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10GBASE-T - optical fibre fights back

The volume market in commercial premises cabling is the horizontal cabling i.e. to the desk. In comparison, backbones comprise a small fraction of components. Data centres may contain substantially more cabling than the backbone systems. The market to fight over is therefore the horizontal and the data centre. This is to some extent quite convenient for the copper cabling guys - they cannot compete to deliver the high data rates over the extended lengths of campus and backbone cabling sub-systems but it is a relatively small market so who cares - let the optical fibre guys keep that market. Instead, the battlelines are drawn in the dust of the office floor and the data centre.

Top of the list of advantages ascribed to optical fibre is bandwidth. However, we will soon see balanced cabling provide 10 Gigabit Ethernet (10GBASE-T) over 100 metres as compared to the 300 metres maximum achieved by the best multimode optical fibres. Not so different?

Further down the list of advantages comes “freedom from inter-element crosstalk”. However, one principle advantage not listed is the ability to support large numbers of connections. We will return to these advantages later in the article.

The one advantage that optical fibre can never claim is cost. The success of optical fibre as transmission medium does not depend upon the comparative costs of cabling which is on a par with balanced cabling systems. It is the cost of the optical fibre transmission equipment that defines the cost equation which suggests the use of optical fibre only where there is no alternative.

Networks targeted at the desktop are first standardised over copper cabling. Conversely, applications initially destined for use in the backbone are first standardised over optical fibre. Why? - because balanced cabling has an unfair advantage - it conducts electricity - and that advantage is becoming more, not less, prominent. The IEEE 802.3af standard ensures that pairs in a balanced cable can provide up to 13W of power at the end of the 100 metre horizontal channels. There is serious work underway in IEEE to increase this power thereby widening the range of devices that could be powered or re-charged. So the principal reason why fibre-to-the-desk will not become mainstream is not a question of data rate but of the delivery of power to IP-devices.

A data centre contains switching equipment at the zone and main distributors that connects the premises distribution cabling to data sources inside the building (i.e. servers) and the outside world (i.e. broadband connections).

Structurally, as can be seen in Figure 1, data centre cabling systems are the mirror image of the premises distribution cabling. While conventional premises cabling is designed to produce channels by reconfiguration of fixed cabling links with changes undertaken at patching fields. In contrast data centres can, and regularly do, evolve by the addition of equipment, cabinets and even rows of cabinets. This demands additional cabling links rather than reconfiguration of existing ones. Enabling this type of growth very quickly, avoiding massive disruption and risk of service provision failure is a key objective of the top data centre designers.

Optical fibre is a “non-radiating transmission medium”, it provides “freedom from electromagnetic interference and from inter-element crosstalk”. In a high data rate, high density cabling environment where cables are packed tightly together these advantages are critical. Not only does optical fibre cabling reduce the electromagnetic signature within the data centre, it can provision multiple circuits in a single cable without risk of interference thereby reducing the size and weight of the cabling. Optical fibre, using MPO and similar connections, can deliver twelve circuits in a connection no bigger than the end of your little finger. 10GBASE-SR can support at least ten mated connections over lengths of up to 200 metres (with some cabling system suppliers offering even greater support). While such complexity is rarely needed in even the most resilient building backbone constructs the data centre is a different world altogether.

