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DATA CENTRES
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THE OPTICAL OPTION

by

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I was just reading Barry Elliott's column under the "BICSI backstop" banner in last months issue. The title of the article was "How many connectors does it take to make a data centre?" I was somewhat intrigued by one of the statements relating to optical fibre cabling channels in which it was suggested that one should "check that the number of connections in an optical (fibre cabling) channel is below the optical (power) budget for the link". The reason that I was intrigued was that this advice would have been good a few years ago when the maximum data rates we were passing over optical fibre cabling would have been 100 Mb/s. However, now that we are regularly using optical fibre for 1Gb/s and 10Gb/s links this advice is incorrect. So I thought it might be useful to bring readers up to date with the design and planning of high-bit rate (1Gb/s and above) infrastructures using multimode optical fibre.

There are two key points. Firstly, the optical power budget of the network is now completely irrelevant as a design tool. High bit-rate networks such as 1000BASE-SX do have an optical power budget and for that network it is 7.5dB. Unfortunately, if you built an infrastructure with even 6.5 dB of attenuation it most probably would not function. Secondly, high bit-rate networks there are two separate design limits. The first is the maximum channel insertion loss (which is length dependent) and the maximum channel length. Both of these are dependent on the modal bandwidth of the optical fibre. The US standard for data centres (ANSI/TIA/EIA-942) does not explain this at all. However, EN 50173-5 and the forthcoming ISO/IEC 24764 (the European and international standards for generic cabling in data centres) do contain the base information. There is also a thesis by the author of this article on the FIA web-site at www.fia-online.co.uk/pdf/QS/thesis050001.pdf which goes into much more detail than either of these standards.

To cut a long story short, the higher the bandwidth of the multimode optical fibre used, the higher the channel insertion that is allowed at a given length. For example when implementing 1000BASE-SX over a channel length of 250 metres, the maximum channel insertion loss using 62.5/125 μm OM1 optical fibre is 2.7 dB but with 50/125 μm OM3 optical fibre the allowed loss increases to 5.3 dB. The differentiation becomes even more marked as the network bit-rate rises to 10Gb/s. But one thing is worth noting - both these values are well below the optical power budget of 7.5 dB.

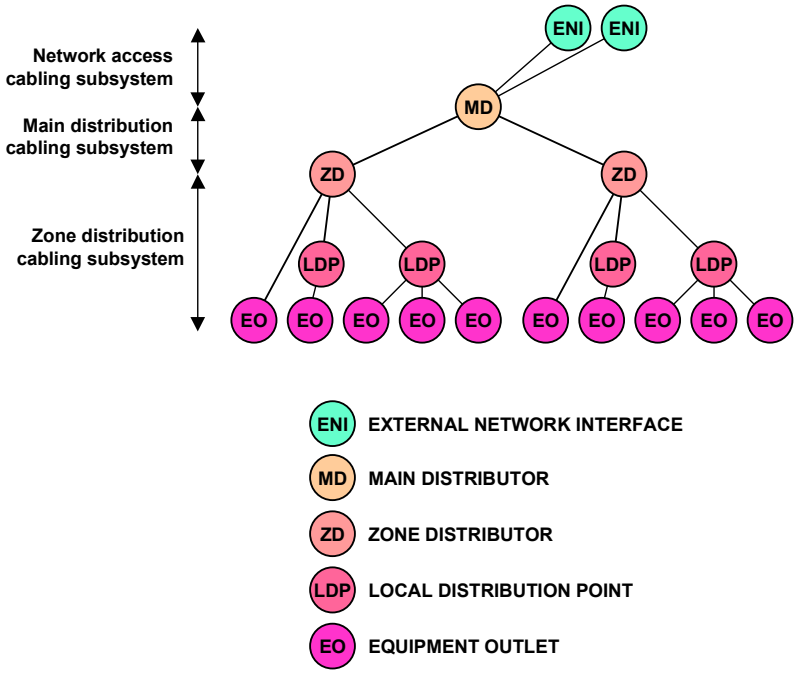

Figure 1:
Cabling structure in data centres according to EN 50173-5:2007 (and ISPO/IERC 24764:2008)

So now back to the question that Barry Elliott was addressing although he was concentrating on copper cabling. “How many connectors does it take to make a data centre?” With reference to the Figure 1 the more interesting question for optical fibre in data centres is “can we create wholly passive connections between any two pieces of equipment?” In other words can we connect equipment at one Equipment Outlet (EO) to an piece of equipment at another EO without the need for centralised hubs/switches at the Zone or Main Distributors (ZDs and MDs). To do so would dramatically reduce the cost of equipment needed i.e. by 50%. However, we would need to support at least six connections for EO-ZD-EO and ten for EO-ZD-MD-ZD-EO. Can this be done?

To find out we have to start by limiting the maximum channel length for our model. If we limit the distance from the Main Distributors to the Equipment Outlets to 100 metres meaning an EO-EO distance of 200 metres, the maximum channel insertion loss allowed for 10GBASE-SR using OM3 optical fibre is 4.9 dB of which 4.2 dB can be allocated to connections - but how many? Unfortunately it is not as simple as dividing 4.2 dB by the loss per connection. On the up-side there is a recognised statistical reduction in average connection loss as the number of connections in series. However, on the down-side, modal noise can affect high bit-rate signalling in a way that is not experienced by low data rate networks. Modal noise has to be considered as an additional, yet unmeasurable, loss for each connection.

This leaves us in a strange position - knowing that we should be able to do something but being unsure whom to ask if it will work. I have just returned from an ISO/IEC meeting in Hawai’i where this very topic was discussed in relation to the forthcoming ISO/IEC 24764 standard (generic cabling for data centres). No clear standards-based solutions was forthcoming at this stage. For the moment, the only guarantors will be system suppliers. Many have optical fibre system guarantees based on the number of connections (panels and splices) within a channel of a given length. These suppliers will have undertaken detailed assessment of statistical losses and the impact of modal noise on their own connection systems. There are many suppliers who will guarantee ten connections over a channel length of 200 metres.

The FIA has a wide range of Technical Support Documents aimed to assist users in all areas of specification and operation of optical fibre cabling. If you wish to access the resources provided by the FIA go to www.fia-online.co.uk. Enquiries can be e-mailed to jane@fiasec.demon.co.uk.or, alternatively, you can contact the FIA Secretariat in 01763 273039.