Rosenberger

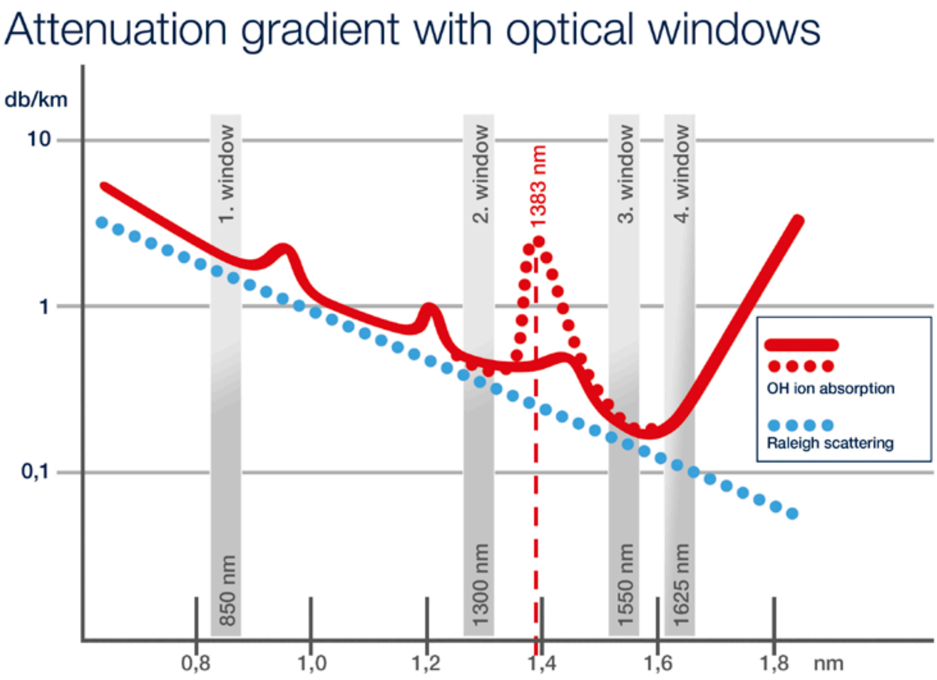
OM5 versus OM4 – Solution concepts and potential applications

WHITEPAPER

The OM5 fiber is the latest member in the 50 µm multimode fiber family. The reason for the development of this new fiber type is that the continuous increase in data rates demands the constant optimization of the transmission media.

Review

In the late 1990s, the second optical window was optimized at 1300 nm for 50µm multimode fibers because the attenuation of an optical fiber at 1300 nm (OM2) amounts to only approximately 1/3 of the attenuation of the optical fiber in the first optical window at 850 nm. However, due to the development of low-cost 850 nm VCSEL lasers, the optimization of optical fibers in the first optical window was to become of decisive importance despite the higher fiber attenuation (OM3, OM4).

