

# White Paper

## Category 6, 6<sub>A</sub> and Category 7<sub>A</sub> (ISO Class Fa) – A Comparison.



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### Overview

Structured cabling has evolved over a number of years since its inception in the mid to late 1980's.

Over the period the popular standards prevalent in the market were:

EIA/TIA Category 5e (ISO Class D)

EIA/TIA Category 6 (ISO Class E)

However, due to increasing demand for bandwidth, new standards have been developed over the last few years to provide a future-proof solution to growing needs of the LAN.

Hence the IEEE released 802.3an the 10GBase-T standard in April 2006, this was intended to use Category 6 Augmented, in simple terms this became widely known as Category 6<sub>A</sub> or ISO Class Ea. The requirement of the systems was to offer 10Gb/s speeds at a frequency up to 500MHz. This increase in throughput was achieved using a combination of the higher performing cabling system along with new and improved encoding techniques.

### Category 6

Typically an Unscreened solution (although some countries insist on a Screened version), Category 6 was introduced to anticipate the requirement for more bandwidth than 1Gbs networks. Application Switches were now able to allocate Quality of Services Policies (QoS) to enable users to run some applications faster than others. These applications were typically Video Applications (Video Conferencing over IP) and large image files (CAD drawings). Therefore this increase in frequency to 250MHz (two and a half times that compared with Category 5e which operates at 100MHz) would assist in this however what wasn't anticipated was the fact that the IEEE changed/improved the Ethernet encoding technique, which allowed 10 times the bandwidth for a 5 fold increase in frequency from 100Mhz to 500Mhz.

Category 6 is still only capable of providing 1Gbs Ethernet, so the bandwidth is the same as Category 5e however it does have a number of features that provide a tangible benefit over Category 5e.

With the proliferation of Power over Ethernet (PoE) tests have shown a significant benefit regarding the heating characteristics and the ability of a Category 6 cable to be less impacted by the increase in Attenuation (reduction in signal) due to heating up when carrying power as well as data. All forecasts suggest that the PoE market is not only going to keep on increasing in size the level of power deployed will also increase.

### Category 6<sub>A</sub>

The first Category 6<sub>A</sub> solutions were based around both Unscreened solutions, as well Screened but in recent times the preferred solution has become a Screened system. This is mainly due to concerns over interference both from other data cables as well as external sources better known as Alien Crosstalk (ANEXT) at the new higher frequencies now used.

Category 6<sub>A</sub> is designed to perform at a frequency of 500MHz, twice the range of Category 6 and 5 times that of Category 5e. This high frequency operation can leave the cabling susceptible to external interference from local EMI and RFI signals, unfortunately the Transceivers involved cannot cancel out this interference from external sources and it must be done in the cabling. This interference can be minimised with improved installation techniques and the design of the components for an Unscreened solution, hence the Standards state they 'may' be compliant by design. However the client is still within their rights to have that confirmed by Alien Crosstalk testing

A Screened solution on the other hand is not seen to be susceptible at all to any external interference affecting performance, therefore all Standards agree Alien Crosstalk testing is 'Not Required' and on this basis Screened solution are now becoming the system of choice for most end users.

### Connectors

The Category 6<sub>A</sub> solution offered by all manufacturers is still based around the RJ45 connector, offering full backwards compatibility from switch connections in the Data Centre through to the outlet at a workstation. Standards compliant Category 6<sub>A</sub> RJ45 Patch Cords are produced by the manufacturers for the Category 6<sub>A</sub> systems.

## Frequency Capabilities

Category 6<sub>A</sub>/ISO Ea is designed to operate up to 500MHz, the current standard for 10Gbps Ethernet transmission. Multiple Applications are also supported, including VOIP Telephony, IP Security (CCTV, Door Entry Systems, Alarms and Environmental Controls)

Modern construction methods of Category 6<sub>A</sub> Screened solutions have reduced the Excel Category 6<sub>A</sub> U/FTP cable diameter by over 14% to 6.7mm – just 0.5mm bigger than Category 6 U/UTP. This has seen the use of U/FTP solutions increase significantly for 10Gbps requirements, but also the increase the overall cable size and the use of a screen has future-proofing capabilities for future PoE (Power over Ethernet) developments.

## ISO Class Fa (Category 7<sub>A</sub>)

ISO Class Fa systems are constructed using Category 7<sub>A</sub> components however no EIA/TIA Standard exists for systems (Channels & Links). The ISO Class F Category 7 market is dominant in central European countries due to the long history of using Screened systems for the implementation of 'Sheath Sharing' which is no longer allowed by the standards but used to be prevalent for 10/100 systems that only required 2 pairs.

## Multiple Proprietary Connectors

The ISO Class FA standard is also unique in that it does not state a specific type of connector for the system. This has resulted

## Frequency Capabilities

The frequency range of ISO FA systems is 1000-1200MHz, and no applications are designed to run at this frequency. The original design of ISO Class F was a 350MHz operational frequency, with future-proofing headroom to 600MHz. This was seen as a great advantage in the mid 1990's but new cabling technology has superseded this capability using traditional RJ45-based solutions.

