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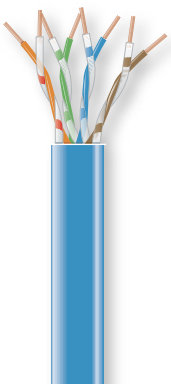
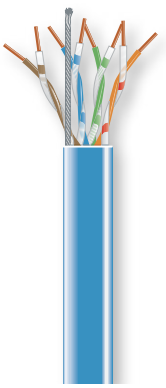
NETWORK SERVICES

CAT 6A F/UTP vs. UTP: What You Need to Know

Using CAT 6A in 10-GbE networks





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The standards

Any discussion of Augmented CAT6 (CAT 6A) requires a background briefing on the 10GBASE-T and CAT 6A standards.

The IEEE released the 802.3an 10GBASE-T standard in June 2006. This standard specifies 10-Gbps data transmission over four-pair copper cabling. 10-Gigabit Ethernet (10-GbE) transmission includes up to 37 metres of CAT6 cable (with installation mitigation techniques), 100 metres of Augmented Category 6 (CAT 6A) UTP or F/UTP cable or 100 metres of S/FTP CAT7/Class F cable.

CAT 6A is the ANSI/TIA 10-Gigabit Ethernet (10-GbE) over copper standard. Its requirements are covered in ANSI/TIA-568-C.2 (Balanced Twisted-Pair Communications Cabling and Components Standard) published in August 2009. It defines 10-Gigabit data transmission over a 4-connector twisted-pair CAT 6A copper cable for a distance of 100 metres. This ensures that the system is ready to support IEEE 802.3an, the IEEE standard for 10GBASE-T, which specifies using Class E-augmented cable.

Category 6A cabling is designed to support next-generation applications, including the transfer of large amounts of data at high speeds, up to 10 Gbps. CAT 6A extends electrical specifications to 500 MHz from 250 MHz for CAT6 cabling. CAT 6A cables are fully backward compatible with previous categories, including CAT6 and 5e. Category 6A is also designed to support bundled cable installations up to 100 metres and PoE+ low-power implementations. The standard includes the performance parameter, Alien Crosstalk (ANEXT). Because of its higher performance transmission speeds and higher MHz rating, CAT 6A cable needs to be tested for external noise outside the cable, which wasn't a concern with previous cabling categories. CAT 6A UTP also has a much larger diameter than previous cables.

Shielded vs. unshielded: the background

As networks transitioned to twisted-pair Ethernet, unshielded twisted-pair cabling became the standard, especially in the United States. UTP cable has been and still is relatively inexpensive and easier to terminate and install (for the most part) than shielded cable, until CAT 6A. Shielded cable typically is also used only in noisy environments with a lot of EMI/RFI and in high-security type venues, such as finance, government, casinos, etc. Shielded cable is also favoured in many European nations.

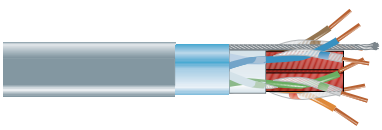
Alphabet soup: the acronyms

There are two types of CAT 6A cable: CAT 6A F/UTP and CAT 6A UTP. When comparing the two, it's important to define the acronyms. The ISO/IEC has designated that the first letters indicate the type of overall shield. The latter letters indicate the type of shielding on each pair and the balanced element.

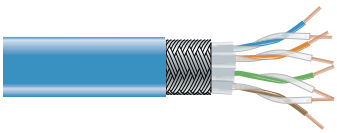
UTP means unshielded twisted pair. STP can mean any shielded twisted-pair cabling but traditionally refers to the older Type 1 Token Ring cabling. Most cabling installed in the U.S. is UTP, which consists of four unshielded twisted pairs.

F/UTP denotes foiled/unshielded twisted pairs, which consists of four unshielded twisted pairs encased in an overall foil shield. Other names for this type of cable are FTP (foiled twisted pair), ScTP (screened twisted pair), or S/UTP (screened/unshielded twisted pair). There is also an S/FTP (screened/foiled twisted pair) cable, normally a CAT7 cable, that has four individually shielded twisted pairs encased in an overall braided shield. This type of cable is more common here in Europe.

