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The Cabling Partnership

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IS 11801 and EN 50173-1: Hi-Fibre Diet or Optical Eclipse?

Introduction

The previous three articles in this series have reviewed the content and future impact of the second edition of ISO/IEC 11801 and EN 50173-1 (the second edition of EN 50173). The first article in the June 2002 issue of NCN looked at the requirements of these standards in comparison with the ANSI/TIA/EIA-568B series of US standards. The second in July reviewed the complexity of the new reference implementations described in the new standards and in August we looked at the true meaning of conformance to these standards. However, throughout virtually all the articles we have concentrated on the copper cabling issues.

This article summarises the requirements of the new standards as they relate to optical fibre cabling and explains the measures that designers and installers alike will have to implement to ensure water-tight compliance. Allocating only one out of four articles to optical fibre unfortunately limits the level of detail that can be included but hopefully this review will cover the major items.

What does "conformance" really mean?

Readers of the August edition of NCN will recall that true conformance to both the second edition of ISO/IEC 11801 and EN 50173-1 requires that:

- the cabling structure and configuration shall meet certain minimum requirements;
- the performance of the each cabling channel has to meet the requirements of a specific Class;

and

- the interfaces to the cabling have to meet a specified set of requirements.

Cabling structure

Figure 1 shows the standard cabling structure of the standards. The campus distributor (CD), building distributors (BD) and floor distributors (FD) provide the breakpoints between the three cabling sub-systems. Figure 1 also shows the centralised structure options where building or floor distributors are "removed" thereby providing direct connections from the BD to the telecommunications outlet (TO) or from the CD to the FD or even from the CD right through to the TO. This concept of centralised architecture applies to both balanced cabling and optical fibre cabling in equal measure but was first considered for optical fibre in order to remove connections from the resulting channels.

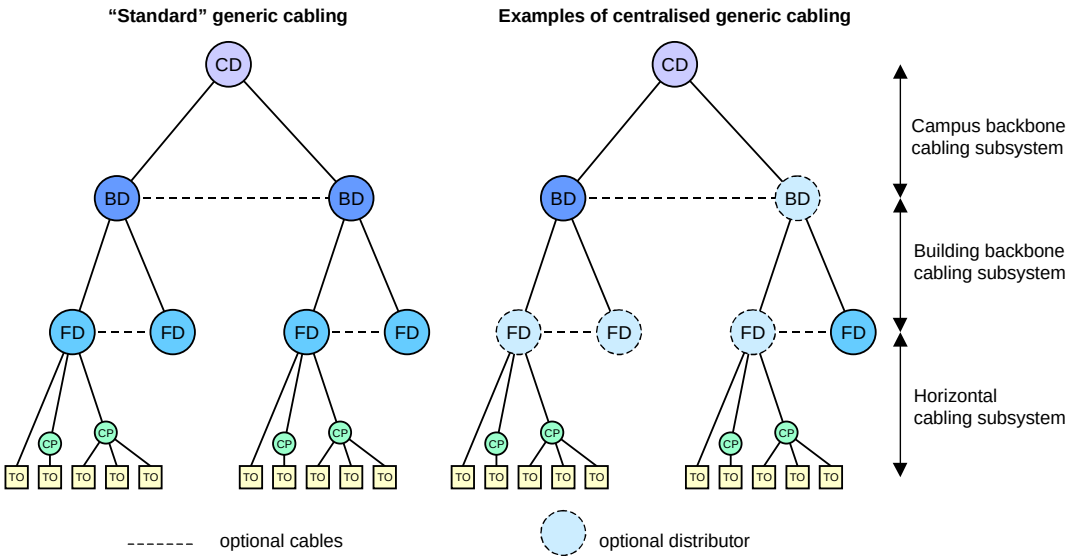

Figure 1: "Standard" and centralised generic cabling

The reason for this is that, unlike their copper counterparts, optical fibre connections have an attenuation specification that can represent a significant reduction in supported channel length. The removal of connections between cabling sub-systems thereby provides maximum channel lengths but at the cost of reductions in infrastructure flexibility.

However, there is one area in which a reduction in the numbers of connections is desirable - the cabling sub-system itself. In previous articles, diagrams have shown a maximum of four connections per cabling sub-system. Within the horizontal cabling sub-system this configuration allows for a cross-connect at the floor distributor and the consolidation point (CP) and the TO on the floor. While this configuration is supported by the standards, independent of the cabling medium used, it is inferred throughout the rest of the standard that an optical fibre channel within a cabling sub-system only contains two connections. This has some unexpected consequences for users wishing to provide resilience routes via patching fields.

