Nexans

Why Screening

Screened Cabling vs Unscreened

White Paper
Nexans Cabling Solutions
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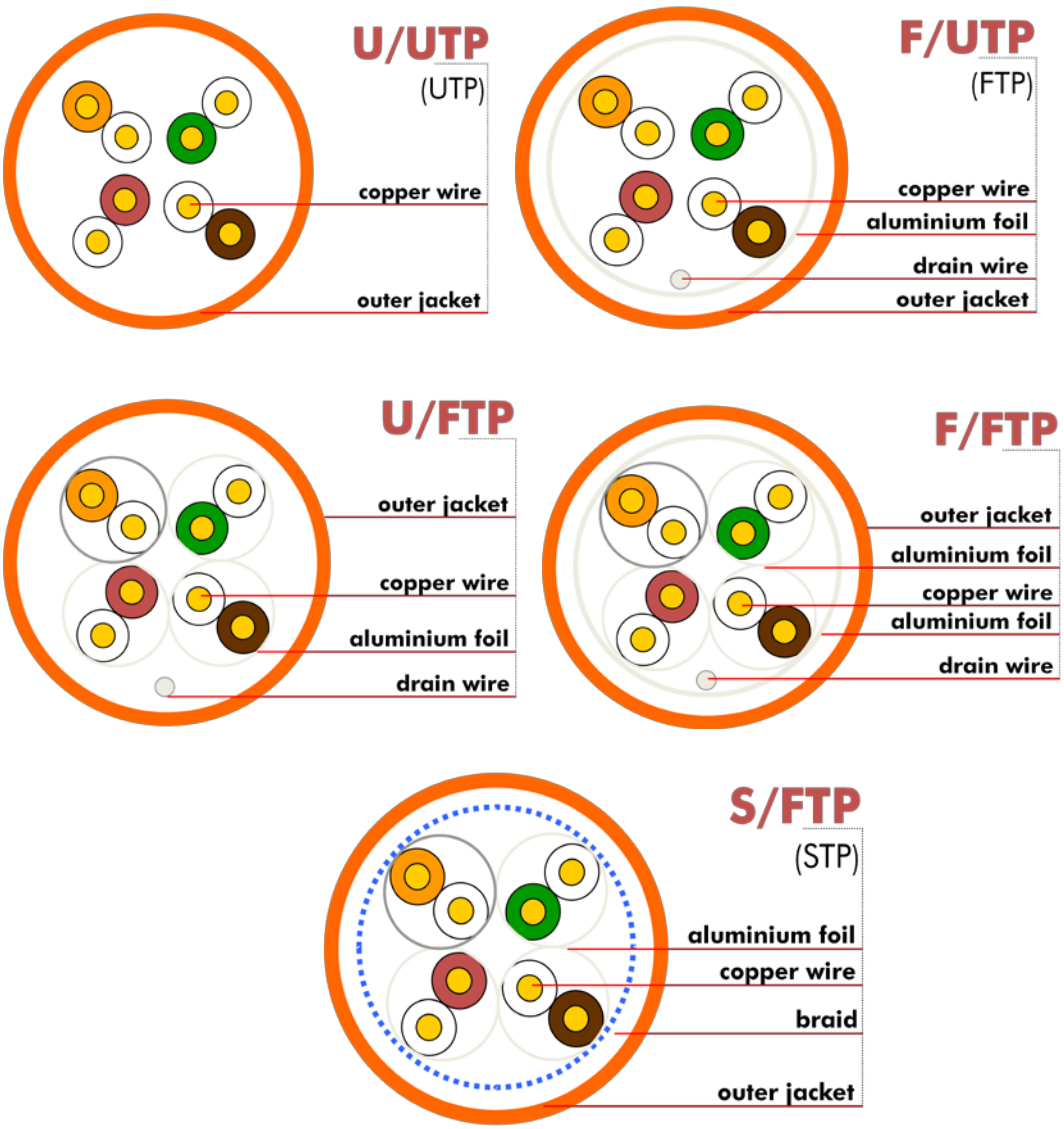
Screened vs Unscreened

In addition to the performance classes and categories within structured copper cabling there are two main different technologies: shielded and unshielded twisted pair (U/UTP) systems. Both types have been in existence since the earliest cabling standards were defined. While shielded cabling became popular from the outset in countries like Germany, Austria, Switzerland and France, U/UTP was quickly adopted in the rest of the world. Although both systems work fine at 1 Gigabit Ethernet data rates, shielded systems can demonstrate superior performance at higher data rates such as 10G due to their ability to reliably support higher frequency transmission.

