

Cabling for high speed LANs in data centres

Ethernet isn't the only show in town

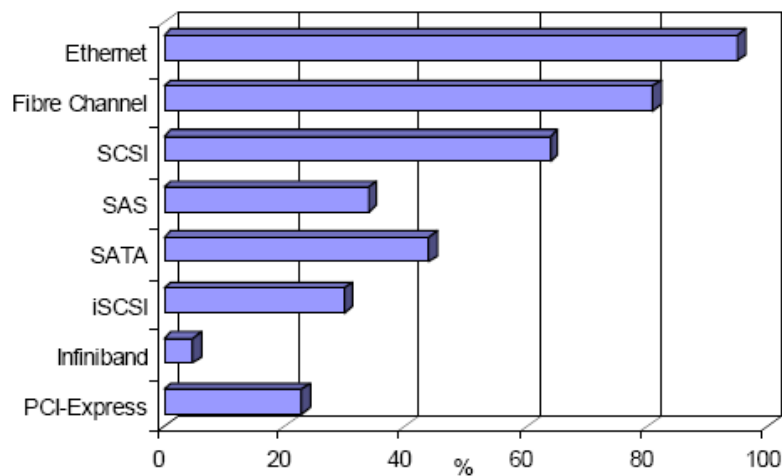
belliott@capitoline.co.uk

Ethernet is by far away the market leader in the Local Area Network business. It has been with us for twenty years and is becoming prevalent in telecommunications and industrial networking markets as well as the traditional office-based LAN where it has an almost 100% market share.

Ethernet doesn't have it all its own way however. Some commentators believe that although Ethernet is good because it is cheap, available and offers high speed communications, it is also a jack of all trades and master of none. It isn't optimized for real time applications such as voice and video; it is too complex and cable intensive for industrial applications and the relatively small packet size and high overheads makes it cumbersome for high volume data transfer.

So in the industrial market we have competitors like LONworks, BACNET plus a host of others and in the high volume data transfer market, known generically as Storage Area Networks, or SANs, we have protocols such as Fibre Channel and Infiniband.

Although Ethernet dominates the office LAN market, the data centre market shows continuing interest in the more specialist Storage Area Networks as a means of supplementing a traditional Ethernet based system.



LAN protocols in use in American data centres – source: *BSRIA 2008*

In the statistic published by BSRIA, the leading market research company in this field, Ethernet has almost a 100% market share in the data centre environment but Fibre Channel, a specialised SAN system, takes nearly 80% as well, at least in the American market.

Other systems also have their place as well. The question for the data centre manager becomes, 'what kind of cabling will handle these SAN protocols?' The question can be split into two again to ask; 'what SAN protocols will work over structured cabling and what needs dedicated cabling?'

Fibre Channel and Ethernet can both work over structured cabling with both copper and fibre interface options. Infiniband has its own special cable and can offer a 25 m link at 1 Gb/s and up to 15 m for a 10 Gb/s. It has been stated that for these 15 m links an Infiniband connection is the

lowest cost method of delivering 10 Gb/s. For longer links Infiniband has a standard structured cable (optical fibre) option.

The ideal must be to have one common set of cabling, e.g. structured cabling, that can offer one foundation interconnection layer that anything can work on. Certainly a well designed Category 6 or Cat6A and an OM3 optical fibre connection will handle all the requirements of Ethernet, Fibre Channel and Infiniband.

It's worth considering Fibre Channel and Infiniband in a bit more detail.

Fibre Channel is a high speed, duplex, serial link working from one Gb/s and beyond. Its main application has been found in Storage Area Network (SAN) topology.

For short distance transmission, up to 35 m, two types of copper connectors are specified for box-to-box interconnect: Style 1: the venerable 9-pin D-Subminiature (commonly known as "DB-9") and Style 2: the High Speed Serial Differential Connector (commonly known as the "HSSDC").

For transmission distances longer than 35 meters, optical interconnect has been the principal solution. This was the original targeted market of Fibre Channel until disk drives steered the market towards high-end storage applications. Optical interconnect is more costly than copper, but offers numerous advantages such as longer distance, reduced EMI, high noise immunity, smaller cables, lower power consumption and future migration to higher link speeds.

Fibre Channel uses three cable/wavelength options. Singlemode fibre supports distances between 2Km-10Km using 1300nm. 50 micron multimode fibre supports distances between two and 500 m (at 1.0625Gb/s) or 2-300m (at 2.125Gb/s) using 850nm. 62.5 micron multimode fibre supports distances between 2 and 300 m (at 1.0625Gb/s) or 2-150m (at 2.125Gb/s) using 850nm.

