/library/litindex.nsf/$all/LAN-437-EN/$file/LAN-437-EN.pdf

[2] A2Z Cables Incorporated, "62.5 Micron vs 50 Micron Fiber Tutorial"
http://store.a2zcable.com/50micronfiber.html

[3] Williams, Ken and Johnathan Blitt, ITT Industries, "Fiber and the Enterprise Network"
http://lw.pennnet.com/display_article/115610/13/ARTCL/none/none/1/Fiber-and-the-enterprise-network/

[4] Corning Incorporated, "Application Engineering Note—Multimode Fiber Compatibility"
http://www.corning.com/docs/opticalfiber/an4256.pdf

For further information on Tap technology:

http://www.netoptics.com
Net Optics, Inc.
5303 Betsy Ross Drive
Santa Clara, CA 95054
(408) 737-7777
info@netoptics.com

Customer First!