Different cable constructions



What is a cable shield good for?

F/UTP

A F/UTP cable has a common shield (foil) around the four pairs of the data cable. This common shield minimises:

1. Radiation of data transmission signals which leave the cable and disturb neighboring cables (e.g. adjacent cables in the same bundle)
2. Unwanted high frequency signals from other cables or other sources of noise from entering the cable.

Both effects are very important to maintain a high quality of data transmission. If an alien signal is strong enough it could overlap the wanted signal and could slow down the system performance or even bring down the network.

S/FTP

In addition to a common shield, a S/FTP cable has individual foils wrapped around each of the 4 twisted pairs. The foil protects the four different signals from each other – which leads to much higher NEXT (Near End Crosstalk) values. Increased NEXT means higher signal to noise ratios, improved transmission performance and faster system throughput. The NEXT values provided by S/FTP cables cannot be achieved with other cable designs like U/UTP. Therefore only S/FTP for Cat.7 (600 MHz) and Cat.7_A (1000 MHz) is specified in ISO 11801 but no U/UTP.

10GBASE-T – the beginning of a new cable problem: Alien Crosstalk

The standard for 10 Gigabit Ethernet over twisted-pair copper (10GBASE-T) was published in 2006 providing a new protocol which represented a ten-fold increase in comparison with the previous 1000Base-T version.

1000BASE-T transmission requires all internal cabling parameters (Attenuation, NEXT, Return Loss etc) to be specified for the range 1 to100MHz, this can be achieved using a Cat.5e (Class D) cabling system.

10GBASE-T however requires a cabling channel with all parameters specified to an upper frequency of 500MHz which can be achieved using a Cat.6_A (Class E_A or higher) system.

During the development of 10GBASE-T it became clear that sensitivity to external noise was a problem. This led to the specification of external noise parameters to assess the effect of noise from cables within a bundle on another cable in the same bundle. This effect is known as Alien Crosstalk which worsens as frequency increases.

10GBASE-T systems faced with excessive external noise do not "auto-negotiate" down to a lower data rate – they simply shut down.

Good Alien Crosstalk performance is therefore essential for cabling systems designed to support 10GBASE-T.

- 10GBASE-T is – due to high transmission frequency and complex encoding – quite sensitive to external noise

- Shielded systems have a higher coupling attenuation which gives them in-built protection against external noise (Alien Crosstalk).

- U/UTP systems generally have 0dB margin against the external noise parameters

- Shielded systems support 10G simply by design.

10GBase-T installation: U/UTP vs. FTP

Unshielded systems

- Increased separation distance from power cabling
- Mix of applications (1 Gb/s and 10 Gb/s) in one conduit may lead to ANEXT disturbance

Shielded systems

- Reduced separation distance from power cabling
- Mix of applications (1 Gb/s and 10 Gb/s) possible in one conduit
- No ANEXT field testing

"U/UTP is easier and cheaper to install".... — is there any truth behind this myth?

In reality no, both from a design and installation perspective, the benefits of installing a shielded system outweigh the perceived ease and lower cost of installing a U/UTP system.

