

## Largest Cat 6A Installation in Midwest Pushes Frontiers of Networking Technology

### At a Glance

**Customer:**

Terrance Electric and Technology Company for HSBC

**Industry:**

Banking/Finance

**Location:**

Mettawa, Illinois

**Challenge:**

As the world's largest banking group, HSBC required 10 Gb/s Ethernet for their new state-of-the-art headquarters in Mettawa, Illinois. In order to "futureproof" the installation, and working with a critical construction deadline, technicians needed a certification tool that complied with the new 10G-BASE-T standard and would work quickly enough to certify 40,000 links in two months.

**Solution:**

Fluke Networks DTX-1800 CableAnalyzer with 10G Solution Kit

**Results:**

As a complete solution, the DTX-1800 and 10G Kit, allowed technicians to quickly complete one of the largest Cat 6A installations in the world. Technicians were able to certify all 40,000 links in two months because of the streamlined AXTALK testing and defined procedures tailored to the new 10G-BASE-T specification.

### Overview

One of the largest 10 Gb/s Ethernet over twisted-pair copper cabling (10GBASE-T) installations was just completed. Every link was certified based on the Institute of Electrical and Electronic Engineers (IEEE) 802.3an standard and a significant sampling of links was tested for alien crosstalk (AXTALK). The cable installation provided various challenges, not the least of which was certifying each permanent link to the new Cat 6A standard and testing a representative sample to the demanding AXTALK specifications in that standard.

Terrance Electric and Technology Company, the primary installer for the project, used Fluke Networks' DTX-1800 CableAnalyzer and its accompanying 10 Gig Solution to perform certification on the project. Terrance provides electrical power control systems design, installation and maintenance, structured network cabling and telecommunications services. Each team of two Terrance Electric technicians tested 15 bundles in a single shift. Two two-person teams were able to test and certify all 40,000 links in two months. "The ability to streamline the critical AXTALK testing made it possible to complete three-quarters of the project in 12 weeks as required to synchronize the cabling installation with the construction schedule," said Randy Zezulka, RCDD, Project Manager for Terrance Electric.

The project was the new Mettawa, Illinois headquarters for HSBC North America which is a subsidiary of the HSBC Group, headquartered in London. The HSBC Group is one of the world's largest companies and the world's largest banking group, as calculated by the annual Forbes list of the world's largest firms published on April 2, 2008. HSBC North American comprises all of HSBC's U.S. and Canadian businesses, including the former Household International businesses. HSBC North America serves nearly 60 million customers in the areas of personal financial services, consumer finance, commercial banking, private banking and corporate investment banking.

### One of the world's largest Cat 6A installations

The HSBC facility was constructed with features that reduce energy consumption including abundant natural lighting and under-floor air conditioning. The building is Gold Certified under the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™. Construction began in spring 2006 and HSBC began occupying the facility in the first half of 2008. The building has one main distribution frame (MDF) with 23 intermediate distribution frames (IDFs) and. The IDFs are connected to the main distribution frame with redundant 12 strand laser enhanced fiber optic cabling, the only fiber used in the project.

The cabling installation supports 5,500 work areas, each with three links for phone, computer and auxiliary device, plus 1,600 specialty locations with two drops each for closed circuit television (CCTV),



The cable installation at HSBC headquarters was designed to be both state-of-the-art and future-proof. High performance and energy efficiency were key element of the data center design.

Photo Courtesy of Terrance Electric, ©Nick Novelli, Novelli PhotoDesign

building automation, wireless access points, multifunction devices and audio-visual systems. There are a total of 22,500 Cat 6A links. Every link is wired for Power over Ethernet. At the present time, the company is running 100BASE-T to the desktop but the cabling is fully certified for 10 Gigabit Ethernet. Anixter International built the IDF racks in advance including patch panels, wire management panels and labeling. As always, the cable installers had to follow the lead of the construction plan. As each floor was finished, modular furniture was installed. The furniture has a center wall that supports between 6 and 12 cubicles. The network cable runs along the center spine of the furniture and is distributed out to jacks in the baseplate along with electric power. The cable was routed through the raised floor and the modular furniture so no terminations could be performed until the furniture was installed.

### **The performance specification was ratified in the middle of the job**

“HSBC made it clear to us that they wanted to futureproof the project,” said James Sauvageau, RCDD, Vice President for Environmental Systems Design, Inc., the consulting engineer firm for the project. “We kept a close eye on the various drafts of the evolving network standards so we were ready when the IEEE approved the standard for 10GBASE-T in June 2006. Fluke Networks promised that they would be releasing test sets that complied with the new standard by the time we would be ready to begin testing.”

