Cabling performance standards

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Today, whether you're an end user, consulting engineer, contractor or distributor; it is essential to consider the dynamics between network protocols, building/campus topology, cabling system performance and cabling system life expectancy. This is because it would be a waste of money to specify a cabling system which didn't satisfy the current and future performance requirements of a corporate or institutional information systems strategy. Equally, of course, it would also be a waste to over-specify a cabling system because of a misunderstanding of the requirements or issues for each option.

But what are these issues? Certainly, over recent years, cabling system performance has become a key consideration, and there have been many attempts at classifying cabling system transmission by the relevant industry bodies. Inevitably, perhaps, given the rate of technological progress, these well-intentioned efforts have produced a situation which, for many, is at best complex, and, at worst downright confusing. Here, we clarify the situation by summarising the current situation in the context of events which preceeded it. We will focus on the issues related to performance.

Before the mid-1980s, efforts to define a commercial cabling standard were largely based on the specific requirements of a particular equipment vendor. The first major attempt to define a generic standard began around 1985, and, by 1995 - after several major revisions - there appeared to be stability in the cabling system industry. Standards were then established that specified performance requirements for components and completely installed systems, providing guidelines to manufacturers of cable and connecting hardware, manufacturers of hand-held field testers and contractors who install and verify complete cabling systems.

Written for cabling systems that supported network protocols like 10BASE-T, 4 or 16 Mbps token ring, 100 Mbps FDDI, 100 Mbps Fast Ethernet - and even 155 Mbps ATM - it seemed that these standards would be sufficient for almost any application. But it was confidence which reckoned without the pace of change; by the mid 90s, as hardware continued to get faster, and application software continued to use more memory and require more network bandwidth, the demands on cabling system performance was increasing significantly.

And manufacturers responded; cabling systems began to change. Terms like “enhanced”, “headroom”, “margin”, “high-end Cat 5”, “Cat 5+”, “Level 6”, “Category 7”, “Class E and F” began to enter the jargon, along with phrases like “characterised to 350 MHz”, “able to transmit 622 Mbps to the workstation area” and “able to transmit 1000 Mbps to the workstation area”. They were terms designed to describe various amounts of added performance margin which accompanied premises cabling systems. In fact, the latest work from IEEE for ’Gigabit Ethernet’ has even called into question the assumption that optical fibre can do anything.

But what do these terms mean?

The anticipation of increasing network bandwidth requirements, and the uncertainty that a Class D system would have good enough transmission and electro-magnetic emissions performance for an emerging 622 Mbps ATM application to operate properly, resulted in a need to generate a specification to ensure that high speed data could run over copper cable systems. A subcommittee of the Deutsches Institut für Normung (DIN), the German standards body, generated it's own standard for a 600 MHz cabling system, which specified cable requirements produced by a number of (mostly European) manufacturers. The only cable design that met this standard (so far) is referred to as PiMF (Pairs in Metal Foil) which describes a 4-pair, 100 Ohm cable where each twisted pair is wrapped in foil and then surrounded by an overall shield. In theory such a cabling system would support 622 Mbps ATM on two pairs using simple NRZ encoding.

At the same time, in North America, efforts were also made to put some boundaries around the numerous "enhanced" Category 5 cables that were being marketed as "enhanced performance" or "Cat 5+". One attempt to set boundaries defined three levels of performance:

- Level 5 – similar to Category 5 with the additional specifications of 10 dB pair-to-pair ACR (attenuation to crosstalk ratio) at 100 MHz and 10 dB power sum ACR at 80 MHz.
- Level 6 – a new 'level' that specifies cable with 10 dB pair-to-pair ACR at 155 MHz & 10 dB power sum ACR at 100 MHz.
- Level 7 – another new 'level' that specifies a cable with 10 dB pair-to-pair ACR at 200 MHz and 10 dB power sum ACR at 160 MHz.

The biggest concern with this approach was that it only specified ***cable*** performance. Network protocols run over a complete installation of cable, connecting hardware, patch and work area cables plus active devices. The draft Gigabit Ethernet standard for balanced cabling (1000BASE-T) seems to add more parameters at each revision. To cover this important issue the ANSI/TIA/EIA UTP System Task Group is in the process of releasing two addenda to ANSI/TIA/EIA-568-A. One is titled, "Additional Transmission Performance Specifications for 100Ω 4 -Pair Category 5 Cabling" (issued) and the second one is entitled, "Additional Transmission Performance Specifications for 100Ω 4 -Pair Enhanced Category 5 Cabling" The additional requirements are summarised below (Figure 3).

	Addendum	
Parameter (See glossary for definition)	Cat 5	E-Cat 5
Power Sum NEXT		√
Power Sum ELFEXT	√	√
Return Loss	√	√

Figure 3

These additional requirements are also being added into the International Standard ISO/IEC 11801 and it is expected that a second issue, to be called ISO/IEC 11801 (2000) will be released towards the end of the year 2000. This will be matched by a revised CENELEC EN 50173 (2000) and an ANSI/TIA/EIA 568-B standard. Other benefits to all will include common definitions for links, more help for fibre-to-the -desk installations etc.

'Category 6/Class E' and 'Category 7/Class F'

Additionally, the ISO/IEC Joint Technical Committee 1/SC 25 Working Group 3 (ISO/IEC JTC 1/SC 25/WG3) decided, at the conclusion of its September 1997 meeting, to proceed with new cabling categories and classes that will provide significant improvement over Category 5 and Class D. WG 3 is undertaking simultaneous development of these new balanced cabling categories and classes. 'Category 6/Class E' will specify cabling system positive channel performance to 200 MHz and 'Category 7/Class F' will specify cabling system positive channel performance to around 600 MHz. 'Category 6/Class E' also specifies that the modular jack interface shall be maintained for all user interfaces at the TO (telecommunications outlet). The 'Category 7/Class F' interface connector at the TO will be capable of 4-pair termination and performance. This interface connector will be internationally standardised. At this time the modular jack interface is the default connector.

At their subsequent January 1998 Orlando meeting they added more performance details to the evolving drafts e.g. 'Category 6/Class E' channel test requirements at 250 MHz.

'Gigabit Ethernet' and optical fibre

The IEEE committee has identified that most multimode optical transceivers use LED, digital (on - off) technology, and their operating limit is about 622 Mbps. A new transceiver technology -VCSEL

(Vertical Cavity Surface Emitting Laser) - has been developed to bring 'Gigabit' capability to multimode optical fibre networks. VCSELs also operate at the same wavelength ('short' - 850nm) as the most common LEDs.

The performance implications for large-building horizontal networks and backbone applications can be critical. 50/125µ and 62.5/125µ optical fibres can provide 'Gigabit' short wavelength system performance in the horizontal (100 metre) cabling but only the right 50/125µ optical fibre can give this performance in the building backbone (500 metres).

For this distance, 62.5/125µ optical fibre requires optical transceivers working at the 'long' (1300nm) wavelength and these transceivers need high performance (and price) lasers. In addition, special 'launch conditioning' adapter leads are needed. When the campus backbone is longer than around 550 metres only singlemode cabling and transceivers will handle 'Gigabit Ethernet'.

The Author
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