UTP: unshielded twisted pair



F/UTP: foiled/unshielded twisted pair (An overall foil shield over four unshielded twisted pairs. Shown with rip cord, Mylar ® sheath, and pair separator.)



S/FTP: shielded/foiled twisted pair (A braided shield over four individually foil-shielded twisted pairs)

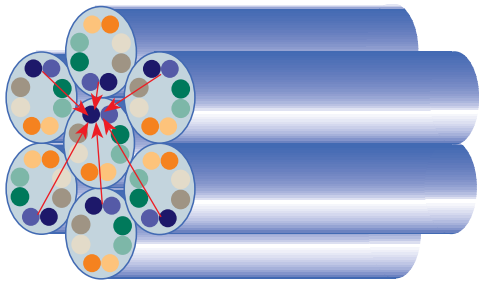
ANEXT

Before discussing CAT 6A cable in 10-GbE systems, a discussion of alien crosstalk (ANEXT) is needed, which is a critical and unique measurement in 10-GbE networks. Crosstalk, measured in 10/100/1000BASE-T systems, is the mixing of signals between wire pairs within a cable. Alien Crosstalk, in 10-GbE systems, is the measurement of the unwanted signal coupling between wire pairs in different and adjacent cables or from one balanced twisted-pair component, channel, or permanent link to another.

The amount of ANEXT depends on a number of factors, including the type of cable, cable jacket, cable length, cable twist density, proximity of adjacent cables and connectors, and EMI. Patch panels and connecting hardware are also affected by ANEXT.

Typically in a laboratory, measuring alien crosstalk is based on cables in a "six-around-one" configuration. The central or affected cable is called the victim cable, and the surrounding, adjacent cables are the disturber cables. This test configuration bundle presents a worst-case scenario, and the centre cable would be adversely affected by ANEXT. A total of seven equal length links are connected to each other at previously defined distances. Every pair is measured against the other so there are 96 individual measurements.

This illustrates a six-around-one configuration with a victim cable. Alien Crosstalk measures the crosstalk induced in a wire pair in the victim cable by wire pairs in adjacent disturber cables.



10-GbE

CAT 6A is currently the cable of choice for future-proofing cabling installations. You will typically replace your electronic equipment three to five times during the lifespan of one cabling system, which can be as long as 15–20 years. So cabling deployed today will need to support at least two generations of Ethernet. As technology advances, it is estimated that the 10-GbE standard will be widely deployed by 2013. That's why you should consider getting the best cabling you can—CAT 6A minimum. It has been extensively tested and has been proven to support 10-GbE systems with plenty of headroom. CAT6 may support 10-GbE in links less than 37 metres, such as in a data centre. But it is not likely to be able to support it 100 metres to the desktop because of ANEXT and other modifications in the cable.

10-GbE and CAT 6A UTP

CAT 6A UTP is constructed in a certain way to help minimise crosstalk and ANEXT. This includes larger conductors, (23 AWG minimum), tighter twists, an extra internal airspace, an internal separator between the pairs, and a thicker outer jacket. These features typically increase the outer diameter of the cable. CAT 6A UTP cable can have diameters up to 0.35 inches, up from 0.25 inches for CAT6 UTP cable. This increased diameter creates a greater distance between pairs in adjacent links, thus reducing the between-channel signal coupling. But CAT 6A UTP is still affected by ANEXT.

According to the standards, ANEXT can be improved by laying CAT 6A UTP cable loosely in pathways and raceways with space between the cables. This contrasts to the tightly bundled runs of CAT6/5e cable we are used to. The tight bundles present a worst-case scenario of six cables around one, thus the centre cable would be adversely affected by ANEXT. CAT 6A UTP also needs to be tested for ANEXT. This is a complex and time-consuming process where all possible wire-pair combinations need to be tested for ANEXT and far-end ANEXT. It can take up to 50 minutes to test one link in a bundle of 24 CAT 6A UTP cables.

