

# White Paper

## To Screen or not to Screen? – that is the question.



### Should Category 6<sub>A</sub> cabling installations be Screened? What are the arguments?

#### Overview

The debate rages on in many sectors of the market concerning whether ISO/IEC 11801 Class EA, or Category 6<sub>A</sub> should or in fact NEED to be, in some people's eyes, Screened to effectively support 10Gig Ethernet transmission.

Each method has its pros and cons; there is a belief that unshielded is cheaper and easier to install and terminate and that shielded has its own issues in relation to grounding and bonding.

In this following paper we aim to balance a number of these choices and dispel some of the myths and try to give the reader a balanced view on what is the best route to follow. In the last few years there have been a number of studies carried out by manufacturers in their own right and independent studies that have been part or wholly funded by manufacturers, we will look at some of those findings.

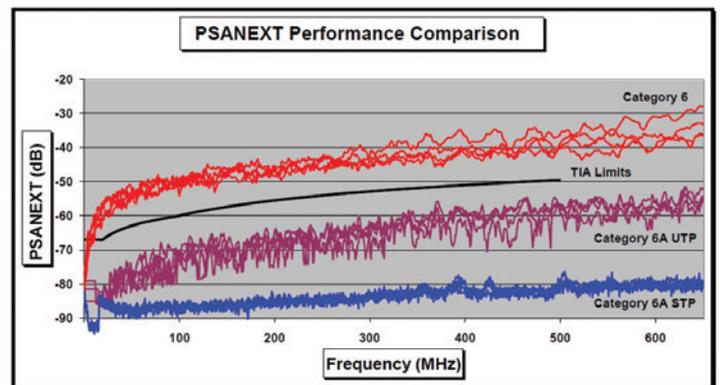
The IEEE 802.3an-2006 standard for 10GBASE-T operation was ratified in June 2006. It defined an application standard for 10 Gb/s data transmission over copper twisted pair cabling of up to 100 metres, it includes use of both unshielded twisted pair (UTP) and shielded twisted pair (STP) copper cabling systems.

#### Detail

In 10GBASE-T applications, the noise source that most limits the ability to transmit 10Gb Ethernet over copper cabling is alien crosstalk. Because the 10GBASE-T receiver cannot compensate for the noise from adjacent channels, this effect must be cancelled out wherever possible by the cabling system to ensure reliable data transmission. This noise is measured as Power Sum Alien Near-End Crosstalk (PSANEXT) and as Power Sum Alien Attenuation to Crosstalk Ratio at the Far-End (PSAACRF). Both ISO/IEC 11801 Ed 2.1 Class EA and TIA-EIA-568-B.2-10 Category 6<sub>A</sub> require that crosstalk be measured in a 6-around-1 cabling configuration that takes into account the worst-case effect on a centre cable with six cables tightly bundled around it.

A Category 6 U/UTP system will not meet the alien crosstalk limits required for 100 metres of 10GBASE-T transmission (see Figure 1).

Figure 1. 100-Metre Channel PSANEXT Performance Characteristics



The above shows the TIA limits, it must be noted that ISO/IEC limits are somewhat tighter, meaning the Category 6 is even further from success and whilst Category 6<sub>A</sub> U/UTP still passes, it is closer to the limits than a shielded system.

Coming back to the question of whether to screen are not there are some basic considerations to weigh up when making the choice. Some of the benefits for a shielded solution are clear from the above chart, however there are a number of shielding types available and in turn each one has a different level of effectiveness and we will look at that in more detail later however the basics remain the same.

With properly installed and bonded shielded cabling the foil shield within the cable prevents signals from coupling, which reduces alien crosstalk well below the required limits. All the tests we mentioned in the opening of this paper indicate that shielded cabling systems provide significant margin over the IEEE 802.3an-2006 specification for 10GBase-T PSANEXT and PSAACRF. This increased performance means the need for time-consuming and complicated field-testing of alien crosstalk is eliminated.