Channel Classes

The main change in the new editions of the international and European cabling standards with regard to optical fibre is the introduction of the optical fibre Classes for installed cabling performance as shown in Table 1 and Figure 2. As is common with new ideas they appear quite simple at first glance. Nevertheless, they are actually quite complex to interpret and require a good deal of consideration before diving straight in to use them. A given Class can be specified for both multimode and singlemode optical fibre.

A channel of a Class has a specified maximum length and maximum attenuation. The reason for the inclusion of a maximum length for each Class is that the new applications supported by the cabling (up to and including 10 Gigabit Ethernet) are bandwidth limited. The inability to measure installed cabling bandwidth forces the use of a maximum physical length limit. The attenuation is specified at both operating windows relevant to the type of optical fibre used - if a test is to be performed to prove conformance then it has to be undertaken at both wavelengths.

Class	Maximum length (m)	Maximum attenuation (dB)			
		Multimode		Singlemode	
		850nm	1300nm	1310nm	1550nm
OF-300	300	2,55	1,95	1,80	1,80
OF-500	500	3,25	2,25	2,00	2,00
OF-2000	2000	8,50	4,50	3,50	3,50

Table 1: Installed optical fibre channel Class requirements

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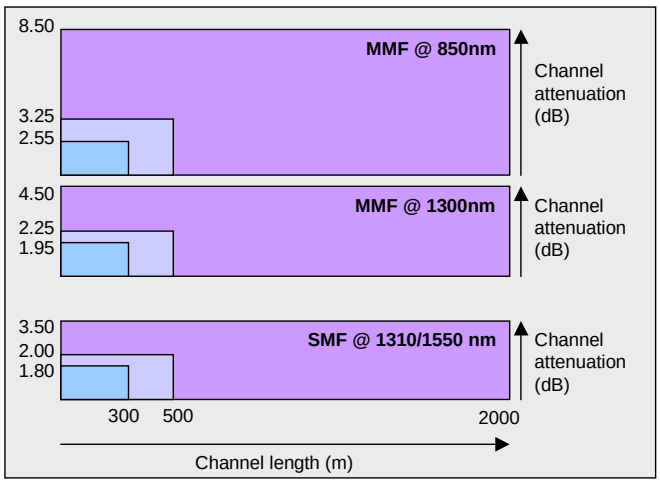

Figure 2: Channel Class requirement schematic

Application mapping and cable Categories

The next thing to consider is how applications map onto the Class structure i.e. which networks operate over which installed channel Class? The absence of any mention of whether the multimode optical fibre of a given Class is 50/125 or 62.5/125 and which attenuation and modal bandwidth specifications are applicable indicates that the application mapping is going to be complicated - and indeed it is. Unlike the balanced cabling Classes (A to F) and the mapping that simply states that an application is, for example, Class D, the optical fibre Class mapping exercise demands that the optical fibre cable performance be defined before the mapping can be undertaken.

In order to proceed the optical fibre cables had to be awarded Categories; OM1, OM2, OM3 for multimode and OS1 for singlemode. The optical fibre cable Category system is specified in Table 2. OM3, the new high bandwidth product set, is 50/125 only. This makes application mapping relatively straightforward (see Table 3). Unfortunately it could not be agreed that OM1 was 62.5/125 only or that OM2 was 50/125 only so mapping is much more complex and is not included in this article. Perhaps, this level of complexity is intentional and assists in the current drive towards the use of OM3. However, as with most conspiracy theories it is much more likely that “cock-up” is to blame here.

		Multimode OF				Singlemode OF
		50/125 or 62.5/125		50/125		
	Wavelength	OM1	OM2	OM3	Wavelength	OS1
Attenuation coefficient (dBkm^{-1} max)	850nm	3,5			1310nm	1,0
	1300nm	1,5			1550nm	1,0
Modal bandwidth OFL (MHz.km min)	850nm	200	500	1500		
	1300nm	500	500	500		
Modal bandwidth LL (MHz.km min)	850nm	-	-	2000		
	1300nm	-	-	-		
Propagation delay (ns.m^{-1} max)	850nm	5			1310nm	5
	1300nm				1550nm	