The Fibre Channel protocol has two 'bases', Base 2 and Base 10. Base two starts off at 1 Gb/s, then goes to 2 Gb/s, then four, then eight and so on. Base 10 starts off at 10 Gb/s and will go in multiple speeds of 10. The two bases have different underlying coding; 64.66 with base two and AB10 with base 10.

'BASE-T' is a recent innovation to get fibre channel to work over standard structured cabling and the table below is an extract from the Fibre Channel Industry Association roadmap.

Table 1: BaseT***

Product Naming	Throughput (MBps)	Line Rate (Gbaud)	T11 Spec Completed (Year)	Market Availability (Year)
1GFC	200	1.0625	2006	2007
2GFC	400	2.125	2006	2007
4GFC	800	4.25	2006	2007
8GFC	1600	8.5	TBD	Market Demand
10GFC	2400	10.52	TBD	Market Demand

Following on from this is a draft ANSI standard from the *Inter National Committee for Information Technology Standards or INCITS*, committee T11.

FIBRE CHANNEL

BaseT (FC-BaseT)Rev 1.01

INCITS working draft proposed American National Standard for Information Technology. April 24, 2007

The table shows the predicted distances for Fibre Channel transmission over different grades of copper cables, namely Cat5e (Class D), Cat 6 (Class E) and Cat 6A (Class E_A).

Table 2: Cable Types with Supported Data Rates and Lengths

FC Data Rate	Category 5e Reach	Category 6 Reach	Category 6a Reach
1GFC-BaseT	100m	100m	100m
2GFC-BaseT	60m	70m	100m
4GFC-BaseT	30m	40m	100m

Note Category 5e, Category 6, and Category 6a are also referred to as Class D, Class E and Class E_A.

Table 3: The Data centre cable capability chart

	Copper electrical performance LAN protocol						
	Ethernet 10BASE-10 Mb/s	Ethernet 100BASE-T 100 Mb/s	Ethernet 1000BASE-T 1000 Mb/s	Ethernet 10GBASE-T 10000 Mb/s	Fibre channel 1GFC 1 Mb/s	Fibre channel 2GFC 2 Mb/s	Fibre channel 4GFC 4 Mb/s
Cat5	100 m	100 m	100 m		100 m	60 m	
Cat6	100 m	100 m	100 m	37 m	100m	70 m	40 m
Cat6A	100 m	100 m	100 m	100 m	100 m	100 m	100 m

Optical systems LAN protocol	Optical system performance.						
	Fibre type						
	OM1	OM2	OM3	OM3+/OM4	OS1	OS2	
Ethernet							Speed
100BASE-FX	2000 m	2000 m	2000 m	2000 m			100 Mb/s
1000BASE -SX	275 m	550 m	1100 m	1100 m			1000 Mb/s
1000BASE -LX	550 m	550 m	550 m	550 m			1000 Mb/s
10GBASE-SR	33 m	82 m	300 m	550 m			10 Gb/s
10GBASE-LRM	220 m	220 m	300 m	300 m			10 Gb/s
10GBASE-LX4	300 m	300 m	300 m	300 m	10,000 m	10,000 m	10 Gb/s
10GBASE-LR/W					10,000 m	10,000 m	10 Gb/s
10GBASE-ER/W					40,000 m	40,000 m	10 Gb/s

Infiniband								
1X-SX 2 fibres	SDR	125 m	250 m	500 m	500 m			1Gb/s
	DDR	65 m	125 m	200 m	200 m			
	QDR	33 m	82 m	300 m	300 m			
4X-SX 12 fibres	SDR	75 m	125 m	200 m	200 m			4 Gb/s
	DDR	50 m	75 m	150 m	150 m			
8X-SX 2 x 12 fibres	SDR	75 m	125 m	200 m	200 m			8 Gb/s
	DDR	50 m	75 m	150 m	150 m			
12X-SX 2 x 12 fibres	SDR	75 m	125 m	200 m	200 m			12 Gb/s
1X-LX	S/D/ QDR					10,000 m	10,000 m	1 Gb/s
4X-LX	SDR					10,000 m	10,000 m	4 Gb/s
Fibre Channel								
1GFC		300 m	500 m	500 m	500 m	10,000 m	10,000 m	1 Gb/s
2GFC		150 m	300 m	300 m	300 m	10,000 m	10,000 m	2 Gb/s
4GFC		70 m	150 m	380 m	380 m	10,000 m	10,000 m	4 Gb/s
8GFC		40 m	100 m	300 m	300 m	10,000 m	10,000 m	8 Gb/s

Barry Elliott

Capitoline LLP

belliot@capitoline.co.uk

www.capitoline.eu

LOW CARBON CONSULTANTS

