N°1 WhitePaper

MultimediaConnect

THEME OF THE MONTH

FIBRE OPTIC NETWORKS

Multi-mode (MM) fibres, the perfect combination of performance and cost - using the right optical fibre for the right purpose

Although more costly than single mode structures, multi-mode fibres tend to be used in data centres, and local and industrial networks. The reason behind this choice is of course related to the reduced active device costs when using electroluminescent diode transmission technology.

For distances shorter than 1000m at 1Gb/s, and 300m at 10Gb/s, using MM fibres in conjunction with LED or VCSEL devices can halve costs in comparison to LASER transmissions using single mode fibres (SMF).
Different kinds of multi-mode fibres are available for different applications, and this guide aims to summarize the full range of multi-mode fibre properties and identify the fibre that best meets your needs.

The Game 50 µm VS 62.5 µm

In the 70s, the first fibre optic telecommunication cables were developed with a 50µm core. In the 1980s, these were replaced by single mode fibres that were more suitable for long distance transmissions.
In 1985, 62.5µm multi-mode fibres were created to meet the demands of 10Mb/s Ethernet, which required more powerful optical reception. The objective during this period was to send a larger number of optical signals through a larger core, while maintaining identical optical sources. It was a technological development that proved too effective, and made 62.5 fibre the benchmark standard across the world, especially in Europe. However, in the year 2000, the increased demand for bandwidth occasioned by the advent of 1Gb and 10Gb made 62.5 fibre an inferior choice. Today, 62.5µm fibre is more costly while less effective, and its future has been cast into doubt.

FRENCH MARKET SHARES BY FIBRE TYPE

	OM1 (50 µm)	OM2 (50 µm)	OM3 (50 µm)
2005	45%	40%	15%
2006	39%	41%	20%
2007	34%	41%	25%
2008	30%	42%	28%
2009	25%	43%	32%
2010	20%	43%	37%

Source: BSRIA - 2008

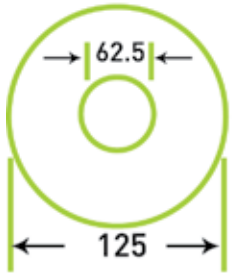
N°1 WhitePaper

MultimediaConnect

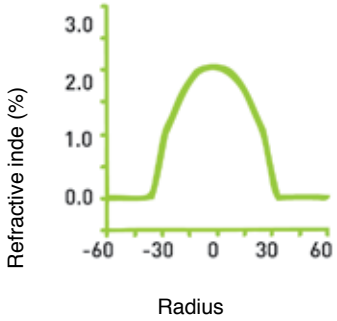
The two main factors in optical transmissions are transmission loss (also known as attenuation), and bandwidth: these two factors determine the maximum effective distance for an optical protocol.
The main difference between 62.5µm fibre and 50µm fibre lies in transmission loss. Rays of light are more tightly packed within a 50µm core, and are therefore less likely to scatter and transmission loss is reduced.

MULTI-MODE FIBRE : 50/125 µm

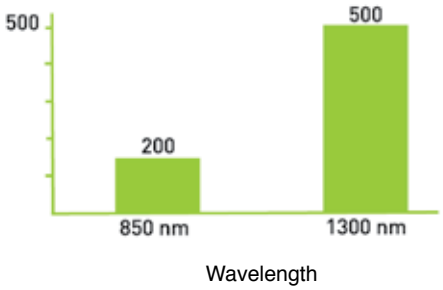
Dimentions



Refractive index profile

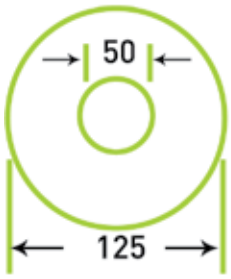


Bandwidth

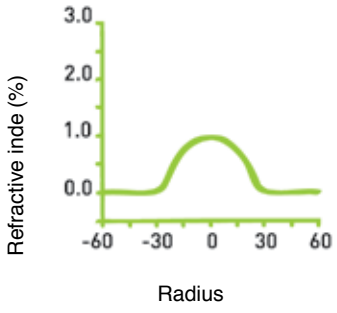


MULTI-MODE FIBRE : 62.5/125 µm

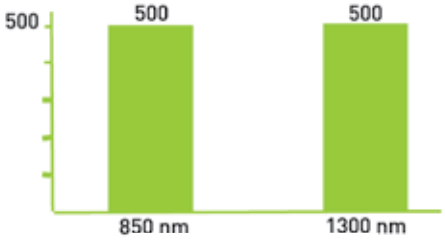
Dimentions



Refractive index profile



Bandwidth



WHY IS 50µm FIBRE BETTER FOR TODAY'S NETWORKS?

