

Belden IBDN™ 10GX Solutions

**10GX: THE MOST ADVANCED
END-TO-END UTP STRUCTURED
CABLING SYSTEM — DESIGNED
FOR BEYOND 10G™ PERFORMANCE**

BELDEN CDT Networking™



Optimizing Your IT Strategy

Belden CDT Networking — the result of a merger between Belden Electronics Networking Group and NORDX/CDT — has invigorated the industry by its ability to draw upon the profound technological experience and service capabilities of these once separate, but equally strong, networking companies. The results have been both immediate and far reaching.

Under the new Belden IBDN[™] umbrella are a number of outstanding structured cabling systems, i.e., FiberExpress[®] optical fiber structured cabling systems and a series of end-to-end Copper UTP structured cabling solutions.

Now, we expand our copper solutions product line above and beyond any offering in the marketplace today by providing:

The Belden IBDN System 10GX – the industry’s most advanced end-to-end UTP structured cabling system delivering guaranteed performance Beyond 10G.

What differentiates our 10GX System from other 10 Gigabit Ethernet offerings? The Belden IBDN System 10GX is not an improved or boosted Category 6 system, but a revolutionary innovation designed around a series of dynamic enabling technologies. The 10GX System is suited for not only the high speed, high bandwidth demands of today’s networks, but this advanced solution is ready to meet the challenges of the networks of tomorrow.



Why 10 Gigabit Ethernet?

Ethernet technology, first conceived in 1973, took a little over 20 years to progress from speeds of 3 Mb/s to 100 Mb/s. Then, propelled by the proliferation of networks and the users' growing bandwidth and networking requirements, the industry moved relatively quickly from 100 Mb/s to Gigabit Ethernet and now to 10 Gigabit Ethernet.

In fact, in 2002 the IEEE ratified a 10 Gigabit Ethernet standard for a full-duplex, fiber only technology. Although fiber is particularly well-suited for a number of high security, densely trafficked environments – or when longer distances (up to 550 meters) are involved – the cost to install an optical fiber system and the electronics necessary to take fiber-to-the-desktop has greatly slowed its progress.

This cost prohibition has spurred the quest for an unshielded twisted pair (UTP) solution – since UTP technology offers the greatest overall economies in new installs and since it allows for a seamless migration from existing 100BASE-T and 1000BASE-T cable plants.

In consideration of the market's needs, the technology's potential and the economies offered by UTP cabling, both the IEEE and TIA/EIA are now fast at work on standards for 10 Gigabit transmission over Copper – targeting distances from 55 to 100 meters.

Some manufacturers may have been able to "stretch" their specs to meet the proposed requirements of a 55 meter run. But few – if any –

can meet the electrical performance demanded for 10 Gigabit Ethernet, especially at any length over 55 meters.

You need to consider both circumstances – you need the assurance that your 10 Gigabit system is truly a quantum leap over the proposed requirements – plus you need to address not just the shortest or the average building run, but the longest run in the building. In effect, you need Belden IBDN System 10GX.

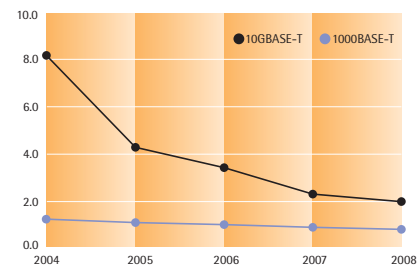
What Needs Are Addressed by 10 Gigabit Service?

Today, 10 Gigabit Ethernet is a viable solution for data centers, server farms, storage area networks (SANs), network access nodes (NANs), campus backbones, metropolitan area networks (MANs) and for short distance backbone connections where there is a high concentration of data traffic.

Emerging bandwidth-intensive applications such as uncompressed high resolution digital video, medical imaging, digital animation, CAD/CAM, high speed data storage and cluster computing also require the quality of service (QoS) inherent in 10 Gigabit Ethernet.

Additionally, as high reliability IP-based services such as VoIP and video become commonplace they will require extended bandwidth and reliable power distribution. Greater bandwidth is also required as voice, data and video networks converge onto a single infrastructure – as is the case for today's more advanced security systems. Is your network able to handle this load?

