EASY MIGRATION TO 40/100G

A step-by-step guide to future-proofing DCs with optical connectivity

MPO-based connectivity using OM3 and OM4 fibre is the ideal solution for enabling data centres to meet current and future needs, providing an easy migration path to 40G and 100G Ethernet. R&M share some insights and practical tips.

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The current demand for bandwidth and storage continues to grow at breathtaking speed. This is significantly impacting data centre managers and designers, who need to find ways of efficiently managing migration from 10G to 40G and 100G whilst keeping networks open and flexible - and without cost spiralling out of control.

Optical connectivity based on multimode connectors can provide the solution. This can act as the basis for a reliable, manageable data centre infrastructure that meets current and future data requirements, whilst also allowing for expansion and scalability. The inherent modularity makes TIA-942-compliant structured cabling ideal for this purpose. There is ample capacity for adding servers, switches and storage as well as support for a migration path towards 40G and 100G.

Multi-fibre migration

However, with the introduction of MPO components and parallel optical connections, data centre planners and managers face new requirements. Cable lengths must be planned carefully, the correct MPO types must be selected (see box) polarities observed across the entire link and attenuation budgets calculated with precision. Short-term changes become (almost) impossible and planning mistakes can be costly. Parallel optical connections involve tougher requirements in terms of planning, administration and product evaluation. This situation involves high-end structured cabling. Polarity management and the arrangement of the individual fibres must be precisely defined for each channel. Attenuation losses of the individual cable links and connectors must also be considered to ensure maximum transmission quality in the end. Consistent planning and installation will help achieve efficient, flexible and error-free data centre operations.

A closer look at the 40G/100G Ethernet standard

In 2010, IEEE ratified the 802.3ba 40G/100G Ethernet standard, which details 40G and 100G transmission with multimode and singlemode fibres. The only multimode fibres included in the standard are OM3 and OM4, and there is no guidance for Category-based unshielded twisted-pair or shielded twisted-pair copper cable.

At the time this standard was developed, VCSEL modulation was limited to 850-nm. OM3 and OM4 are optimised for 850-nm transmission, hence the preference for the parallel-optics transmission of multimode. This relies on a parallel optical interface to simultaneously transmit and receive data over multiple fibres This makes multimode with parallel optics the best choice for short data centre interconnects. 40G uses 4x10G channels on four fibres per direction and has a minimum modal bandwidth of 2000

MHz.km whilst 100 G uses 10x10G channels on 10 fibres per direction has an effective modal bandwidth of 4700 MHz.km.

Some things to watch out for

When adapting data centres, a useful approach is to first replace existing passive components, followed by active components as they become available and affordable. The TIA-568-C standard refers to female trunk cables and male modules. However, we recommend the installation of trunk cables in the male version and the modules in the female version to make migration easier. In the migration to the parallel optical signal, female-female MPO patch cords be used to connect to the trunk. (see box 1)

With parallel optical connections, the power budget plays a crucial part in network planning. If the admissible budget is exceeded, transmission links automatically become smaller for a given bandwidth or the bandwidth becomes smaller for a required link. IEEE 802.3ae defines 300m as the maximum length for OM3 fibres at 10 GbE (10GBASE-SR). To reach this, a loss up to 2.6 dB is admissible for the link, with 1.5 dB for the connections. For 40 GbE and 100 GbE, IEEE 802.3ba defines only 100 m for OM3 fibres and 150 m for OM4. A maximum insertion loss of 1.5 dB for the connections is therefore critical for assuring the required bandwidths and links. (see box 2)

Worthwhile investment

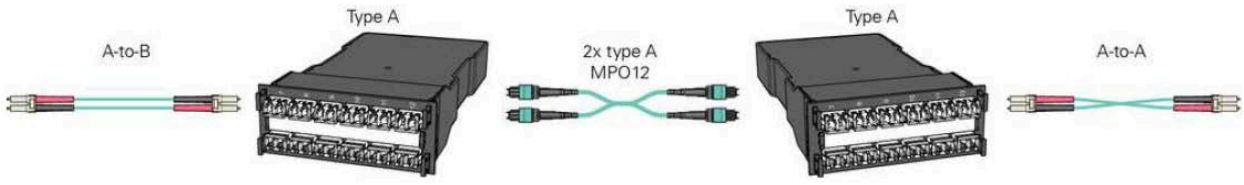
MPO technology with multi-fibre connectors offers everything required to set up high-performance data networks which can handle future requirements. Scaling and migration to 40/100 Gigabit Ethernet are easier and more efficient and the investment steps become significantly clearer. The necessary infrastructure may be created with just a handful of basic components: pre-assembled trays, racks and trunk cables.

These solutions offers further advantages in the area of short installation periods, tested and verified quality for each individual component and reliable operations and investments for years to come. This, in combination with the future-proof character of the solution makes the increased investment worthwhile.