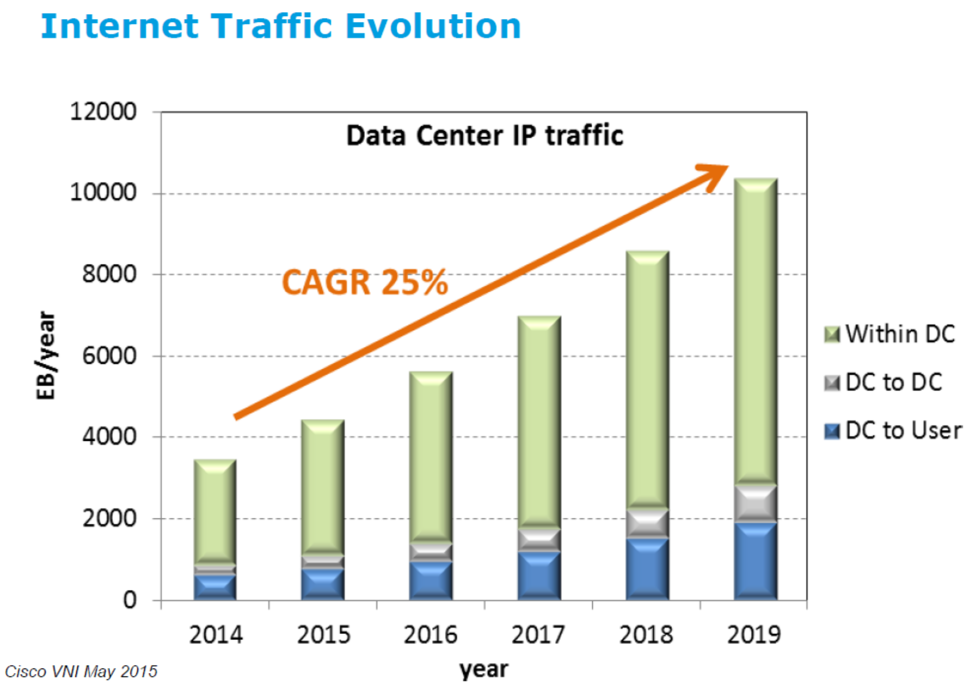


In the past, the focus of the development has been on the optimization of the transmission characteristics of a single wavelength. The fiber optimized at 850 nm was given the name “New Fiber” and is now known as “OM3”. At the same time, the planning of optical networks was simplified by the development of a classification of various fiber types that has been assigned to the different applications such as Ethernet, Token Ring, FDDI, ATM, Fibre Channel, etc. on the basis of their transmission speeds and maximum transmission length, published for the first time in 2002 labeled as “OM1 – OM3” in ISO/IEC 11801. At that time, there was only one class for single-mode applications: “OS1”

The OM3 fiber made it possible to transfer 10 Gbit/s of data over acceptable transmission lengths (300 m) at - for a first time - a relatively economical cost.

In general, an increase in the data rate always brings about a reduction in the transmission length. The dramatic increase in transmission speeds therefore made the constant further development of multimode fibers necessary in order to meet requirements.

In 2010, an OM4 fiber with an improved bandwidth, or improved effective modal bandwidth, was defined in ISO/IEC 11801. The maximum transmission length of an OM4 fiber was now 550 m for 10 Gbit/s.