- ☑ Moins coûteuse
- ☑ Moin de perte
- ☑ Bande passante plus importante
- ☑ Facilité d'installation
- ☑ Déploiement de réseaux LAN sur d'importantes longueurs

N.B. whether 62.5µm or 50µm, multi-mode optical fibres use the same optical connection.

N°1 WhitePaper

MultimediaConnect

OM1, OM2 OR OM3, WHICH FIBRE DO I NEED FOR MPURPOSES?

Multi-mode fibres named and defined in line with ISO/IEC 11801

			BANDWIDTH	
Fibre Type	Core diameter (µm)	Wavelength (nm)	Bandwith (scattered source)* Mhzkm	Bandwith (concentrated source)** Mhzkm
OM1	62.5 ou 50	850	200	-
		1300	500	-
OM2	50	850	500	-
		1300	500	-
OM3	50	850	1500	2000
		1300	500	-

*"Scattered source" bandwidth is that obtained using an electroluminescent diode light source.
**"Concentrated source" bandwidth is that obtained using a VCSEL (Vertical Cavity Surface Emitting diode) light source.

The fundamental difference between these three types of optical fibre is the bandwidth. These differences are created by loading the optical fibre preforms (glass bars used to make optical fibres) with varying quantities of particles that refocus rays of light at the centre of the fibre's core. This is known as "modal compensation".

APPLICATION LENGTH AND FIBRE TYPE

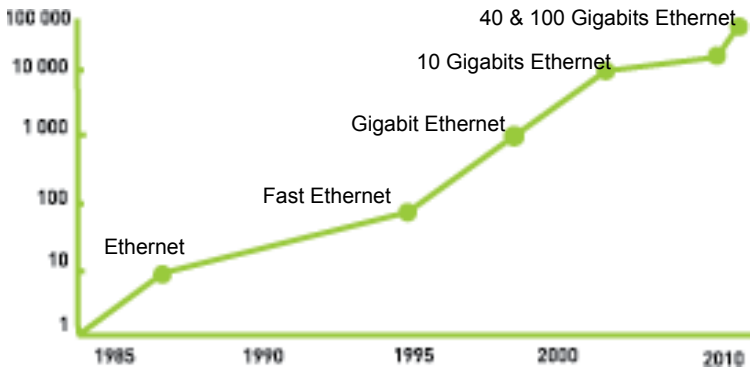
Applications	Longueur d'onde (nm)	OM1 62 µm	OM2 62.5 µm	OM2 50 µm	OM3 50 µm
100 BASE SX	850	300m	300m	300m	300m
1000 BASE SX	850	220m	275m	550m	550m
1000 BASE LX	1300	550m	550m	550m	1000m*
10G BASE SX	850	28m	28m	86m	300m
10G BASE LW	1300 (multiplexage)	220m	220m	220m	220m
10G BASE LX4	1310 (multiplexage)	300m	300m	300m	300m

Source AD1.0 ISO/IEC 11801/* on optimized fibres

N.B. Wavelength multiplexing technology makes it possible to send 10Gb Ethernet through all multi-mode fibre types over distances of 220m or 300m. These active devices remain nonetheless costly and it is therefore often better to invest in OM3 50 fibre for all 10Gb Ethernet beyond 86m.

FUTURE POSSIBILITIES

Bandwidth needs continue to grow (HD video, video-conferences, data centres, supercomputers, etc.): this means that new network protocols need to be developed as soon as possible. This is the motivation behind the IEE802.3ba working group, which sets out to develop a 40Gb and 100Gb Ethernet protocol. Scheduled for 2010, this new protocol will lead to the development of new optical communications technologies such as OM4 fibre.



OM4: THE FUTURE

With a bandwidth of over 4700Mhz*km at 850nm, double that of current OM3, this new optical fibre will enable relatively simple devices to be used to carry enormous bandwidths.

OM4 is therefore one solution for 40Gb and 100Gb Data Centre environments, where the distances are generally quite short, but with considerable bandwidth requirements. It is also planned to use OM4 fibre to send 10Gb across distances of over 300m.

The final properties of OM4 fibre are yet to be set, but it is currently under evaluation by the world's major standardization committees (IE6 86A & EIA/TIA TR42.8).

What is certain is this: multi-mode fibre optics are the future, given that it is the preferred fibre in the development of HSSG (Higher Speed Ethernet Study Group), that will be part of the network within the next 10 years.

ABOUT CAE LABS

CAE Group dedicates a significant share of its profits to technological development and innovation. We would like to provide information on our main areas or research from time to time.
This document was drafted in partnership with the TFO plant, specialist in the production of "preforms" and single mode and muliti-mode fibres.
CAE Group and TFO are part of the Dutch group TKH7.