WHITE PAPER

OM5 WIDEBAND MULTIMODE FIBRE

Multimode fibres and VCSEL transceivers play a central role in today's data centres and local networks, and are by far the most widespread transmission medium when fibre optic technology is required. With transmission speeds of 100 Gbit/s and above, however, the range problem is exacerbated. No more than 100 metres are possible with standard transceivers – even with the best multimode fibres. Can the new OM5 wideband multimode fibre in combination with SWDM, a copyrighted wavelength multiplexing technology, make any difference?

OM5: the best-performing MM fibre?

Wideband multimode fibre (WBMMF) is designated as OM5 in the standards. But, as the name suggests, this fibre medium is not the next even higher-performance multimode fibre to succeed OM3 and OM4. In fact, it is a version of the OM4 fibre (with a peak bandwidth of 880 nm) and a bandwidth characterisation of 850 nm and, in addition, 953 nm.

Fig. 1: Colour comparison between OM5 connector and SM-APC connector

TIA has defined "lime" as the colour for OM5. This colour is a rather unfortunate choice, because it can easily be confused with the classic green of single-mode APC connectors. Resistance to this colour choice is therefore on the rise, and at expert level there are increasing calls for new consultations at international level. It remains to be seen whether the colouring for OM5 will be changed.

Does OM5 give longer operating ranges?

All Ethernet and Fibre Channel applications up to 400G, whether standardised or currently in the process of development, use only one wavelength (850 nm) for multimode fibre transmission but use several fibres connected in parallel for transmission rates of 40G and over.

OM5 fibres do not therefore provide a longer range than OM4 fibres for the transmission of 40G to 400G at 850 nm.

With the proprietary SWDM applications such as 100G-SWDM4, on the other hand, OM5 fibre gives a greater range (150 m) than OM4 fibres (100 m).

OM5 vs. OM4

The optical and mechanical attributes of OM5 fibre comply with OM4 specifications and include the additional specifications of effective modal broadband (EMB) and fibre attenuation at 953 nm. OM5 fibre is suitable for operation with VCSEL transceivers in the wavelength range between 846 nm and 953 nm.

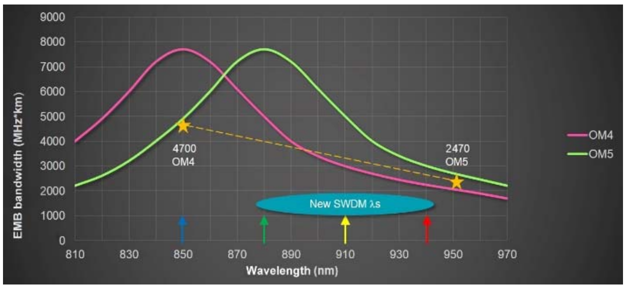

Fig. 2: Comparison of bandwidth characteristics based on wavelength

What is SWDM?

SWDM (Short Wave Division Multiplexing) is a proprietary multiplex technology for transmitting data in multimode

Criterion	Wavelength [nm]	OM4	OM5 WBMMF
Fibre attenuation [dB/km]	850	< 2.5	< 2.5
	953	n/s	< 1.8
	1300	< 0.8	< 0.8
EMB bandwidth [MHz*km]	850	≥ 4700	≥ 4700
	953	n/s	≥ 2470
	1300	≥ 500	≥ 500

Fig. 3: Comparison of attenuation and EMB values provided by today's high-end fibres

fibres (MMF) over four wavelengths – between 850 nm and 940 nm. Here SWDM transceivers are connected to each other by two fibres (duplex channel).

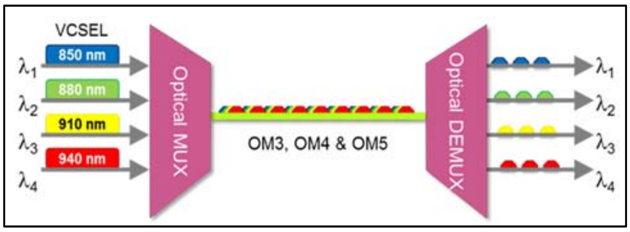

Fig. 4: SWDM transmission with four wavelengths in MMF

An OM5 fibre is not absolutely necessary for SWDM transmission. As can be seen in the chart below, OM3 and OM4 fibres are also suitable for this type of transmission. Existing installations can therefore be used for SWDM applications even without new cabling. Depending on the choice of fibre and transceiver type (BiDi or SWDM4), link lengths of between 100 and 440 metres are feasible at 40G, for example.