“The client’s decision to go with the 10GBASE-T standard created some challenges,” Zezulka said. This was magnified by a late decision to run three cables rather than two to a typical workstation. “We adapted to the larger Cat 6A cable diameter by changing the routing, including some additional trays and runs. At the peak of the project we had 34 technicians on the job. Productivity was critical. We had to turnover almost a floor per week to meet the customer’s deadline. We were squeezed for time at the end of the project because they could build furniture faster than we could test. So we added additional crews to pick up the slack”.

### **In-channel testing**

Our technicians began testing as soon as the cable was installed,” Zezulka said. “Our approach was to do all of the in-channel testing first. We picked the Fluke Networks DTX-1800 because it is the fastest field test tool on the market.” The DTX-1800 executes a Cat 6 Autotest in 9 seconds. Extending the frequency range to 500 MHz for the 10 Gig Ethernet application increases the test time to 22 seconds. Fluke Networks estimates the total time to certify a 10 Gig link for in-channel compliance at 44 seconds. This includes the Autotest time of 22 seconds plus 2 seconds to save the test results and 20 seconds to physically connect the tester units to the next channel.

The field certification of twisted pair cabling for 10GBASE-T consists of two phases. First, all the cabling links must meet the performance specified by the in-channel test parameters currently specified in the TIA/EIA-568-B document for Cat 6 or in the ISO 11801 standard. They are: Insertion Loss, Return Loss, Pair-to-pair NEXT, Power Sum NEXT, Pair-to-pair ELFEXT, Power Sum ELFEXT, Propagation Delay, Length, Delay Skew and Wiremap. The 10GBASE-T test limits for these tests are identical to the limits for Cat 6 up to 250



Terrance Electric used Fluke Networks’ DTX CableAnalyzer to certify the new installation to 10GBASE-T. Multiple two-man teams were used to test and document over 40,000 links.

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MHz, but the frequency range and performance specifications (limit values) are extended to 500 MHz to support the much higher bandwidth required for the 10 Gb/s Ethernet technology.

### **AXTALK testing**

Because of the high bandwidth required for 10GBASE-T signaling, alien crosstalk (AXTALK), or crosstalk that occurs between wire-pairs in adjacent cabling links, must be added to the test parameters. Two types of alien crosstalk must be measured: Alien Near-End Crosstalk (ANEXT) which appears on the same end of the cabling link from which the disturbing signal is launched and Alien Far-End Crosstalk (AFEXT) which appears on the opposite end of the cabling link from the disturbing signal. Power Sum Alien NEXT (PSANEXT) and Power Sum Alien Attenuation-to-Crosstalk-Ratio from the Far end (PS AACR-F) assess the combined impact of many wire-pairs in the bundle upon the wire-pair under test, referred to as the “victim”.

“The decision to go with the new standard meant that we had to perform alien crosstalk testing,” Zezulka said. “We had never done 10 Gig testing before. But fortunately, Fluke Networks had a solution that was based on the DTX-1800 Cable Analyzers that we were already using. They came out to our office, demonstrated the product and offered additional technical support and training to help us get started. We bought 4 DTX-1800s, two DTX 10 Gig Kits and plenty of terminators. We were thinking down the road that we would not only need the equipment for this project but for the many future 10 Gig projects that we expect to be involved in.”

Fluke Networks’ solution for 10 Gigabit/s Ethernet testing consists of its DTX-1800 CableAnalyzer certification tester plus its DTX 10 Gig Kit. The DTX 10 Gig Kit consists of a set of communications modules that snap into the DTX-1800 main and remote units. The new DTX 10 Gig Solution measures 10 Gig in-channel test parameters and also measures ANEXT and AFEXT to 500 MHz. calculating the PSANEXT and PSAELFEXT test parameters in full compliance with the IEEE 802.3an standard. The 10 Gig Solution automates all the tasks and computations involved in AXTALK measurement, so it is possible to measure and evaluate all possible wire pair combinations in two links in approximately 30 seconds.

Compliance with the 10GBASE-T requirements is most difficult for the longest links. If the longest links in an installation pass, the shorter links will very likely pass with even higher margins. In this case, Environmental Design Systems specified that a random sample consisting 2% of the total number of cabling links or 400 links should be tested for AXTALK.

### **Developing AXTALK testing procedures**

“I trained my technicians using the interactive demo on Fluke Network’s website,” Carmen Paradiso, Terrance Electric Project Foreman said. “The demo goes step by step through the entire process of testing a link for alien crosstalk. I assigned my top two technicians to do the tests. With two DTX-1800s



The DTX CableAnalyzer test multiple “victim” links for alien crosstalk during 10 Gigabit/s Ethernet testing. Results are quickly analyzed and stored on a laptop, providing complete documentation of this phase of the 10 GB/s test process.

and two Smart Remote units they were able to test two bundles simultaneously. One tech worked in the closet operating the laptop connected to the DTX-1800 main unit and the other was on the floor moving the terminators or the remote units around. The technician in the closet initiated the test on one laptop, then moved to the second laptop and got that one started. By the time he got back to the first laptop, it had completed the test. The two technicians communicated by cell phone to coordinate the movement of the remote units.”

