

SYSTIMAX® Solutions

Category 6A UTP Cabling Passes EMC Tests Verifies Robustness of UTP for 10GBASE-T Support

White Paper
October 2010

IT users around the world are accelerating their migration from 1 Gigabit Ethernet networks to 10 Gigabit Ethernet networks. According to the market research firm IDC, shipments of 10 Gigabit Ethernet ports exceeded 1 million ports in the 2nd quarter of 2010.

Looking at the different options available to support 10 Gigabit Ethernet, 10GBASE-T has emerged as the technology of choice for many. A May 2010 IT Brand Pulse survey indicated that approximately 50% of IT professionals said they would prefer to connect their 10 Gigabit adapters with 10GBASE-T.

Approximately 90+% of these new 10GBASE-T installations feature cost effective, easy-to-use Unshielded Twisted Pair (UTP) copper cabling infrastructure. At CommScope, we have supplied IT users with millions of 10GBASE-T capable UTP channels since the introduction of the GigaSPEED X10D® UTP Solution in 2004. With each of these channels backed by CommScope's 20 Year Extended Product Warranty and Applications Assurance, customers are assured that their 10GBASE-T applications will work as intended.

With the ratification of the IEEE 802.3an 10GBASE-T standard, once again attention has been drawn to the relative merits of unshielded and shielded cabling systems. While both are fully capable of supporting 10GBASE-T applications and are included in the IEEE and the ISO/IEC 11801 cabling standards, doubt has been cast once again regarding the capabilities of unshielded cabling systems to support an emerging application. History is once again repeating itself, and while yesterday there were doubts about the ability of UTP to support 16 Mb/s, today doubts are being cast about the ability of UTP to support 10GBASE-T.

CommScope Labs' Systems Engineering Group (SEG) works independently and in concert with other IT industry leaders to provide ongoing system and applications testing to verify product and application performance. CommScope Labs' SEG recently commissioned a series of studies associated with 10GBASE-T applications over Category 6A UTP cabling. The results from each of these studies clearly indicate that Category 6A UTP, like CommScope's GigaSPEED X10D® UTP Solution, is fully capable of supporting 10GBASE-T in a variety of "noisy" environments.



Test:

Electromagnetic Compatibility (EMC) Tests for 10GBASE-T with SYSTIMAX® GigaSPEED X10D® UTP Cabling at an independent EMC Laboratory.

Summary:

CommScope SEG worked with National Technical Systems (NTS), an independent industry-leading provider of EMC engineering and compliance testing services, to put CommScope's GigaSPEED X10D® UTP cabling infrastructure to the test. A total of five EMC tests were conducted including Radiated Emissions, Electrostatic Discharge (ESD) Immunity, Radiated Immunity, Electrical Fast Transient (EFT)/Burst Immunity, and Conducted Immunity. While delivering maximum sustainable throughput, GigaSPEED X10D UTP cabling infrastructure passed all the EMC tests performed, a clear indication that Category 6A UTP provides a robust medium for 10GBASE-T transmission.

ELECTROMAGNETIC COMPATIBILITY (EMC) TEST RESULTS

For 10Gb/s IEEE 802.3an 10GBASE-T with GigaSPEED X10D® UTP		
Tests	Limits	Results
Radiated Emissions IEC CISPR 22, EN 55022	Class A 30 MHz to 1 GHz	Pass
ESD Immunity IEC 61000-4-2	Contact Discharge: 4 kV Air Discharge: 8 kV	Pass
Radiated Immunity IEC 61000-4-3	3 V/m 30 MHz to 1 GHz	Pass
EFT/Burst Immunity IEC 61000-4-4 Signal/Control Lines	500 V	Pass
Conducted Immunity IEC 61000-4-6	3 Vrms 0.15 MHz to 80 MHz	Pass

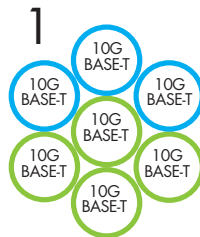
The EMC testing was performed at NTS Laboratory in March 2010. NTS is a fully TUV and ISO/IEC 17025 accredited independent EMC laboratory.