A step by step guide to capacity expansion

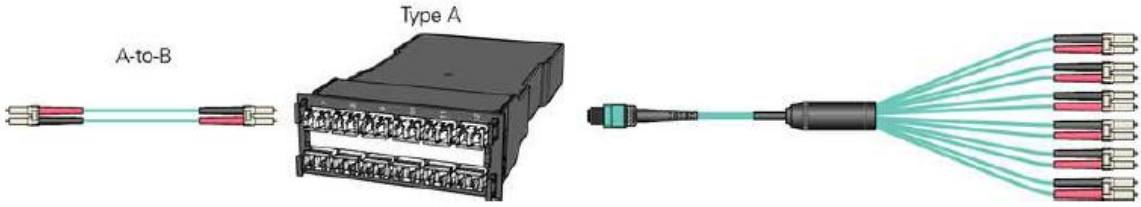
Existing 10G environments

Method A



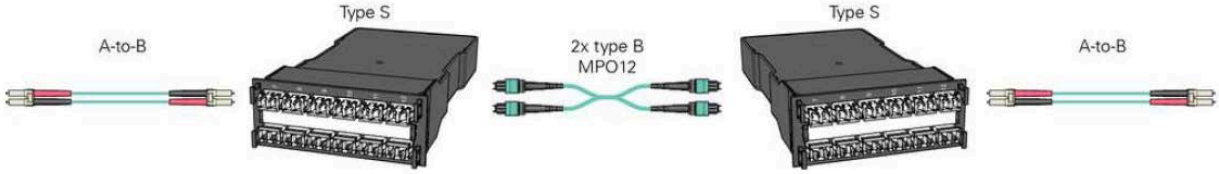
1: MPO trunk cables (type A, male-male) replace legacy duplex trunk (middle). MPO modules (type A, female) provide transition to LC Duplex patch cords A-to-B (left) and A-to-A (right). The two 12-fibre MPOs can be consolidated in a 24-fibre X cable.

2: MPO trunk cables (type A, male-male) replace duplex trunk (middle). MPO module (type A, female) provides transition to legacy LC Duplex patch cord A-to-B (left). Adapter plate (type A) and harness cable (female) replace LC Duplex patch cord. Connection consists of LC Duplex patch cord A-to-B, MPO module (type A, female) and harness cable (male).



3: LC Duplex patch cord A-to-B, MPO module (type A, female) and harness cable (male).

Method S



4: 10G - MPO trunk cables (type B, male-male) replace duplex trunk (middle), MPO modules (type S, female) provide transition to the legacy LC Duplex patch cords A-to-B (left, right). Type S module Tx and Rx is distributed to one MPO, so assumed arrangement is one X cable and two trunks.

10G to 40G

When replacing 10G switches with 40G versions, MPO adapter plates can be installed easily (instead of MPO modules) to make the next adaptation.

Method A

1: Replacement of MPO modules with MPO adapter plates (type A) and LC Duplex patch cords with MPO patch cords type A, female-female (left) and type B, female-female (right). A legacy X cable can serve only two 40 G links.

Method S or Method B

2: Replacement of MPO modules with MPO adapter plates (type B) and LC Duplex patch cords with MPO patch cords type B, female-female (left, right). Methods S and B are identical for parallel optical signals. A legacy X cable can serve two 40G links.

40G to 100G

Finally, in the last step, 100G switches can be installed. This requires 24-fibre MPO cables3. The legacy 12-fibre connection can be expanded with the addition of a second 12-fibre connection or replaced with a 24-fibre connection.

Method A

1: Capacity expansion for MPO trunk cable (male-male) with the addition of a second trunk cable; the MPO adapter plates (type A) remain unchanged; the MPO patch cords are replaced with Y cables.

2: The MPO-24 solution - using one MPO-24 trunk cable (type A male-male); the MPO adapter plates (type A) remain unchanged. The patch cords used are MPO-24 patch cords type A, female-female (left) and type B, female-female (right).