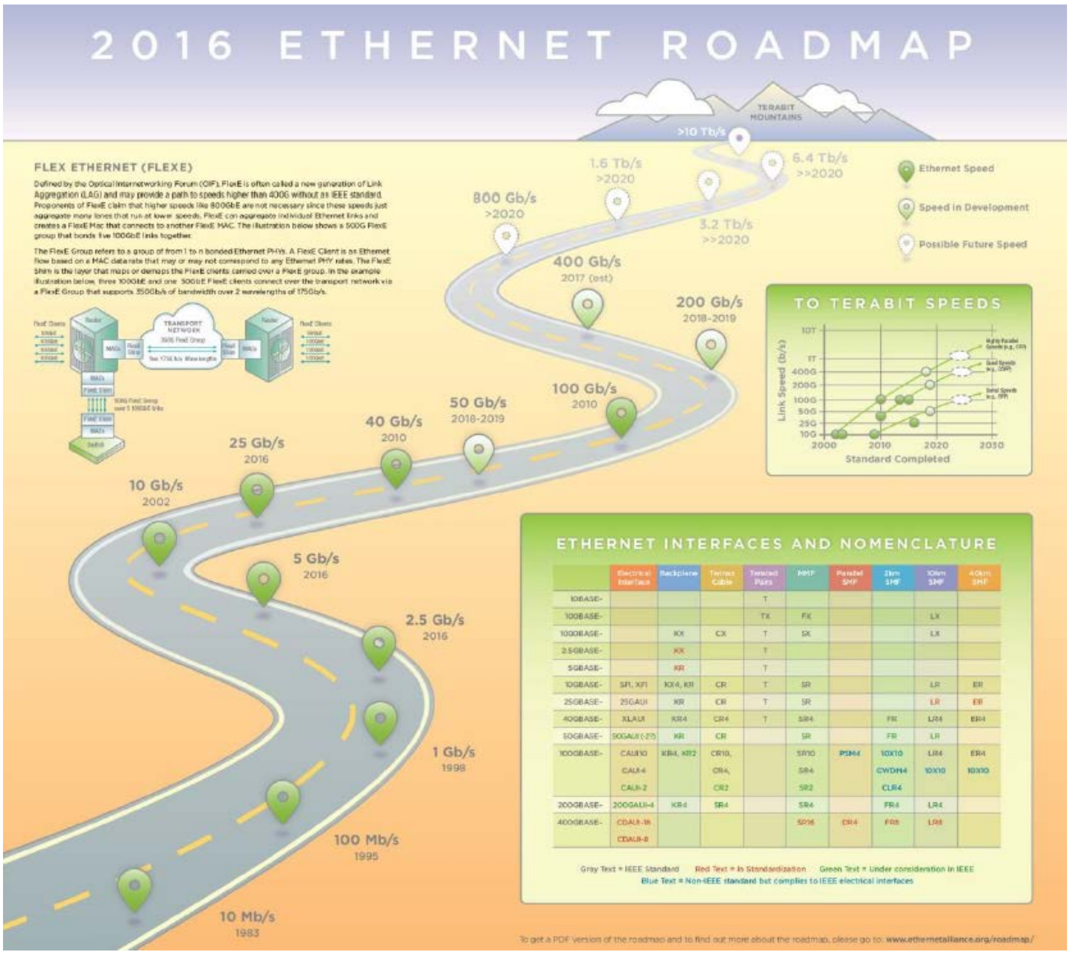


New solution concepts for increasing data rates

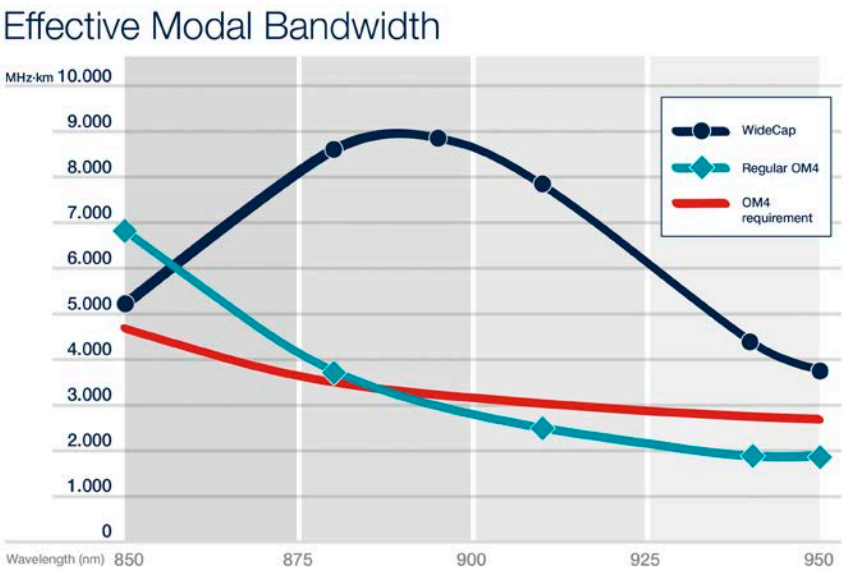
The data volumes and data rates for new applications – for example in the form of the “Internet of Things” or “Big Data” – are constantly increasing. The increase in data volumes is significantly outpacing the speed of development of high-performance multimode fibers. If we also consider the development of the so-called “Ethernet roadmap”, it becomes clear that the gap between the optimization of multimode fibers and the growth in transmission speeds is growing ever greater.

That is why other solution concepts are needed in order to cope with the continued explosion in data volumes.

One way is to multiply the number of fibers and the parallelization of data rates as the use of Multimode applications standardized in accordance with IEEE (Ethernet): 40GBase-SR4, 100GBase-SR10 and 100GBase-SR4.