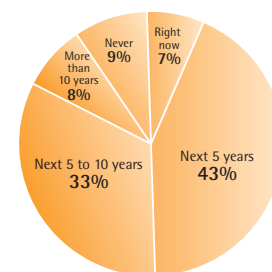
RELATIVE ECONOMICS OF 10GBASE-T VS. 1000BASE-T



The 10x3 rule specifies that a new technology must be at least 10 times as fast at no more than 3 times the cost to justify standards consideration – 10 Gigabit Ethernet meets this criteria.

Source: Reed Business Information/In-Stat

MARKET DEMAND FOR 10 GIGABIT ETHERNET



Source: Cabling Installation & Maintenance Magazine

Meeting the Design and Performance Challenges of 10 Gigabit Service

To present a future-proofed 10 Gigabit UTP System, two major performance issues must be solved: Alien crosstalk reduction and controlled performance during high frequency operation.

Alien Crosstalk – the New and, By Far, the Greatest Challenge

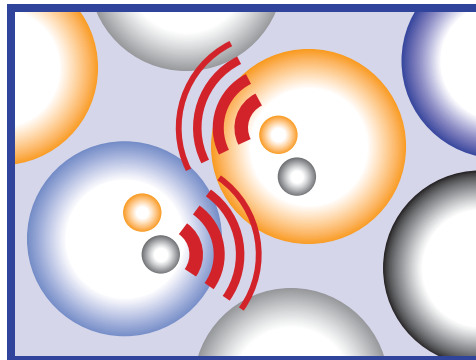
Near-end and Far-end Crosstalk (NEXT and FEXT) refer to the noise caused when one of the pairs within a cable interferes with another pair within the very same cable. There is, however, a fairly simple remedy for this type of crosstalk since the active equipment used for 10 Gigabit Ethernet transmissions will employ sophisticated digital signal processing (DSP) techniques to cancel out NEXT/FEXT and any impedance mismatch (echo). The active equipment can also implement sophisticated coding algorithms to correct for and to reduce the probability of errors.

However, Alien crosstalk, which is the crosstalk between adjacent cables that share the same pathway, cannot be cancelled by DSP techniques. Granted, the level of Alien crosstalk is generally much lower than the crosstalk that occurs within a cable, but to meet the demands of a 10GBASE-T application, the level of Alien NEXT needs to be about 15 dB, or 30 times, lower than the Alien NEXT for 1000BASE-T (at a distance of 100 meters). Or, the distance needs to be reduced from 100 meters to 55 meters.

REQUIRED PSANEXT – Cat 6 @ 100 MHZ

CHANNEL LENGTH	DECIBEL REQUIREMENT
55 meters	47 dB
70 meters	52 dB
85 meters	57 dB
100 meters	62 dB

ALIEN CROSSTALK IS THE POTENTIAL 10G "KILLER"





High Frequency Performance

IEEE 802.3an (10 Gigabit Ethernet) utilizes 4-pairs with a bidirectional data rate of 2.5 Gb/s, per pair. This data is encoded using a sophisticated coding scheme resulting in an effective symbol rate of 800 Mega symbols per second. The bandwidth required to transmit this information is one half the symbol rate

plus 25%, or 500 MHz. Therefore Insertion Loss, Return Loss, NEXT, PSNEXT, Alien PSNEXT, ELFEXT, PSELFEXT and Alien PSELFEXT need to be well controlled within this frequency band to ensure reliable transmission. The specifications for these parameters are still under development for augmented Category 6 cabling in the TIA and ISO standards committees.

Be sure that the 10 Gigabit system that you specify addresses these all-important performance issues – and offers you lots of margin for the future. Don't settle for a turbo prop system when you can have a jet!

How Can We Measure Alien Crosstalk?

The standards bodies have yet to determine a “standard” methodology for testing Alien crosstalk in a channel or at the component level and currently there is no commercially available field-test device.

In order to measure Alien NEXT on a channel, adjacent channels must be carrying a signal. This “signal” on adjacent channels must be generated by either the active equipment or by the test device. To reduce the amount of testing, it is likely that the alien noise will be measured with all adjacent channels energized. It is also expected that 10GBASE-T equipment will have some built-in diagnostic testing capability.

Belden CDT Networking is working together with tester manufacturers to discover the best methods of testing the 10G requirements.

What Makes the Belden IBDN 10GX Solution the Most Advanced 10G Technology System in the Marketplace?