The only data application that can currently be supported over and above 500MHz is Fibre Channel (FC) which would require the higher performing ISO FA (Cat 7) at 600MHz, but this restricted to the lower speed FC and is now negated by the wide deployment of higher speed Fibre Channel systems requiring Fibre connectivity.

One other application currently using a frequency over and above 500MHz is Analogue CCTV at 862MHz, therefore requiring the higher performing ISO FA (Cat 7<sub>A</sub>) at 1000MHz, but this is also now rapidly shrinking due to the advent of IP CCTV systems which are capable of Megapixel quality images over standard LAN cabling. It is not anticipated that any new build projects will employ an analogue CCTV system, and so Category 6<sub>A</sub> will be the most viable cost effective solution for all applications of High Speed LAN, VOIP Telephony, and IP Security systems, given its capabilities at higher levels of PoE being planned.

## Cabling Bandwidth Overview

Standard	Type	Frequency	Length	LAN Applications	Notes
Cat 5e/ ISO Class D	U/UTP, F/UTP	100MHz	100m	100Mbps, 1Gbps	General LAN use
Cat 6/ ISO Class E	U/UTP, F/UTP	250MHz	100m	100Mbps, 1Gbps	General LAN use
ISO Class Ea Cat 6 <sub>A</sub>	U/UTP, U/FTP, F/FTP	500MHz	100m	100Mbps, 1Gbps, 10Gbps	High Speed LAN use
ISO Class F/ Cat 7	S/FTP	600MHz	100m	10Gbps	High Speed LAN use Fibre Channel
ISO Class Fa Cat 7 <sub>A</sub>	S/FTP	1000-1200MHz	100m	10Gbps	High Speed LAN use Fibre Channel

in two FA connectors being produced and accepted, including the TERA connector and the GG45 connector. These connectors are all proprietary to their own systems and are typically 30-40% more expensive than RJ45 based solutions, whilst these connectors are available to licence by other manufacturers other than the patent holders the terms involved are very restrictive which will limit their deployment.

## Custom Patching Equipment

Special custom patch cords will also be required to convert the ISO FA connector to a traditional RJ45 connector for switch connection. These are also typically 30-40% more expensive. However this will bring the performance of the overall system back to the 'lowest common denominator' there if the RJ45 is of Category 6<sub>A</sub> performance then the whole system will be limited to that.

"With the proliferation of Power over Ethernet (PoE) tests have shown a significant benefit regarding the heating characteristics and the ability of a Category 6 cable to be less impacted by the increase in Attenuation (reduction in signal) due to heating up when carrying power as well as data. All forecasts suggest that the PoE market is not only going to keep on increasing in size the level of power deployed will also increase."

## Future High Frequency Requirements

### Data Centre Applications

With the announcement of the NGBase-T working group by the IEEE it set out a series of requirements for the future, the first announcement was to try 40Gbps over Copper using an RJ45 'Style' connector (not any of the proprietary connectors that had been approved for Category 7<sub>A</sub>) the transmission distances required would be 25-30m Channels to support 'Top of Rack/End of Row' topologies within the Data Centre.

This work whilst started in 2013 still has some way to go however the Cabling Task Group suggested that a Category 8 screened cable supporting 2000Mhz would be required,

ISO are working on a interim solution using a 1600Mhz cable and either TERA or GG45 connectivity at a further reduced distance of possibly as short as 15m.

### 10 Gbs Hardware Manufacturers

It is not anticipated that switching hardware manufacturers will be making proprietary switching equipment for each of these aforementioned 7<sub>A</sub> connectors, and so the RJ45 interface remains the accepted connector for its copper 10Gbps interface. The only anticipated change will be in the fibre backbone where multi channel fibre connectors (MTP) are used for 40Gbps and 100Gbps backbone connections between switching equipment.

## Cable Performance Summary

Category	5e		6		6 <sub>A</sub>			7	7 <sub>A</sub>
	U/UTP	F/UTP	U/UTP	F/UTP	U/UTP	U/FTP	F/FTP	S/FTP	S/FTP
Construction	U/UTP	F/UTP	U/UTP	F/UTP	U/UTP	U/FTP	F/FTP	S/FTP	S/FTP
Bandwidth	★★★★	★★★★	★★★★	★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Headroom*	★	★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
PoE Performance	★	★★	★★	★★★★★	★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Alien Crosstalk	★	★★★★	★★	★★★★	★★★★	★★★★★	★★★★★	★★★★★	★★★★★
EMI/RFI Immunity	★	★★★★	★★	★★★★	★★	★★★★	★★★★★	★★★★★	★★★★★

Note: Headroom is the additional margin expected at the maximum bandwidth of the previous Category

i.e. 1Gbps using Category 6 rather than Category 5e

Legend: all values are marked between 1 to 5 with 5 being the highest value

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