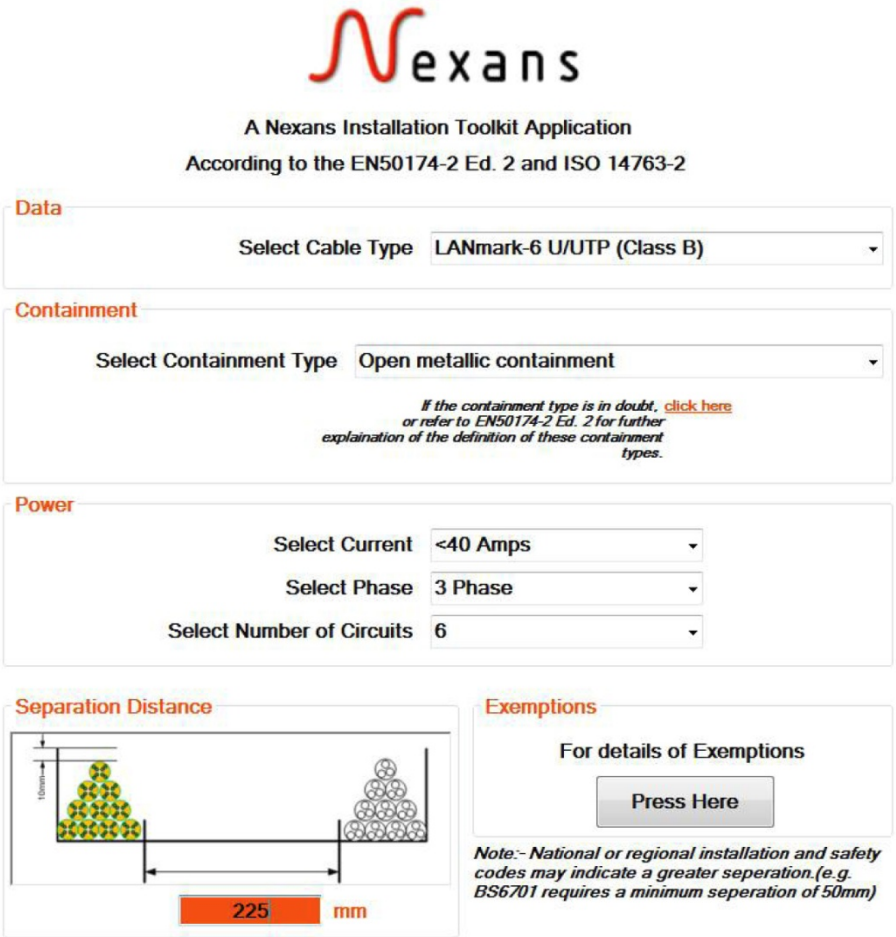
Separation distance from data- to power cable

In the standard EN50174-2 coupling attenuation (ca) limits are defined for different cable types. They are classified from A (low ca, poor) to D (highest ca, very good).
Table 3 from EN50174-2

AC1 Table 3 – Classification of information technology cables

Information technology cable			
Screened	Unscreened	Coaxial/twinaxial	
Coupling attenuation at 30 MHz to 100 MHz dB	TCL at 30 MHz to 100 MHz dB	Screening attenuation at 30 MHz to 100 MHz dB	Segregation classification
≥ 80 [a]	≥ 70 − 10 × lg *f*	≥ 85 [d]	d
≥ 55 [b]	≥ 60 − 10 × lg *f*	≥ 55	c
≥ 40	≥ 50 − 10 × lg *f* [c]	≥ 40	b
< 40	< 50 − 10 × lg *f*	< 40	a

Installers need to know the segregation class to find out the required distance between data- and power cables. The higher the coupling attenuation of the data cable is – the shorter is the distance allowed. Below you will find 3 examples of what that could mean in practice (screenshots are taken from Nexans Toolkit – available for free download on Nexans website):



Example 1: U/UTP: (Class B cable – coupling attenuation >/= 40dB) -> 225mm

A Nexans Installation Toolkit Application

According to the EN50174-2 Ed. 2 and ISO 14763-2

Data

Select Cable Type: LANmark-6A F1/UTP (Class C)

Containment

Select Containment Type: Open metallic containment

If the containment type is in doubt, click here or refer to EN50174-2 Ed. 2 for further explanation of the definition of these containment types.