#### Independent Testing

In a recent independent test a leading testing establishment selected 5, Class EA Cabling Systems from five different market-leading suppliers there were 2 U/UTP systems 1 x F/UTP solution and 2 x S/FTP systems. The test set up involved the use of real 10GBase-T equipment and live 10Gb/s traffic.

Figure 2 – Initial Findings

	System 01	System 02	System 03	System 04	System 05
Channel type	U/UTP	U/UTP	F/UTP	S/FTP	S/FTP
Insertion loss (margin) [db]	8.8	8.6	8.6	10.5	15.5
PS NEXT (margin) [db]	5.5	8.2	7.8	5.8	6.2
TCL (margin) [db]	9.2	8.9	9.6	5.45	10.4
RL (margin) [db]	8.8	9.5	3.4	6.9	8.2
PS ANEXT (margin) [db]	-7.6	0.93	27.44	31.37	37.92
Coupling Attenuation [db]	45.0	47.5	78.0	76.0	79.0

The findings did show a couple of startling results one of which being the U/UTP systems tested demonstrated significantly weaker ANEXT performance and coupling attenuation in comparison to STP systems.

The other findings included immunity against fast transient electrical disturbances such as powering of fluorescent lamps and immunity against radiated electromagnetic fields such as those produced by GSM based mobile phones, once again the U/UTP systems performed badly in comparison to the Screened Systems.

Figure 3 – Practical Radiated HF

Test (3m distance)	System 01	System 02	System 03	System 04	System 05
Walkie-talkies	X	X	✓	✓	✓
Mobile communication devices (mobile phone, GSM card)	X	X	✓	✓	✓

Pushing the push-to-talk switch or the call set-up button impaired the data transmission of unscreened systems (system 01 and 02) or even led to complete loss of signal traffic.

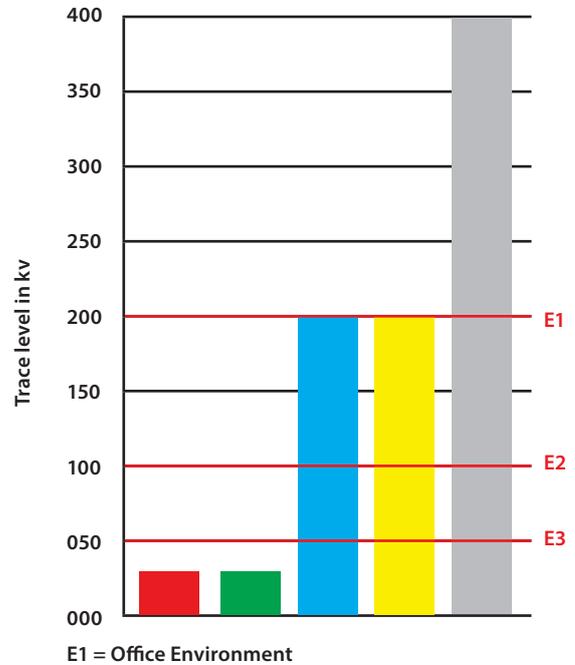
There was no influence on the screened systems

Figure 4 – Fast Transients

● Powering of fluorescent lamps

U/UTP systems failed this test for all electromagnetic environments

STP systems pass this test for all electromagnetic environments



Without knowing the full details of the systems selected and cable constructions used, it would be wrong to jump to the conclusion that all U/UTP systems will fail to meet the performance requirements, so we should look to consider some of the other factors that are being discussed.

Different manufacturers use different termination techniques for their products. The majority have invested time and effort in reducing the time taken to terminate their screened offerings, following demand from the installer market. In fact, given some of the findings discussed earlier in this document, more care is required when terminating some U/UTP products which is leading to parity between the two systems.

**Field Testing**

Since 10GBASE-T applications are sensitive to Alien Crosstalk, the requirements for field testers capable of assessing the performance of installed Category 6<sub>A</sub>/Class EA cabling systems are specified within the TIA-568-B.2-10 and IEC 61935-1 standards. These Standards specify both the measurement procedures and accuracy requirements for the field testers for all historical parameters as well as the alien crosstalk parameters PSANEXT loss, PSAFEXT loss and PSAACRF.