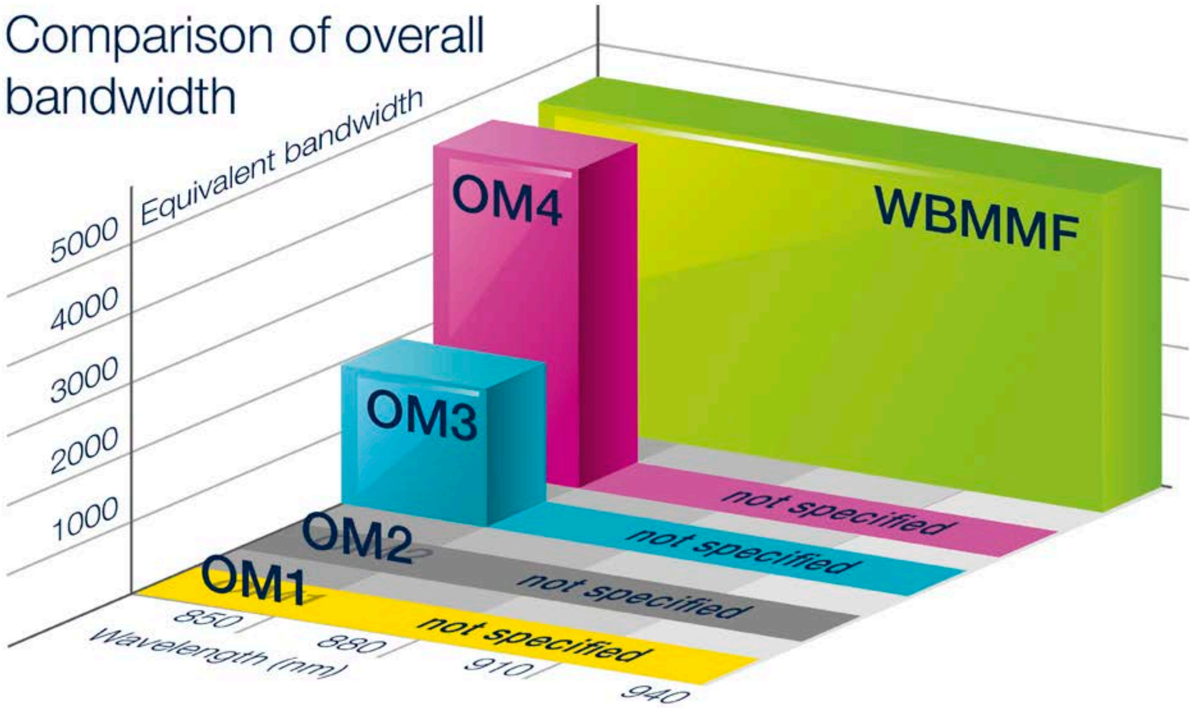
One alternative to this is the parallel transmission of multiple signals over one fiber. This approach resulted in the development of the so-called WBMMF fiber (Wideband Multimode Fiber) which provides optimized transmission parameters for the range 840 nm to 953 nm. For a transmission at 850 nm, exactly the same parameters as for the OM4 fiber apply.



Characteristics and applications of OM5

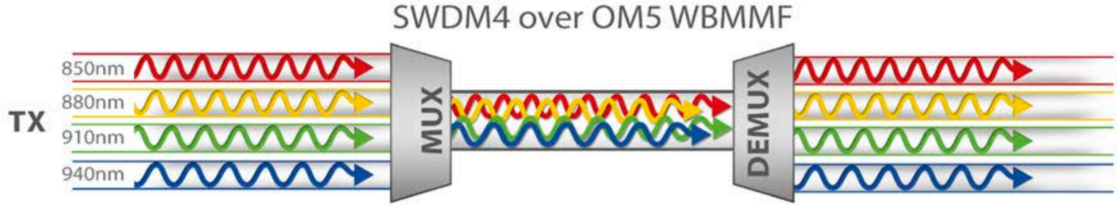
Hence, the new WBMMF fiber is the 5th variant of the multimode fiber and is therefore called the OM5 fiber.
So far, the step up to the next higher OMx class has always been characterized by a significant improvement in the quality of the fibers – in particular, the bandwidth-length product (a parameter that determines transmission performance) – for one specific transmission window.
By contrast, the OM5 fiber is optimized over a larger range of wavelengths that permits data transmission by means of wavelength multiplexing in the area around the first optical window.