Terrance Electric technicians performed the AFEXT measurements with a DTX-1800 and a Smart Remote unit. They plugged a special AXTALK communication module into the back of the DTX-1800 and Smart Remote units. The technicians connected the remote tester units to different disturber links at the far end (opposite end at which the main unit is plugged into the victim link). “The instructions say to pick an unused cable to connect the main and remote tester units to synchronize the testers,” Paradiso said. “But we saved time by making up a 200 foot long cable that saved the time of having to move patches around. We also purchased additional terminators.”

The technician installed these special termination plugs at the end of the two links being measured to avoid reflections from “open” far ends which would interfere with the measurement process. The main unit was plugged into the selected victim cable while the Smart Remote was connected to one of the 11 other cables which served as the disturber links in this test. The technicians connected the DTX-1800 main unit to a laptop computer using a USB connection. The AXTALK Analyzer software running on the computer controlled the DTX-1800 tester to run the AXTALK measurements. The AXTALK Analyzer software imports the pair-to-pair ANEXT and AFEXT measurement results data and calculates in real time the power sum test results for each wire pair in the victim link.

The technician then moved the remote unit and terminator to another cable in the same bundle to measure its disturber effect on the pairs in the victim link. The AXTALK measurements were then repeated for this new disturber and for each of the 11 cables in the bundle. As the crosstalk effects of wire pairs in additional disturber links were measured, the AXTALK Analyzer software automatically calculated the combined effect of all the disturbers included in the test so far and displayed the power sum AXTALK test result.

### **Getting the job done quickly**

Testing and calculating the PSANEXT for the four wire pairs in a single link in a bundle of 12 cables required measuring each of the 16 possible wire-pair combinations in the link against each of the 11 possible disturbers for a total of 176 possible measurements. All of this is done by the DTX 10 Gig Solution Kit. The measurement for each wire-pair combination took about 30 seconds with the 10 Gig Solution Kit so the total test time for a link was about 5.5 minutes. In addition, time was required to connect the leads and upload test results to the PC which raised the total time to about 10 minutes for a link. The same amount of time was required to make the PSAFEXT measurements for the selected victim link. The total test time was about 20 minutes for one link. By testing two links simultaneously, Terrance’s 2-man technician teams were able to fully certify two victim links for AXTALK compliance in about 30 minutes. Thus the total test time to test the 400 selected links for ANEXT and AFEXT was about 400 man-hours.

It should be noted that since the release of the IEEE 10GBASE-T standard the Telecommunications Industry Association has approved Amendment 10 of the TIA/EIA-568-B.2 document, the new Augmented Cat 6 (Cat 6A) standard. There are some differences between the IEEE 10GBASE-T and the Cat 6A standards which should be called out. The test limits in the 10GBASE-T standard are based on the signal-to-noise budget for the transmission channel and take into account the insertion loss of the tested link to set the appropriate Pass/Fail limit values for the AXTALK parameters. The test limit values for AXTALK in the Cat 6A standard establish fixed Pass/Fail limit lines independent of the length or insertion loss of the links involved in the test. Cat 6A provides a higher margin above the minimum requirements of 10 GB/s Ethernet for the in-channel and the AXTALK parameters.

“Terrance Electric did an excellent job on this project,” Sauvageau said. “Despite all the advances in the electronics, the physical world is still critical. They overcame the physical challenges of Cat 6A cabling while maintaining the physical integrity of the cable and the aesthetics of the installation. Their attention to detail was reflected in their ability to meet raceway fill and bend radius specs despite the larger outside diameter of the Cat 6A cabling. Terrance also did a stellar job in coming up to speed so quickly on the requirements for 10 Gig testing and instituting flawless equipment and procedures on the fly.”

“The most challenging part of this project was that the test requirements weren’t fully defined until we were right in the middle of it under enormous time pressure,” Zezulka concluded. “Fluke Networks came to the rescue by providing us with a complete solution and defined procedures tailored to the new 10GBASE-T specification. By the way, they have also adapted their solution to the latest TIA/EIA Cat 6A specifications which are more stringent as noted. Having a supplier that had been there, done that made it possible for us to get into alien crosstalk testing right in the middle of the project without missing a beat. The results exceeded the customer’s expectations which is always the most important thing for us.”

**NETWORK SUPERVISION**

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Printed in U.S.A. 11/2008 3403383 D-EN-N Rev A