Performing a 100% alien crosstalk test in a cabling plant is impractical and virtually impossible in large cabling plants.

Using the specified 6-around-1 method, the formula to determine the number of tests that would need to be run for 100% coverage is  $(n^2+n)/2$  where n is the number of links in the installation. For example, in an installation with 100 links, a total of 5,050 tests would need to be run to test every possible combination. In a 500-link installation the total number of tests increases to 125,250 tests when testing every possible combination. Therefore the ISO/IEC 61935-1 standard provides guidelines for sample testing.

Field tests for alien crosstalk are not required on F/UTP and S/FTP cabling systems as they are said to 'Meet by Design' the requirements due to the screening materials used. Alien crosstalk testing of 10G Category 6<sub>A</sub> U/UTP cabling systems is optional as they may be deemed to be 'compliant by design' which can be a combination of product design as well as the infrastructure design.

ISO/IEC 61935-1 states sample testing should be conducted based upon evaluating links that meet all of the following conditions:

- Links with the Highest Insertion Loss
- Links with the Lowest Insertion Loss
- Links with the Median Insertion Loss
- Longest installed lengths
- Cables within the same bundle
- Adjacent ports in the patch panel

The key weakness of a U/UTP system comes about when you have a large quantity of adjacent ports loaded into patch panels. A fact that is highlighted within the measurement of ANEXT within ISO/IEC 11801 ed2.2 as by definition it does not meet the criteria of the infrastructure design element.

*"Worst case conditions occur where ANEXT coupling occurs over the full length of disturbing and disturbed cabling and where all connections within each link are co-located".*

*"Simple models assume equal lengths of disturbed and disturbing links and co-location of connecting hardware (patch panels)".*

On this basis what are the real differences and myths.

Unscreened	Screened
No Screen, simpler and quicker to terminate. Yes and no; more care is needed in the preparation to ensure twist ratios are maintained etc. Most U/UTP solutions are very tightly twisted pairs with a large plastic separator.	Most manufacturers offer either a termination aid or have toolless products which leads to the overall time taken being quicker than U/UTP. Certainly the cable pulling time will not change
Less Expensive. U/UTP Category 6 <sub>A</sub> systems are approx 15% less expensive than Screened however this is eradicated by the additional containment required.	The cost difference is mainly in the metal outlets. The cable does not show as great a difference due to the greater effort and precision needed to produce a U/UTP cable with the correct characteristics. However this is just material cost, the installation time as we have seen is roughly equal.
Does not require Bonding – This is a myth, all metal panels within a cabinet whether Screened or unscreened need to be bonded within the cabinet in accordance with BS/ EN50310	A small amount of additional time is required to ensure all the outlets within each panel have a clean contact with the frame.
UTP cables are smaller – Again a myth, Most U/UTP cable have an elliptical design and overall OD which is on average anywhere between 7.3 - 9.3mm, depending upon the manufacturer	Average size of an Excel F/FTP solution is 6.9mm U/FTP is 6.7mm
Field Testing - it is recommended that Alien Cross Talk testing is carried out requiring a 6 around 1 test method. A number of field testers make assumptions for this and rely on the manufacturer to back them up. If the full 6 around 1 test is called for the additional time for testing is a minimum 10-15mins per link.	Field Testing – ANEXT testing is not required, typical test time per link is currently 14-22 seconds, although there are next generation testers coming on to the market that claim less than 10 seconds per link.

## Conclusions

All the evidence shows that Screened is best, while unscreened can be a viable option for those who choose to take that route. The one thing that is becoming clear is the number of companies choosing a screened solution is increasing as they start to understand the benefits while at the same time the myths of screening have been dispelled by better education.

It is time to pay your money and make your choice!

*This Technical Note has been produced by Paul Cave, Technical Manager, on behalf of Excel.*

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