Achieving Reliable 10GBASE-T Performance

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Introduction

In a densely cabled environment, such as a data center, the performance of 10GBASE-T links can be negatively impacted by the unwanted signal coupling from adjacent links. This unwanted coupling, known as alien crosstalk, can cause network performance problems when category 6A cabling is not utilized, even at relatively short lengths of 50 meters or less. Unlike category 6 cable, category 6A cabling is required by industry standards to limit the effects of alien crosstalk and therefore provides robust 10GBASE-T performance in data center environments.

Investigation

In order to assess the effects of alien crosstalk on 10GBASE-T performance in data center environments, the Data Communications Competence Center performed application testing using Berk-Tek's LANmark™-10G2 CMP category 6A cable, a competitor's category 6 cable and a commercially available 10GBASE-T capable switch. Cables, connectors and patch cords were then used to create 30-meter category 6A and category 6 channels with two connectors. The horizontal cables were 28-meters long and the patch cords were 1-meter in length. This configuration was chosen since it is a common configuration found in data centers.

Two types of application tests were performed on the channels. The first application test was frame error rate testing (FER). During this test, Ethernet frames were transmitted across the channels at full wire rate and the number of erred frames recorded.

The second application test measured the goodput of the network. Goodput is a metric described in Request for Comment (RFC) 2647 published by the Internet Engineering Task Force (IETF) in 1999. It is the number of correctly transmitted bits delivered, within a timeframe, to an application such as Hypertext Transfer Protocol (HTTP) or File Transfer Protocol (FTP). Goodput quantifies the quality of network performance, providing a measurement of how efficiently applications will run across the network. It takes into account any additional time caused by erred packets having to be retransmitted. It does not count packet overhead such as MAC addresses, IP addresses, etc. **Figure 1** below shows the generalized components of an Ethernet packet carrying TCP/IP traffic and the portions counted in FER and goodput tests.

The IP traffic sent during the goodput test was designed to mimic real world network usage with periods of inactivity dispersed throughout and represented the types of patterns present on many data center and enterprise network links. For this test of moderately utilized links, the maximum achievable goodput is 1.7 Gbps. Links with higher utilization rates will suffer even more from errors caused by having less than category 6A performance.

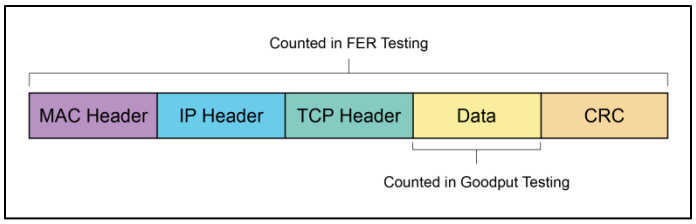

Figure 1: Ethernet Frame Components

Two different channel configurations were tested. A single channel of each category was used to validate the expected maximum 1.7Gbps goodput, followed by the simultaneous transmission of 10GBASE-T over six adjacent channels of the same category representing a typical data center bundle. The results of these tests can be found in tables 1 and 2 below.

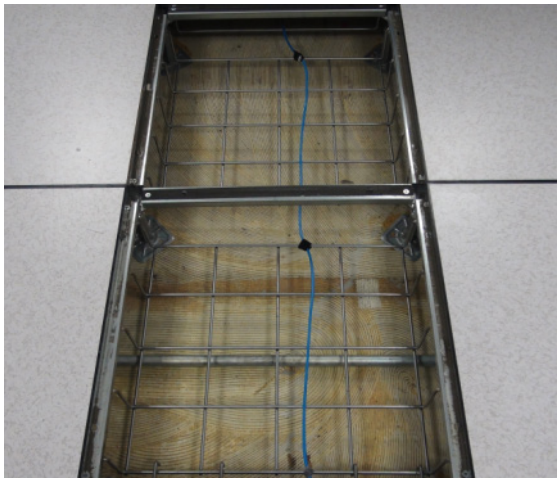

Figure 2: Single 30-Meter Channel Example

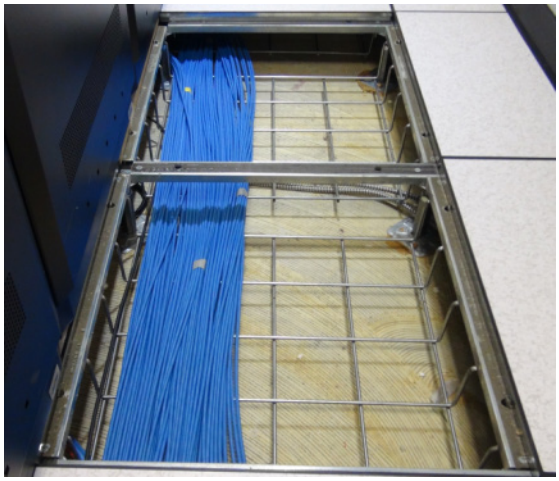

Figure 3: Multiple 30-Meter Channel Example

	10GBASE-T Performance	
	Frame Errors	Goodput (Gbps)
Category 6A	0	1.7
Category 6	0	1.7

Table 1: Single Channel Test Results

	10GBASE-T Performance	
	Frame Errors	Goodput (Gbps)
Category 6A	0	1.7
Category 6	17,819,581,494	0

Table 2: Multiple Channel Test Results

Conclusion

Data centers execute transactions worth millions of dollars every second and support mission critical applications that determine the success or failure of businesses. The competitor's 30-meter category 6 solution was unable to support simultaneous 10GBASE-T applications over multiple adjacent channels, a scenario expected within a data center environment. The large number of frame errors and zero goodput listed in Table 2 indicate that the category 6 network link stopped functioning. Network performance degradation caused by alien crosstalk in category 6 cabling can result in large losses in revenue and significant labor spent by data center personnel troubleshooting a slow or crashed network.

The LANmark™-10G2 category 6A cabling was unaffected by the simultaneous transmission of 10GBASE-T over adjacent channels. This is clearly shown by the lack of errors in the frame error rate tests and by achieving the maximum goodput.

Specifying and installing category 6A cabling ensures robust network performance in densely cabled environments. Relying on anything else creates unnecessary risk.

Data Communications Competence Center

Nexans' Data Communications Competence Center, located at the Berk-Tek Headquarters in New Holland, Pennsylvania, focuses on advanced product design, applications and materials development for networking and data communication cabling solutions. The Advanced Design and Applications team uses state-of-the-art, proprietary testing and modeling tools to translate emerging network requirements into new cabling solutions. The Advanced Materials Development and Advanced Manufacturing Processes teams utilize sophisticated analytical capabilities that facilitate the design of superior materials and processes. The Standardization and Technology group analyzes leading edge and emerging technologies and coordinates data communication standardization efforts to continuously refine Nexans' Technology Roadmap. An international team of experts in the fields of cable, connectors, materials, networking, standards, communications and testing supports the competence center. The competence center laboratories are a part of an extensive global R&D network.