The engineering strength and depth of Belden CDT Networking can truly be seen in the creativity and performance of the 10GX solution.

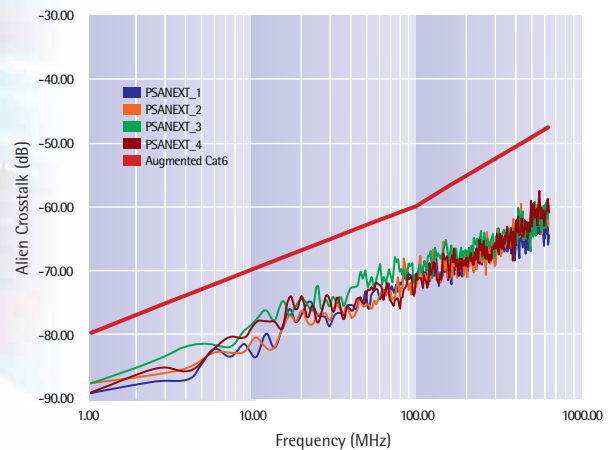
Belden CDT Networking engineers and researchers have come up with innovative, robust cabling technologies that deliver guaranteed performance well beyond the proposed 10GBASE-T standards. Whereas most manufacturers have done their best to push their existing Category 6 systems to their limit, Belden CDT Networking's 10GX solution is blasting its way into the future.

The 10GX solution is not based upon the improvement, or tuning, of existing elements, but on a complete redesign of key channel components. With testing witnessed by ETL on every single, critical parameter beyond the specified 500 MHz range, the 10GX is by far the most advanced 10 Gigabit Ethernet solution available today.

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ALIEN PSNEXT PERFORMANCE



Belden CDT Networking engineers master the most demanding criteria for 10G transmission.



10GX – A Revolutionary Innovation Based Upon Four New Performance-Enabling Technologies

The performance of each critical component of the 10GX solution has been optimized through use of the following performance-enabling technologies:

- > The system's cable is based upon an innovative SpiralFlex™ design that serves to reduce Alien crosstalk by randomizing the distance between the cables
- > A patent-pending IDC design and patch panel circuit layout called MatriX IDC™ technology is utilized to substantially eliminate the issue of Alien crosstalk between the system's modules

- > X-Bar™ technology: The X-Bar is a control device that enables the accurate positioning of each UTP pair before the pair is terminated on the 10GX Module's IDC pins
- > A patent-pending FleXPoint™ PCB (printed circuit board) is used within the module housing to position the compensation circuitry directly at the plug's point of contact. Instant compensation delivers excellent crosstalk performance up to 625 MHz

How Do the Enabling Technologies Stack Up To the Performance Challenges?

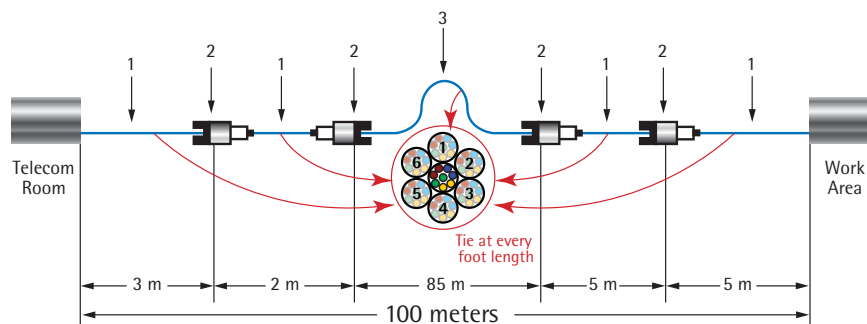
Each of these innovative technologies helps the system overcome the Alien crosstalk and consistency of performance concerns at high frequencies that are paramount to Beyond 10G performance.

What Does the "X" In 10GX Mean?

Of course, "10G" refers to the suitability of the 10GX solution for supporting 10 Gigabit applications. The "X," however, refers to a number of key performance and design characteristics. Specifically, the X means:

- > **EX**tended performance beyond the proposed standards, or Beyond10G
- > The four enabling technologies that provide controlled performance up to 625 MHz:
 - SpiralFlex cable design
 - MatriX IDC technology
 - X-Bar control device
 - FleXPoint PCB technology

ANEXT TEST SET-UP



The 10GX outperforms other solutions even under the worst case six-around-one test configuration.