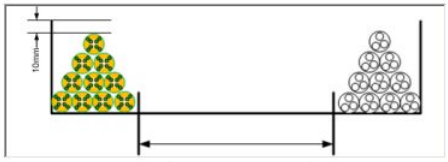
Power

Select Current: <40 Amps

Select Phase: 3 Phase

Select Number of Circuits: 6

Separation Distance



114 mm

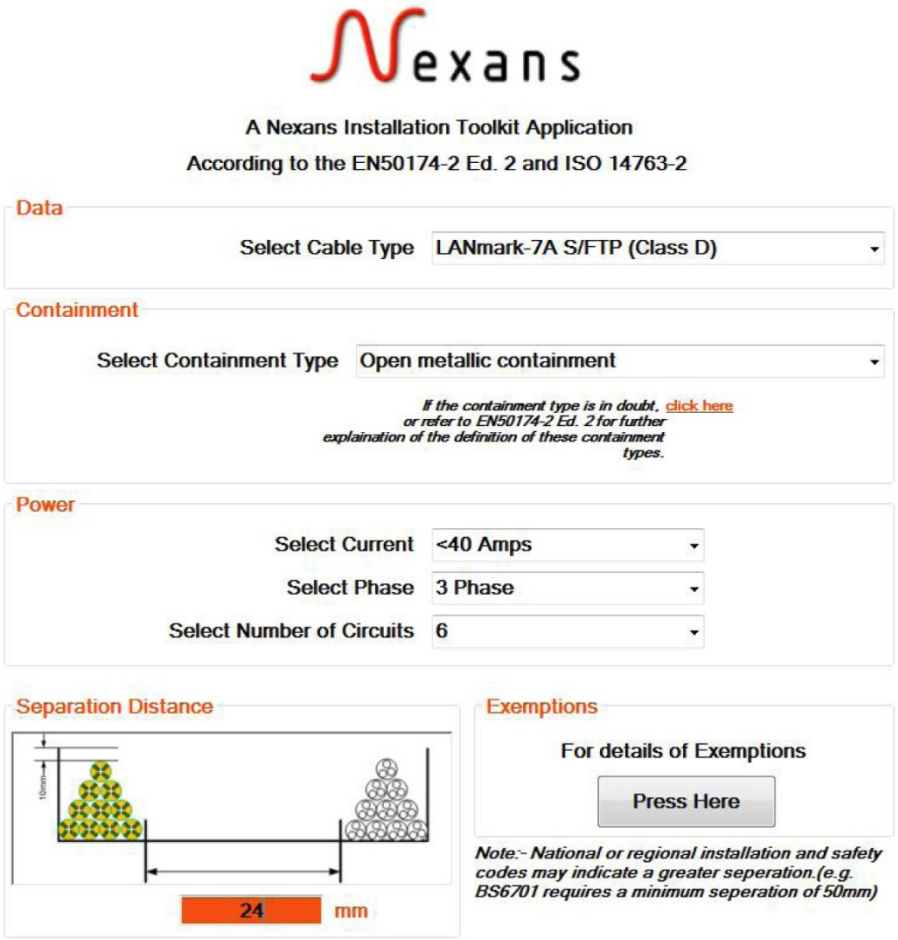
Exemptions

For details of Exemptions

Press Here

Note:- National or regional installation and safety codes may indicate a greater seperation.(e.g. BS6701 requires a minimum seperation of 50mm)

Example 2: F/UTP (Class C - coupling attenuation >/= 55dB) -> 114 mm



Example 3: S/FTP (Class D - coupling attenuation >/= 80dB) -> 24mm

U/UTP cable needs more distance from power cable than any shielded cable. In practice more space means more costs because bigger cable ducts/trays or additional trays dedicated to power or data cables are needed. Worse, these additional requirements are often overlooked or ignored which can generate areas of high disturbance at critical points in the network.
These calculations realised according to the rules described in the EN50173 cabling standard really highlight the effectiveness of the cable screen.
Alien Crosstalk (AXT) theory and comparative measurements (unscreened versus screened) confirm that screened cables also provide a high level of protection against EMI at high frequencies.

Earthing

Protective earthing requirement applies to unshielded, shielded and fibre optic cabling systems alike. All metal parts regardless of the type of cabling must be bonded for personnel safety reasons.
The functional earthing requirement applies to shielded system only. But the only additional operation to be performed is to connect the screen of the connector to the screen of the cable during the termination process on site.
Bonding of the connector screen with the patch panel and of the patch panel with the cabinet are automatically performed when using Nexans Cabling Systems.

Summary

Screened cabling brings valuable EMC performance improvement against unscreened systems: Shielding effectiveness is of particular importance where 10G Ethernet is concerned. Screened or shielded cabling is immune to alien crosstalk transmitted from adjacent cables with the result that the installed system is able to meet the A-XT requirement by design.