Method S or Method B

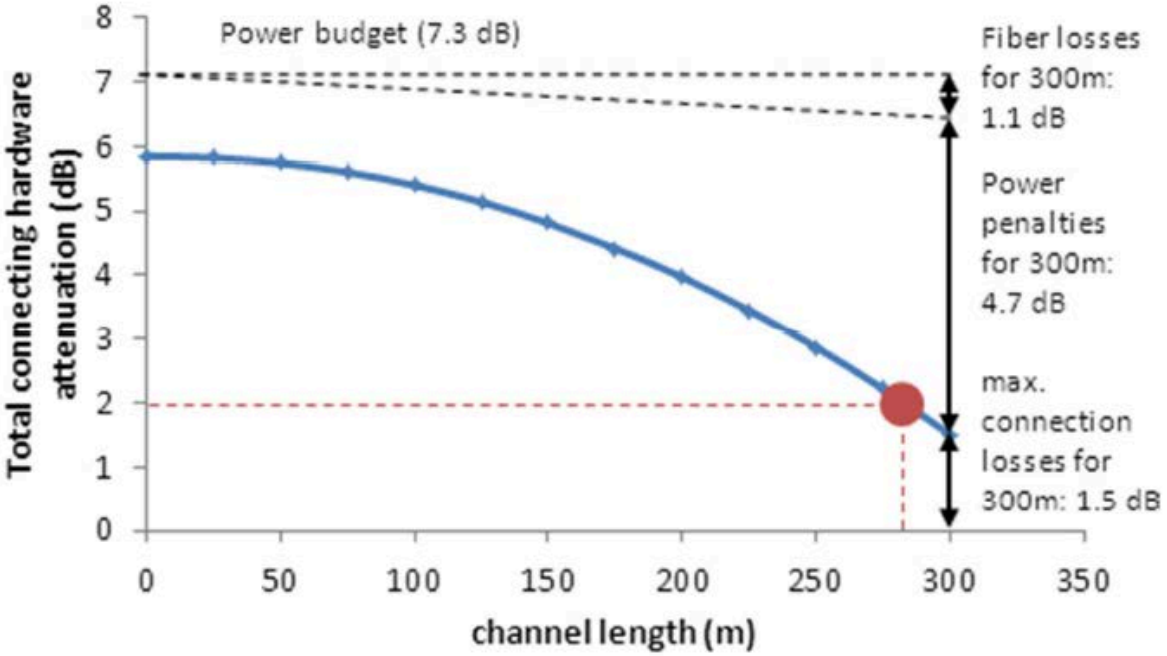
3: Capacity expansion for the MPO trunk cable (male-male) with the addition of a second trunk cable; adapter plates (type B) unchanged; patch cords replaced with Y cables.

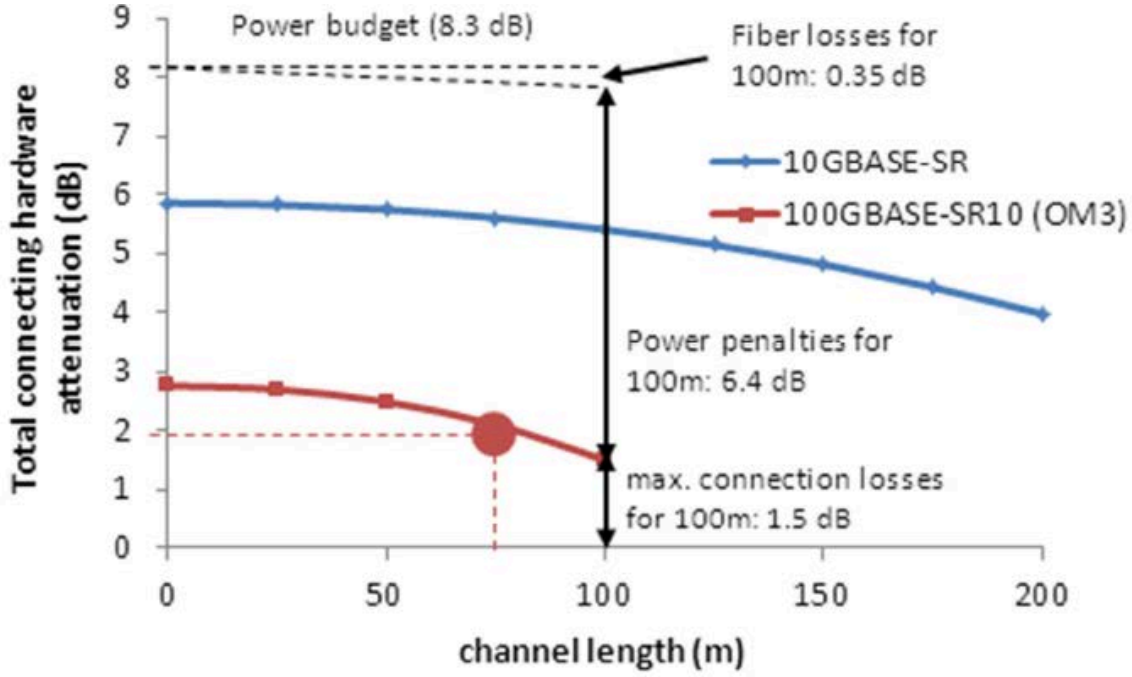
4: MPO-24 solution using one MPO-24 trunk cable (type B male-male); adapter plates (type B) remain unchanged. Patch cords at both ends are MPO-24 patch cords type B, female-female.

BOX 2

1: Total power budget for 100 GbE and in comparison with 10 GbE. This link can be only 55m assuming 2 dB in connection losses.

2: Total power budget for 100 GbE and in comparison with 10 GbE. This link can be only 55 m long assuming 2 dB in connection losses.


Power budget (7.3 dB)
Fiber losses for 300m: 1.1 dB
Power penalties for 300m: 4.7 dB
max. connection losses for 300m: 1.5 dB
Total connecting hardware attenuation (dB)
channel length (m)
0
1
2
3
4
5
6
7
8
0
50
100
150
200
250
300
350


Power budget (8.3 dB)
Fiber losses for 100m: 0.35 dB
10GBASE-SR
100GBASE-SR10 (OM3)
Power penalties for 100m: 6.4 dB
max. connection losses for 100m: 1.5 dB
Total connecting hardware attenuation (dB)
channel length (m)
0
1
2
3
4
5
6
7
8
9
0
50
100
150
200