Test:

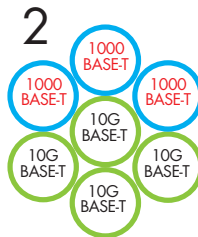
Mixed High-Speed Ethernet Operations over Different Categories of Bundled UTP Cabling.

Summary:

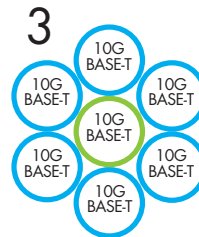
CommScope worked with the Ethernet Alliance (EA) to test the effects of Alien Crosstalk on Category 6A UTP and Category 6 UTP installed in close proximity, exemplified by being in the same structured bundle. There are many possible combinations of mixed-speed Ethernet running over different categories of bundled UTP copper cabling. The four worst case scenarios identified for testing are shown below. The "six-around-one" configuration is utilized with six "Disturber" cabling channels bundled around one "Victim" cabling channel. The Bit Error Ratio (BER) test is conducted on the Victim cabling channel while active traffic is running over the six Disturber channels. The Bit Error Rate (BER) is the ratio of bits received with error to the total number of bits transmitted. All IEEE 10G Ethernet PMD standards including 10GBASE-T specifies the same 10⁻¹² BER. The BER test is a "Pass" when the BER is either zero or less than 10⁻¹² for a statistically acceptable period of time. The following summarizes the BER test results, cabling categories, and Ethernet speeds for each scenario.



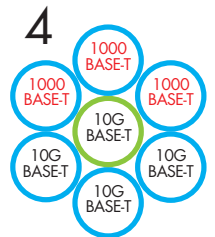
19 hrs 44 mins
BER = 0 (zero)



17 hrs 33 mins
BER = 0 (zero)



18 hrs 29 mins
BER = 0 (zero)



8 hrs 35 mins
BER = 0 (zero)



Based on BER tests, no issues were found when mixing high-speed Ethernet operations including 10 Gigabit Ethernet and 1 Gigabit Ethernet over different categories of bundled UTP cabling, another clear indication that Category 6A UTP provides a fully capable medium for 10GBASE-T transmission.

Test:

1st and 2nd Generation 10GBASE-T Network Interface Cards (NICs) Tested in Real World EMC Environments.


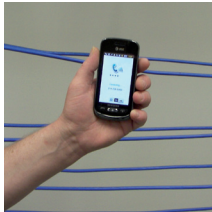
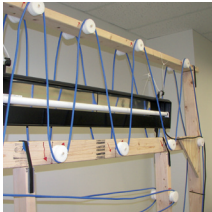
Summary:

CommScope SEG recently put first and second generation 10GBASE-T cards to the test in a variety of real world, worst-case EMI situations utilizing walkie-talkies, cell phones, fluorescent lighting, and power cables.

The first two tests utilize a walkie-talkie whose operating frequency at 147.5 MHz is within the bandwidth of 10GBASE-T. The UTP cabling is placed in a specific setup that has been proposed by ISO/IEC JTC1/SC25 WG3, and then is connected to 10GBASE-T cards installed in servers. The walkie-talkie is activated repeatedly within one meter of the cable. Testing is conducted to determine packet loss when the walkie-talkie is activated. Upon testing a first generation 10GBASE-T card, the test results show a 48% loss in the received packets. Testing of a second generation 10GBASE-T card with the walkie-talkie indicates there are no packets lost.