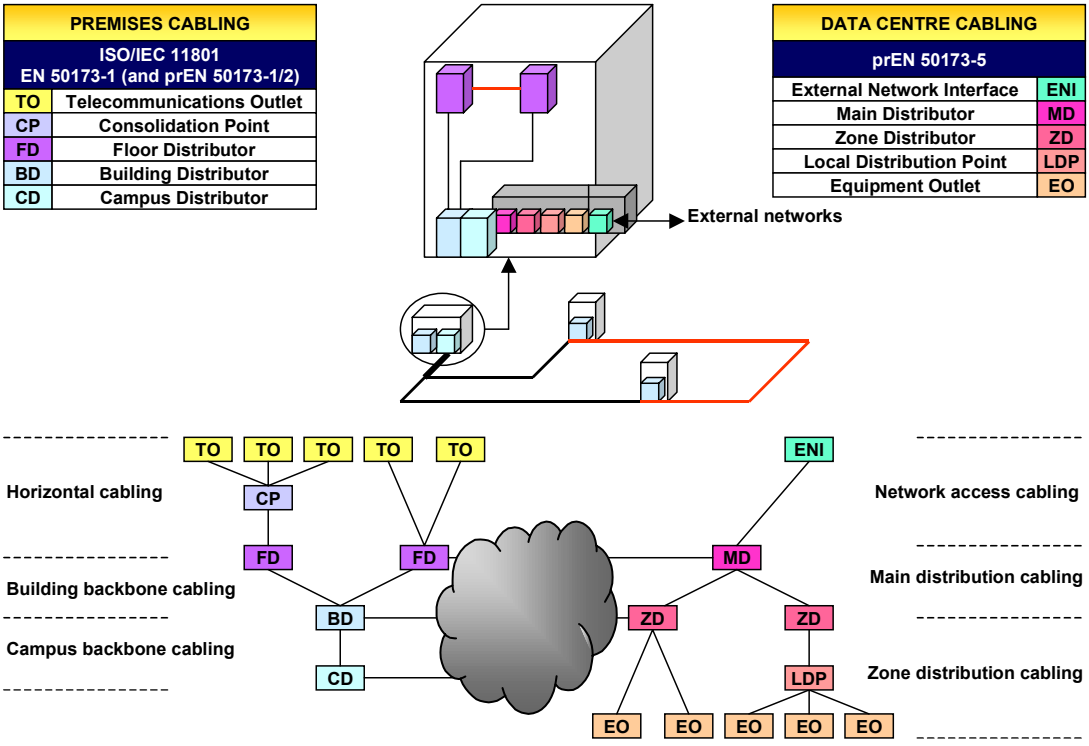

Figure 1 – Cabling structures

Figure 2 – The world of data centres

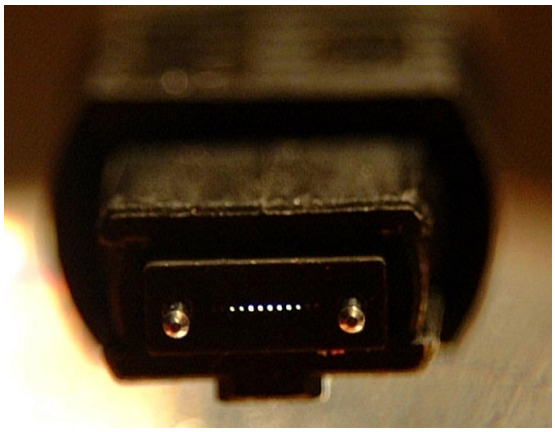

Figure 3 – High density interconnects

Standards-compliant 10GBASE-T networking products are expected to ship in 2006 and, according to IEEE, are aimed initially at data centres with eventual migration to the desktop. 10GBASE-T cabling requires defined cabling performance, generally meeting the requirements of Class E (Category 6 in the USA) extended 500MHz to that frequency. The exact details of the channel performance are largely irrelevant because whatever they are, existing Category 6 cabling is not guaranteed to meet them. Here the story gets more complicated because there are two separate performance specifications being developed – one to confirm that existing cabling can support 10GBASE-T, the other for a new Augmented Category 6_A/Class E_A product set.

Major cabling system suppliers are intent on selling the latter products - and the telecommunications cabling consulting companies are pleased to be able to tell their clients something new.

It is interesting, not to say unnerving, that the characterisation of cabling in support of 10GBASE-T has to address, for the first time, the issue of alien crosstalk (AXT) - the electromagnetic interference between adjacent cables (“inter-element crosstalk” for optical fibre). Control of AXT is “mission critical” since random signals originating external to the channel cannot be cancelled by the digital signal processing. Unfortunately, it will be virtually impossible to measure AXT on an installed system. The number of connections in the 10GBASE-T channel will still be limited to four with AXT a key concern at those panel connections.

With all these issues still being addressed it hardly seems feasible that 10GBASE-T cabling will considered as a credible replacement for optical fibre in the most critical areas within data centres of the type described above.

In reality, 10GBASE-T cabling is targeted at a horizontal cabling market that might not need it, while the data centre market that could use it - probably won't. In the data centre environment, any serious designer knows that there is no such thing as a cost-reliability balance. If you need reliability in the five 9's region then the cost to deliver it is not a primary issue. If you need high density interconnects, low cabling volumes and plug-and-play evolution, cost is not a primary issue.