

**Family:**  
Fiber Optics

**Tech  
Tip**

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## How to select the proper type of Optical Fiber?

***What type of optical fiber should I use, single-mode (SM) or multimode (MM)? Which multimode fiber optic cable is the best option?***

There are two types of basic fibers:

**Single-mode (SM) (two types: OS1 and OS2)**

**Multimode (MM) (four types: OM1, OM2, OM3, and OM4)**

There also are several dozens of jackets, such as polyethylene, PVC, LSZH, silicone, among others. Similarly, the jackets can be armored to prevent rodent attacks; they can have more than one jacket and more than one cladding. These combinations are practically unlimited!

**THERE IS EVEN MORE TO FIBER THAN MEETS THE EYE!**

### Single-mode (SM)

This type of optical fiber is relatively simple and is smaller in diameter than the traditional fibers. SM fiber is made with a core of glass of 9  $\mu\text{m}$  and a cladding of 125  $\mu\text{m}$ . Transmission is possible by only one ray of light. SM fiber has an outer yellow jacket (PVC or LSZH) and it can be used for 100 km connections. Some people refer to single-mode optical fiber (SM) as OS1 and OS2. This is due to the attenuation of the SM thread, which depends on the cable construction and other manufacturing details.

Fundamentally:

- **OS1 "Optical Single-Mode type 1":** Este cable es hecho con la fibra G.652. La atenuación máxima a 1300 o 1500 nm es 1 dB/km.

- **OS2 "Optical Single-Mode type 2":** This cable is constructed with fiber G.652c. This type has maximum attenuation of 0.4 dB/km and it must have loose fibers inside the tube in order to reach such low levels of attenuation. OS2 also has a low water peak and it is useful for Metropolitan CWDM applications in a wide range of wavelengths.

As you can notice, OS1 and OS2 are single-mode (SM) and both of them have the same diameter. Thus, they use the same connectors and components, but 2 km of single-mode (SM) OS2 have lower attenuation than 1 Km of single-mode (SM) OS1. In case you need to deploy 100 km of fiber, OS2 will make your life easier!

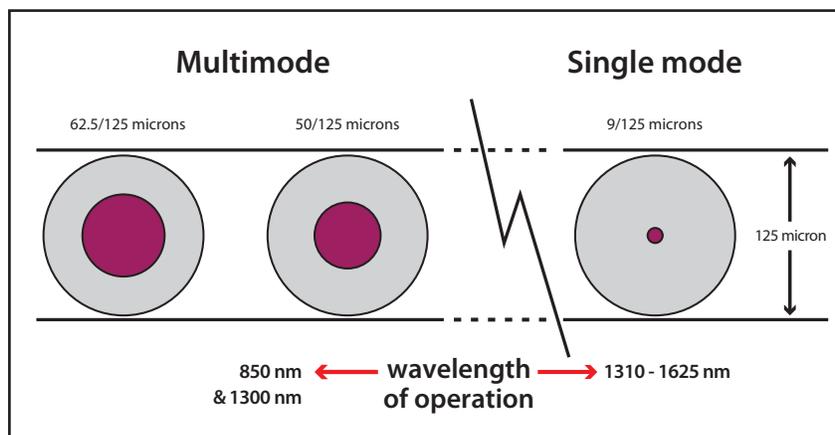


## Multimode (MM)

Multimode optical fiber (MM) transmits several rays of light (modes) simultaneously. There are four basic types: Cores of 62.5  $\mu\text{m}$  (OM1) or 50  $\mu\text{m}$  (OM2, OM3, and OM4). Nowadays it is not enough to buy MM optical fiber. A LanPro client should not request generic multimode fiber; he needs to be more specific and ask for OM1, OM2, OM3, or OM4 since all these types are MM.

### There are four (4) basic types of multimode optical fiber (MM):

- **OM1** (optical mode 1): Original multimode fiber (MM) and rarely used nowadays. It has the largest diametrical core: 62.5  $\mu\text{m}$ . It works for 100 m and 1 G, however, it is limited for the current high demands of speed. OM1 is typically orange; we do not recommend it for new installations since it is not beneficial as 50  $\mu\text{m}$  fibers. In addition, it is more expensive than OM2!