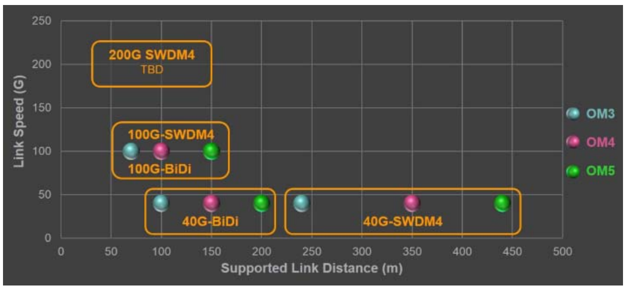

Fig. 5: Overview of SWDM applications and transmission media

40G and 100G BiDi as well as 40G and 100G SWDM4 transceivers are currently available on the market. 200G SWDM4 transceivers are also under development for the future.

No port breakout with SWDM4

Due to the parallel coupling of several wavelengths in one fibre, SWDM applications do not allow the separation of signals into individual channels (port-breakout configuration). So, for example, a 100G SWDM4 link has to be operated in "end-to-end 100G". That is by far the greatest drawback of this technology.

With the port-breakout configuration an SR4 channel is separated into four SR channels. This means that, for example, a 100G-Ethernet signal can be separated into four 25G signals. In today's data centres this operating mode is very popular for the aggregation/disaggregation of high-speed links (SR4 / PSM4 applications) in order to increase port density, saving money and energy at the same time.

You will find more on this topic in our White Paper entitled "Parallel Optics on Duplex" which can be found on our website.

OM5 fibre - myths and facts

In recent times a lot has been written and said about OM5 fibres and their application. A more nuanced and impartial approach is called for here in order to avoid being misled by dramatic statements and possibly making suboptimal decisions for future cabling solutions.

Most of the statements made in the chart below definitely belong to the realm of myth.

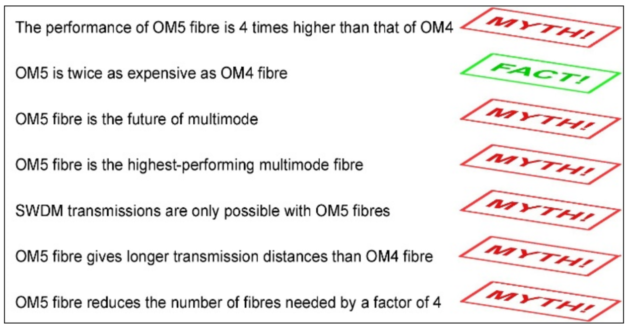

Fig. 6: Facts and myths relating to OM5 fibre

1. The performance of OM5 fibre is four times higher than that of OM4 fibre.

This statement is incorrect, as like is not being compared with like. The difference is that transmission is with four wavelengths in the OM5 fibre and with one wavelength in the OM4 fibre.

2. OM5 is twice as expensive as OM4 fibre.
This statement is correct. At the moment the price of OM5 fibre is twice as high as that of OM4.

3. OM5 fibre is the highest-performing multimode fibre.
This blanket statement is not correct. A more nuanced approach is required: At 850 nm a high-quality OM4 fibre gives a better EMB bandwidth than OM5 fibre. In the bandwidth range from 880 to 950 nm OM5 fibre gives a better EMB bandwidth than OM4 fibre.

4. SWDM transmissions are only possible with OM5 fibres.
This statement is incorrect. The SWDM transceiver specifications define clear link requirements for transmission by both OM3, OM4 and OM5 fibres as well.

5. OM5 fibre gives longer transmission distances than OM4 fibre.
This blanket statement is not correct. A more nuanced approach is required: When VCSEL transceivers (850 nm) are used, OM5 fibre does not have a longer range. When SWDM transceivers (850 to 940 nm) are used, OM5 fibre has a longer range than OM4 fibre (e.g. 100G-SWDM4: OM5 up to 150 m, OM4 up to 100 m).

6. OM5 fibre reduces the number of fibres needed by a factor of four.
This statement is incorrect. The following is correct: With SWDM transceiver technology as compared to SR transceiver technology the number of fibres can be reduced by up to a factor of four at higher transmission rates ($\geq$ 100G).

Conclusion

In the multimode fibre sector OM5 fibre can only yield benefits with SWDM technology. OM4 fibre remains the medium of choice for all other multimode applications inside and outside data centres.

At the moment Datwyler sees no reason to recommend OM5 fibre in general as a medium for data centre cabling. The trend in this environment is rather towards singlemode fibres for future-proof cabling and higher transmission rates.