However, the actual use of these fibers with its expanded transmission area demands a special transceiver.
The OM5 fiber doesn't deliver any optimization of modal bandwidth or a bigger maximal transmission length for the existing optical transmission protocols as the values at 850 nm haven't been changed. In general, the OM5 fiber supports all previous 850 nm applications and backward compatibility is therefore ensured.



Wavelength multiplexing is a long-established procedure for long-distance applications using single-mode fibers. The reason is obvious: When covering long, it is often considerably more economical to invest in active wavelength multiplexing technologies rather than in fiber-intense bulk cabling because the latter's installation and laying are often several times more expensive. When it comes to the time required to install a cable together with all the excavation work and the task of obtaining the necessary approvals, the situation is even more extreme.
In the case of short distances, i.e. in LAN, campus or data center environments, there is no such comparable cost and time outlay.

Here, however, the task is to cope with the demands of the constantly growing data volume. In such cases, SWDM (short wave division multiplexing) is the approach adopted to operate wavelength multiplexing over a multimode fiber using VCSEL lasers. The SWDM Alliance, which is leading the project, is currently focusing on 40 Gbit/s data transmission using four 10 Gbit/s transceivers operating in parallel and transmitting and receiving on different wavelengths (850 nm, 880 nm, 910 nm and 940 nm). In future, attention will turn increasingly to 100 Gbit/s data transmission using four 25 Gbit/s transceivers.



40 G SWDM can also be operated on OM3 and OM4. The maximum achievable transmission lengths with 240 m over OM3 and 350 m over OM4 cannot be transferred to all OM3 and OM4 fibers as these are not specified beyond 850 nm. By comparison, the OM5 fiber that has been specially developed for this application achieves a considerably greater transmission length of 440 m. In laboratory environments and at trade fairs, it has already been possible to achieve transmission lengths of 500 m at a speed of 40 Gbit/s and transmission lengths of 300 m at a speed of 100 Gbit/s over an OM5 fiber. In general, SWDM applications permit, for instance, rapid upgrading from 10 Gbit/s to, for example, 40 Gbit/s without it being necessary to modify the cable infrastructure. Due to the parallel use of different wavelengths on one and the same fiber, SWDM only permits the implementation of 1:1 connections. It does not, however, permit so-called break-out solutions because SWDM does not allow the subdivision of a 40 Gbit/s server port into four 10 Gbit/s storage ports as can be done easily with SR4 technology (parallel optics).

At the purely theoretical level, SWDM makes it possible to achieve four times the transmission volume over the same number of fibers. If we were to construct a new data center on a so called greenfield site, we would already be able to lay the foundations for 400 G (4 channels x 25 Gbit/s x 4 wavelengths) or 1600 G data transmission speeds (16 channels x 25 Gbit/s x 4 wavelengths) thanks to the use of a "parallel optics" fiber infrastructure such as SR4, which corresponds to the Rosenberger OSI PreCONNECT® OCTO system, or, for example, SR16, in combination with OM5 fibers. History shows us that higher data rates are needed sooner than we think. Later conversions to the installed base and modifications to operation are significantly more expensive than an initial installation which, in turn, is less susceptible to the risks that can occur during a conversion.

Summary

Under all circumstances it is necessary to remember that, given the current state of development, the advantages of the OM5 fiber are only available in combination with SWDM technology.

For all other applications in the multimode sector, the OM4 fiber is still the first choice.

About Rosenberger OSI:

Since 1991, Rosenberger Optical Solutions & Infrastructure (Rosenberger OSI) has been an expert in innovative fiber optic cabling infrastructure and service solutions for Datacom, Telecom and Industrial.

The products and services can be found wherever largest amounts of data have to be transferred quickly and securely. In addition to the development and production of a broad portfolio of fiber optic and copper cabling systems, Rosenberger OSI also offers a variety of services such as planning, installation and maintenance of cabling infrastructure. Rosenberger OSI employs about 600 people in Europe and has been a part of the globally operating Rosenberger Group since 1998, a worldwide leading provider of high-frequency-, high-voltage-, and fiber-optic-connection solutions headquartered in Germany.

For further information, please visit: www.rosenberger.com/osi

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