10-GbE and CAT 6A F/UTP

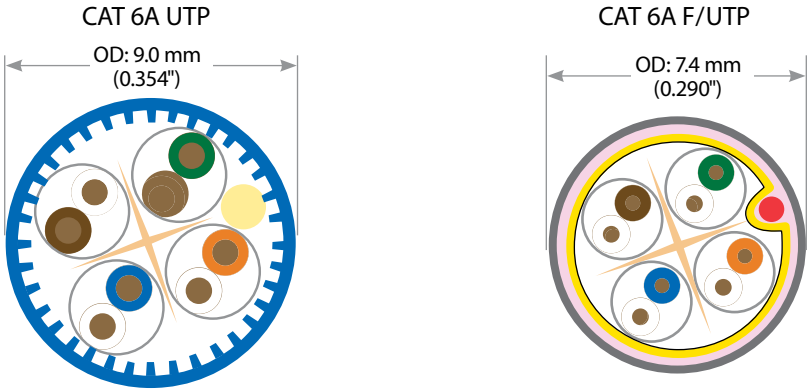
ANEXT and the time needed to test for it can be greatly reduced, if not eliminated completely, by using shielded cables and equipment to isolate adjacent cables from each other. Studies have shown that CAT 6A F/UTP cable does a much better job of eliminating ANEXT than CAT 6A UTP and thus provides significantly more headroom (as much as 20 dB) for 10-GbE over copper. The foil shield acts as a barrier preventing EMI/RFI from coupling onto the twisted pairs from other adjacent cables. In effect, it reflects the noise from machinery, lights, motors, and other sources of EMI, as well as RFI from cell phones, wireless access points, and radios. In addition, the foil shield prevents data signals from leaking out of the cable, making the cable more difficult to tap and better for secure installations.

CAT 6A UTP vs. F/UTP: Bigger isn't always better

The rule of thumb has always been that unshielded cable has a smaller outside diameter and is easier to install than shielded cable. This doesn't hold true with CAT 6A UTP, which can actually present more challenges to the installer.

CAT 6A UTP cable has a larger outside diameter than CAT 6A F/UTP cable. CAT 6A UTP cable has an overall allowable diameter of 0.354". CAT 6A F/UTP cable has an average outside diameter of 0.265"–0.30". That's smaller than the smallest CAT 6A UTP cable. While the difference may seem minute, it creates a great difference in the fill rate of cabling pathways and spaces. An increase in the outside diameter (O.D.) of 0.1", from 0.25" to 0.35" for example, represents a 21% increase in fill volume. In general, CAT 6A F/UTP cable provides a minimum of 35% more fill capacity that CAT 6A UTP cable.

Another by-product of using CAT 6A UTP cable is the reduced density of patch panel connections. This can actually increase costs by requiring more equipment, more pathways, much more careful cable installation, and lengthy testing procedures because of ANEXT.



Fill Capacity (Number of Cables)

Conduit Trade Size	Fill*	CAT 6A UTP 9.0 mm (0.354") O.D.	CAT 6A F/UTP 7.4 mm (.290") O.D.
53 mm (2")	40%	13	20
	60%	20	30
78 mm (3")	40%	30	45
	60%	45	66
103 mm (4")	40%	51	80
	60%	78	116

*40% is the fill ratio recommended for initial runs to allow for growth. 60% is the maximum fill ratio.

While shielded cable has always had the reputation of being bigger, bulkier, and more difficult to handle and install, this is not the case with CAT 6A F/UTP cable. It is actually easier to handle, requires less space to maintain proper bend radius, and uses smaller conduits, cable trays, and pathways. In addition, innovations in connector technology have made terminating CAT 6A F/UTP cable actually easier than terminating bulkier CAT 6A UTP cable. With F/UTP cable, the shield should completely surround the cable along its entire length, and should remain continuous for the entire channel. This can be accomplished by using shielded products in the channel from the patch panel to the jack. For grounding, the requirements for both F/UTP and UTP cable fall under TIA/EIA J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

The advantages of CAT 6A F/UTP vs. UTP

In summary, there are a number of advantages of using CAT 6A F/UTP over CAT 6A UTP in 10-GbE networks:

1. Shielding eliminates ANEXT and EMI/RFI problems and testing.
2. Data line security is enhanced because of shielding.
3. Lighter, slimmer cable provides higher port density.
4. Smaller outside diameter cable is easier to handle and reduces installation costs.
5. Shielded cable uses less space in conduits.