The Main Components of the 10GX Solution and What the Enabling Technologies Offer

The Belden IBDN System 10GX is comprised primarily of the following elements:

- > 10GX Cables
- > 10GX Patch Panels
- > 10GX Modular Cords
- > 10GX Modules

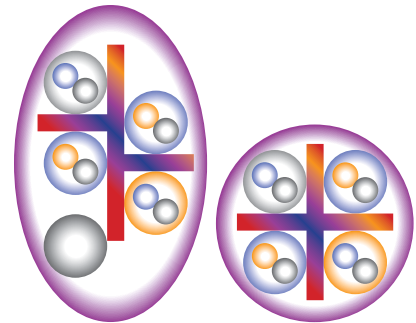
Each of these components is developed around the patent-pending, enabling technologies described below. It should also be noted that all 10GX System components are backwards compatible for easy integration into existing infrastructures.

New 10GX Cable Design Improves Alien Crosstalk

The major technical challenge for traditional UTP cables resides with the electromagnetic coupling between a cable and its neighboring cables. This coupling is typically enhanced by the fact that all the cable pairs have the same twisting lay and therefore have the same resonance frequencies.

Belden CDT Networking's use of SpiralFlex technology introduces randomization in the cable in two ways:

- > It induces randomization with neighboring cables — to accomplish this a filler is twisted around the four cable pairs
- > To create an additional randomization along the full length of the cable, a unique cross-web is incorporated into the cable design

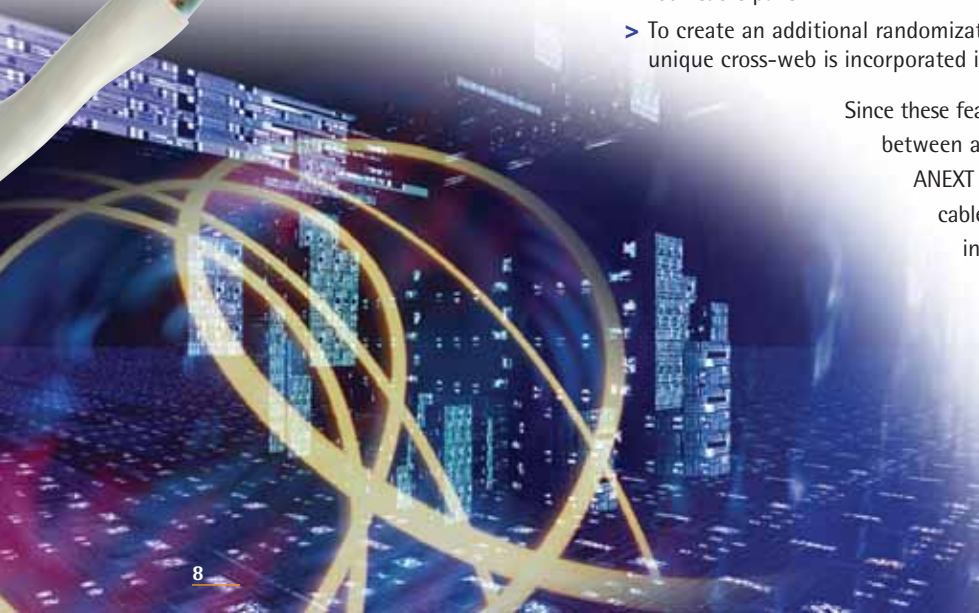
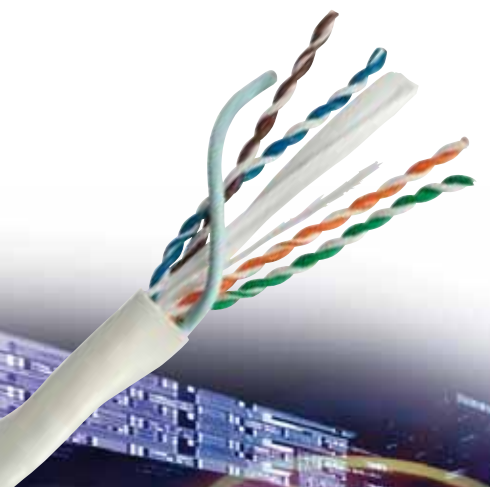


10GX CABLE DESIGN VS. TRADITIONAL CABLE DESIGN

The 10GX Cable (left) has a unique cross-web design for improved EMI and Alien crosstalk immunity. The design of the traditional cable (right) offers little EMI and Alien crosstalk protection. When bundled, traditional cables can have significant ANEXT problems.

