10G – UTP versus FTP and S/FTP

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IEEE has ratified draft 3 of the 10GBASE-T standard. This allows chip makers to move forward with copper components supporting 10 gigabit transmissions over copper connections. Although much buzz exists around this standard as the UTP standard, there are actually shielded cabling components within the standard. The standard refers to ISO category 7/class F, augmented category 6 (category 6A), and up to 55 meters on category 6 with some alien cross talk mitigation.

Sorry folks, more alphabet soup, but this time, for cabling. UTP (unshielded twisted pair) is the most common type of cabling installed throughout the world. One issue that has arisen out of this standard is that we may have maxed out performance on unshielded cabling systems. At higher frequencies, alien cross talk is an issue. Alien cross talk is cable-to-cable noise on like pairs with similar twist rates. This goes away with a shielded cabling system as the shield acts as a barrier to emitted noise and a barrier to received noise. Category 7/class F cabling utilizes S/FTP (screened foiled twisted pairs). Each individual pair has a shield and there is an overall braid shield surrounding the cabling.

In other parts of the world, shielded systems are very common. AT&T introduced unshielded systems years ago in answer to the old IBM Type 1 cabling. All you needed was a balun and now your shielded system could run on unshielded cable. Shielded systems were typically installed in areas where noise is a factor (factory floors, etc) and in the countries that use them either by code or preference such as France and Germany. However, due to alien crosstalk, UTP systems are proving to be more limited in speed increases than their shielded counterparts.

In IEEE, the chip makers determine a cable's abilities on Shannon Capacity. Shannon capacity is basically the ability of a cable to carry data current which goes down as noise increases. Alien crosstalk is this type of noise. The modeling presented shows that category 6 UTP has a Shannon capacity of around 9 gigabits. In order to carry a 1 gigabit data signal, a cable must have a 5 gigabit Shannon capacity. In order to carry a 10 gigabit data signal, the cable needs 16-18 gigabits of Shannon capacity. Obviously, at 9 gigabits, a full 100m channel of category 6 will not be sufficient. As the standard is written today, a category 6 channel will be limited to roughly 55m with some form of mitigation (method to lessen the alien cross-talk). This can include things like unbundling cables, using shielded patch cords, only energizing every other port to 10G, etc.

If we add a screen to this system (FTP), which is an overall foil shield, the Shannon capacity jumps to about 28 gigabits of Shannon capacity. This is enough for 10 gigabit and more. If we move to category 7/class F cabling and connectivity, we get to almost 50 gigabits of Shannon capacity. This is enough for not only 10 gigabit transmission, but also a 40 gigabit communication.

Due to bias towards unshielded systems, a new category 6A system has been developed. The biggest difference in this system is the cabling diameter. The standard has been increased to allow this cable to have an overall diameter of up to .354 (compared to .250 for category 6). This can mean significantly higher construction costs due to larger conduits, increased pathways and spaces. The diameter for a shielded category 6A cable is roughly .265, while category 7 class F is .330. The latter two are both smaller than the new 6A standard.

Another interesting point is in a recent call for interest at IEEE, there was a wish to create a chip that would carry a 10G signal farther than 10GBASE-CX4 (which is limited to 15m) with significantly lower power consumption, but would be designed for field terminatable shielded systems. Currently 10GBASE-CX4 runs over twinax. While this was voted down, in large part due to the number of companies developing chips for unshielded systems, I would venture to say the development has not stopped. The first chip maker that can come up with a chip for blade

servers and storage devices that requires 1/3 of the power that 10GBASE-T chips require will be a rich one in a hurry.

If noise does not have to be cancelled in the electronics, then the chips are much less complex and certainly consume less power. In a data center, day two costs for power and cooling are a major expense. The ASHRAE guidelines state that for every KW of power, an equal thermal unit of cooling is required. If these costs were cut by 1/3 imaging the smiling faces at the end of budget season! Cabling is typically only about 5-7% of overall networking costs. If this 5-7% could save 33% of the operating budget that is an ROI that is hard to beat!

Watch for news on these chips. I would venture to say that you will see them in storage solutions first, blade servers next and then who knows. I think there will be a division in the industry between shielded and unshielded systems and certainly products for both preferences. But in the data center market, where many cables are used, the less noise in the cable plant the better. With grounding and bonding a science, the issues with previous iterations of shielded systems are gone and the door is open to a hearty lower cost operation. I say bring it on!