- **OM2** (very popular nowadays): It is a good combination of performance and price. OM2 has a core diameter of 50  $\mu\text{m}$  and it was introduced in the 80s with 1 gb technology which was being tested at that time, but it is irrelevant now due to the development of laser optimized multimode fibers. OM2 is not recommended for long distances.

- **OM3** It is also one of the most popular fibers nowadays. It has a glass diameter of 50  $\mu\text{m}$  and it is laser optimized. OM3 has been designed to work on the range of 40 G to 100 m and it is identified by its aquamarine color.

- **OM4** It is "The New Kid on the Block" and very expensive. Although it is available since many years, OM4 has just been standardized. It is also laser optimized and has a glass core of 50  $\mu\text{m}$ . This technology is the favorite for the emerging

standards that will work in 40 G and in 10 G if distances are less than 150 m. OM4 is broadly used in data centers. It is suggested as a benchmark for the future.

	62.5/125 OM1	50/125 OM2	50/125 OM3	50/125 OM4	9/125 OS1
<b>f/<math>\lambda</math></b>	200 MHz	500 MHz 850 nm	1500 MHz 850 nm	3500 MHz 850 nm	1310 nm
<b>100 M</b>	2 km	2 km	2 km	2 km	100 km
<b>1 G</b>	275 m	550 m	800 m	1100 m	100 km
<b>10 G</b>	33 m	82 m	300 m	550 m	40 km
<b>40 G/100 G</b>	N/A	N/A	100 m	150 m	40 km



### **Practical examples from the previous chart:**

Let's say our client needs a connection between 10 km and... He will obviously choose the single-mode optical fiber (SM) OS1, ideal for this scenario.

### **Another example:**

Your client needs a connection between two buildings with a distance of 100 m (328 ft). In this case OM3 will be the option, since 10 gb is just around the corner and OM2 does not cover more than 80 m. Likewise, OM3 will be able to manage 40 G at such distance.

**One more try:** Your client requires a 500 m connection (1640 ft). What would you select? OM4 for sure! This will let you reach 10 G, which is a tendency in the next ten years.

Fiber is not like its cousin, the copper wire. Fiber has more variables and details to be considered when selected. You can choose more than one type of fiber for the same scenario, thus the integrator should work at the desire speed, distance, attenuation, installation lifetime, and price of the active components as parameters to be considered when you select a type of fiber for a system. Consider the following aspects before selecting the fiber:

<b>Distance</b>	Unquestionably, single-mode reaches 100 G at 40 km
<b>Speed</b>	Single-mode can provide 40 G as OM4
<b>Safety</b>	No difference. Fiber optic cable is highly safe
<b>Cable price</b>	Small difference, although single-mode is cheaper
<b>Ending</b>	Single-mode has a core of smaller diameter and the ending is slower to do, which is time consuming
<b>Active devices</b>	Prices can be four times higher than multimode optical fiber (this is the biggest downside of single-mode)

To summarize, multimode (MM), types OM2, OM3, and OM4, is usually used for LANs and connections inside and between buildings with distances up to 550 m. In spite of the high price of the equipment, single-mode (SM) is the only alternative for networks based in MAN long distances. However, it is important to note that there will be a tendency to reduce the prices of single-mode equipment (SM), making it more feasible for short connections. For instance, some of our clients use single-mode (SM) for most of their projects no matter the distance, either short or long.

**LanPro** offers a complete array of fiber products available for immediate delivery for your applications, from OM1 to OM4 and SM. In addition, we have a proper inventory of cables for indoor and outdoor environments for the most common applications.

We also have expertise in manufacturing custom-made cables and OEM fibers, special jackets, FTTH styles, hybrids, OEM, mixtures, and many other products.

***LanPro is a US-based company with several decades of expertise that offers solutions for data transmission, either by air (wireless) or copper wire (LAN), and solutions based on light (fiber optics).***

***For further information, do not hesitate to contact us.***