Screened cabling, when grounded at both ends, is a minimum 40dB better i.e. less susceptible to picking up RFI from external sources than unshielded cabling.

What do suppliers of test equipment say?

Ideal Industries

" With modern cables, AXT is negligible for data rates up to 1GB/s, but under certain circumstances, it can be a problem for rates of 10GB/s or higher. Whenever cabling has to meet ISO 11801 Class E_A or Cat.6_A field testing requirements, it must be compliant with AXT specifications. This can be proven indirectly, by measuring the coupling attenuation. Basically, this attenuation describes cabling's immunity against EMI (Electromagnetic Interference) samples in the laboratory. The manufacturer only needs to prove a certain product's coupling attenuation performance once; this doesn't have to be repeated for every customer project.

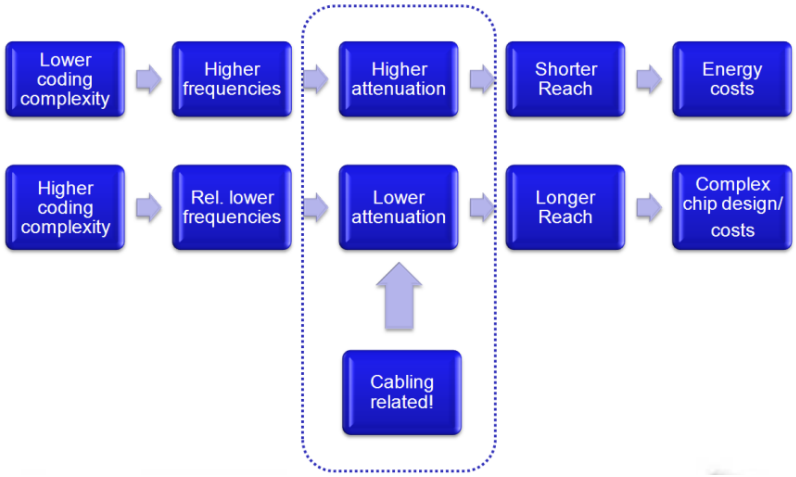
Once laboratory tests have been passed, the manufacturer can issue a certificate for AXT compliance and doesn't have to perform AXT field measurements. This is the safest, easiest and fastest option for installers.

If a manufacturer can't supply a certificate, AXT has to be measured in the field by the installer. The applicable field test standard is Class E_A, according to ISO 11801. Due to the theoretical amount of testing necessary to certify a complete installation, standards only call for sample testing. The installer has to choose a number of short, medium and long cables as so called 'disturbed' cables. After selecting the 'disturbed' cables, the user has to select for every 'disturbed' cable a number of 'disturbers', means cables that potentially can interfere with the 'disturbed' cable. The biggest difficulty in AXT testing is sample selection. Since only a few percent of the complete installation will be tested, the selection of samples is very subjective. Therefore, AXT tests may produce different results depending on the samples selected."

...and beyond 10G?

40GBaseT is currently in discussion in IEEE, ISO and TIA. So nothing is really defined yet but one thing's for sure… 40G will be much more difficult for the cabling system than 10G.

Weighing up the different parameters



The complexity of coding is related to bandwidth - higher frequencies would allow less complex coding which could reduce the chip costs. But higher frequencies would mean higher attenuation. Attenuation on the other hand is related to **reach** (length). The higher the cable attenuation is, the shorter the link length would need to be to offset this, and/or the higher the power for the signal has to be. This means that length is directly linked with energy costs. As the majority of data centers are well below 100m, new standards for 40G cabling will be at a reduced maximum reach. Much research is underway to examine these relationships between reach and performance but it is inevitable shielded cable will be the system of choice.

Conclusion

Shielded cabling does offer a couple of benefits compared to U/UTP. The cable shield offers not only some additional mechanical stability but also a reliable protection against unwanted signals (EMC). Without doubt a shield is the best way to avoid Alien Crosstalk problems in 10G networks. And even beyond 10G shielded Cat.7_A solutions seem to be the best choice for higher speed applications.

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