Table 2: Optical fibre cable Categories

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	Optical channel class using			
	OF OM3		OF OS1	
APPLICATION	850nm	1300nm	1310nm	1550nm
ISO/IEC 8802-3: FOIRL	OF-500			
ISO/IEC 8802-3: 10BASE-FL/FB	OF-2000			
ISO/IEC 8802-5: TR 4/16 Mbit/s	OF-2000			
IEEE 802-12: Demand priority	OF-500			
ATM-52		OF-2000	OF-2000	
CD 9314-9 FDDI-LCF		OF-500		
ISO/IEC 9314-3 FDDI		OF-2000		
ISO/IEC DIS 9314-4 FDDI			OF-2000	
ISO/IEC 8802-3: 100BASE-FX		OF-2000		
ATM-155	OF-500	OF-2000	OF-2000	
ATM-622	OF-300	OF-500	OF-2000	
ISO/IEC 14165-1: FC-133		OF-2000		
ISO/IEC 14165-1: FC-266	OF-2000	OF-2000	OF-2000	
ISO/IEC 14165-1: FC-531	OF-500		OF-2000	
ISO/IEC 14165-1: FC-1062	OF-500		OF-2000	
IEEE 802-3: 1000BASE-SX	OF-500			
IEEE 802-3: 1000BASE-LX		OF-500	OF-2000	
IEEE 802-3: 10GBASE-SR/SW	OF-300			
IEEE 802-3: 10GBASE-LX4		OF-300	OF-2000	
IEEE 802-3: 10GBASE-LR/LW			OF-2000	
IEEE 802-3: 10GBASE-ER/EW				OF-2000

Table 3: Application mapping using OM3 and OS1 optical fibre

Connectors – the SC Duplex still calls the tune

The next issue to be addressed is that of the connectors to be used – and where they are used. As for copper, the standards only define the type of connector to be used at the telecommunication outlet – leaving the choice of connection at distributors (i.e. patch panels) open to the user. It may seem strange to the average cabling installer - busy getting to grips with the LC, 3M Volition and MTRJ connectivity solutions now available on the market - that the chosen connector for the telecommunications outlet is still the SC Duplex. The main reason for this is the vast amount of work undertaken by IEC to guarantee interoperability of the SC connectors - not just that they fit together but are also guaranteed to perform to a certain maximum attenuation.

While the new Small Form Factor connectors such as those listed above are mentioned in the new standards as being potentially useful at other locations than the TO they come with a “health warning”. The warning clearly states that the existing standards for the SFF connectors do not guarantee interoperability and, essentially, that users should seek that plug/socket combinations that are subject to manufacturers guarantee i.e. no mix-and-match connections. As Technical Director of the FIA, I am plagued with complaints about lack of interoperability of these new connectivity systems so I have some sympathy for the standards writers in this area.

The matter of testing

Once again referring back to a previous article, the readers of the August issue of NCN will recall that, for balanced cabling, even if the correct components are used according to the reference implementations of the standards then there is no absolute guarantee that the channel requirements will be met. EN 50173-1 extends this cautionary statement, situated in the all-important Conformance clause of the standard, to optical fibre cabling. The reason for this caution is not to do with mismatches between component and channel specifications, as it is for the copper solutions, but rather one of problems with testing.

The use of light source-power meter test equipment to determine the link or channel attenuation has been well specified at UK, European, international and United States levels. Amazingly, there is almost complete unanimity between all the standards on how to undertake the testing.

It is therefore a great sadness that so few installers use the correct methods. In many cases their error will remain unrecognised but as the installed lengths become shorter (as they are doing now) and the measured values start to reduce then the error produced by the use of the wrong methods will lead to more and more failures.

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Furthermore, the standards-based test methods (including those referenced by the second edition of ISO/IEC 11801 and EN 50173-1) are aimed at simplex connections and test equipment that tests one optical fibre in one direction at a time. The increased use of SFF connectors and newer types of test equipment (frequently copper test equipment with optical heads) is not supported yet by the official standards and therefore even more errors are being made. The FIA has produced interim standards for testing using light source/power meter equipment to cover these areas.

However, even if the correct method is used then as the lengths get shorter and shorter there is an increased risk of the inherent measurement error producing "fail" results. As a result the installer is required to produce a Quality Plan, as part of the conformance requirements of the new cabling standards, to explain to the user how such results will be treated.

In conclusion ……..

On the surface the optical fibre industry should be pleased with the new Categories of optical fibre and the new requirements for installed cabling Classes. At the very least it gives the industry something new to sell. However, as we dig a little deeper there are new problems associated with component compatibility and testing which lurk beneath the surface to cause problems for designers, installer and users.

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