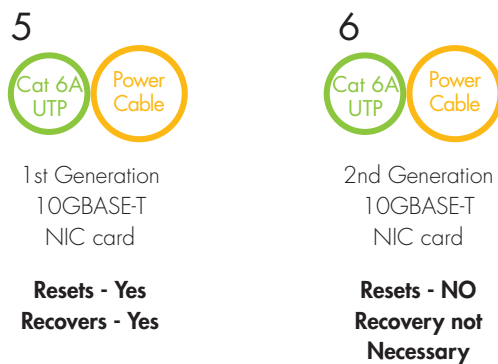
To determine if these 2nd generation cards are affected by other possible external noise sources, a third test was performed using a cellular phone. The cell phone test was performed using a GSM cellular phone at frequencies of 850/900 MHz. Again, there are no packets lost when making calls on the cell phone.

The fourth test included the 2nd generation cards and utilized a fluorescent light fixture placed in the middle of the UTP cabling. To ensure that the disturbance is "worst-case", the light's power cable is tie-wrapped to the UTP cable. As in the previous tests, there are no packets lost with the 2nd generation 10GBASE-T cards.

1	2	3	4
			
1st Generation 10GBASE-T NIC card	2nd Generation 10GBASE-T NIC card	2nd Generation 10GBASE-T NIC card	2nd Generation 10GBASE-T NIC card
Packet Loss 48%	Packet Loss 0% (zero)	Packet Loss 0% (zero)	Packet Loss 0% (zero)

The 2nd generation cards perform flawlessly over GigaSPEED X10D UTP (Category 6A) cabling infrastructure.

In the fifth and sixth tests, to simulate real world transients on power cables, an Electrical Fast Transient (EFT) study was conducted by sending high voltage bursts down a power cable along with the normal AC voltage. In the tests, the Category 6A UTP cable is again tie-wrapped to the power cable and the EFT burst output is set to 2 kV. Once again, we compared the performance of 1st and 2nd Generation 10GBASE-T NICs. The Category 6A UTP cabling is connected to two 10GBASE-T NICs placed in servers. The test was designed to determine if a reset occurs due to the EFT signal. During the test a 3.8 MB file was continually transferred between servers. The test was run for at least 60 seconds, and was repeated several times.



Electrical Fast Transient Test Conditions:

- Burst voltage ± 2000 V
- Burst Frequency 5 kHz
- Burst Period 300 ms
- Burst Duration 1.5 ms
- Spike rise time 5ns $\pm 30\%$
- Spike width 50 ns $\pm 30\%$
- Source Impedance 50 ohms $\pm 20\%$

When the EFT signal is applied, 1st generation 10GBASE-T NICs reset but recover without operator intervention. The 2nd generation NICs do not reset even at the maximum applied 2kV EFT voltage. These results indicate that 2nd generation 10GBASE-T NICs perform much better than 1st generation NICs and can be designed to withstand larger EFT signals. CommScope SEG has provided these EFT test results to TIA.

CommScope believes that 1st generation 10GBASE-T NICs are suitable for use in typical Data Center and Office environments, even though initial tests with 1st generation NICs in “noisy” environments may have helped rekindle the unshielded vs shielded debate. The excellent results obtained with the 2nd generation NICs offer further confirmation of the suitability of Category 6A UTP to support 10GBASE-T.

Summary

As new technologies are brought to bear, inevitably there are those that will attempt to cast undue doubt on their performance; a pattern has repeated itself many times over the course of recent history of networking.

The results achieved in the NTS study, the Ethernet Alliance study and the CommScope SEG study with 2nd generation 10GBASE-T NICs in intentionally "noisy" conditions provide a clear indication that Category 6A UTP provides a fully capable medium for 10GBASE-T transmission. This series of studies also validates the statements that 10GBASE-T equipment vendors have made in their product specifications; namely that their systems are designed to operate over Cat6A UTP cabling to the full 100 meters, and that their systems comply to the applicable EMC requirements.

While IT users have many cabling infrastructure options, a Category 6A UTP cabling infrastructure is now, and will continue to be, a preferred choice for high speed applications to include 10 Gigabit Ethernet.



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