Since these features both increase and randomize the distance between a cable and its neighboring cables, both the ANEXT coupling and RL channel characteristics of the cable are improved. In fact, 10GX Cables were tested in a worst-case scenario — a six-around-one cable environment — and still exhibited performance well over proposed standards.

In addition, this unique 10GX Cable design is more flexible and installer-friendly than other 10G cables.



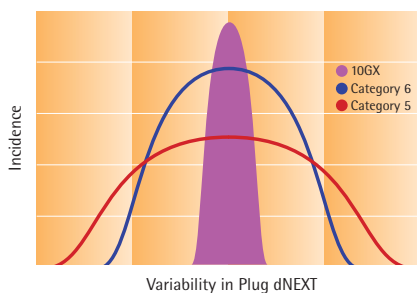


Statistically Controlled Modular Cord Manufacturing

To achieve consistent high performance, Belden CDT Networking uses a statistical process control methodology in its modular cord manufacturing process. This assures perfect tuning between the module and the modular cord and offers improved channel performance.

The design of the 10GX Modular Cord is also based upon a patent-pending plug management design that controls dNEXT and delivers extended channel performance up to 625 MHz.

TIGHTLY CONTROLLED MANUFACTURING MEANS DRAMATICALLY IMPROVED MODULAR CORD PERFORMANCE



Using statistical process control techniques allows the 10GX Modular Cord to be optimally mated with the modules for excellent 10 Gigabit performance.

10GX IDC Design Cancels Out Alien Crosstalk

The IDC is one of the most sensitive areas for Alien crosstalk management. In traditional designs, all of the IDC contacts are aligned so they become perfect antennas, allowing adjacent pairs to both emit and receive noise.

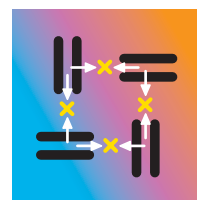
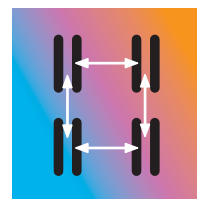
Belden CDT Networking's patent-pending design, called Matrix IDC technology, positions each IDC at 90 degrees to its neighbor – effectively canceling out ANEXT by 15 dB as compared with traditional technology!

The Revolutionary 10GX Module Eliminates Signal Degradation

Traditional jack designs are performance handicapped at high frequencies because of an inherent crosstalk in the plug that cannot be fully compensated for by the jack. This crosstalk occurs because the compensation circuitry is located at some physical distance from the source of the noise, which is at the plug interface. Even a very small physical distance can have a major impact at high frequencies.

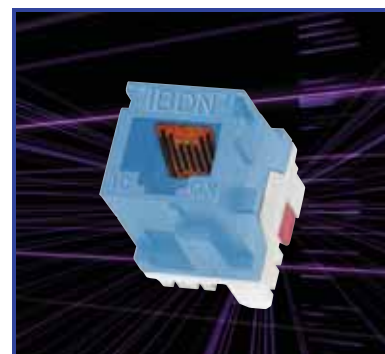
The 10GX Modules feature FlexPoint technology. This technology incorporates the use of a flexible PCB that allows the compensation circuitry to be located directly at the point of the plug contact. This reduces the delay between the source of the crosstalk in the plug and the crosstalk cancellation circuitry on the PCB. As a result the crosstalk noise at high frequencies is dramatically reduced for outstanding channel performance up to 625 MHz!

TRADITIONAL TECHNOLOGY VS. MATRIX IDC TECHNOLOGY



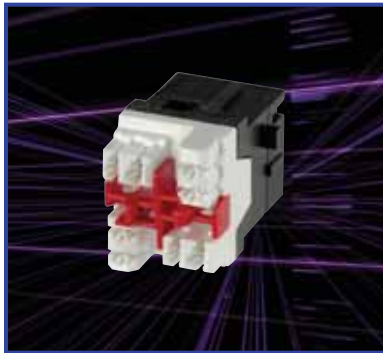
By altering each pair contact position by 90 degrees (*bottom drawing*), the "antenna" effect is effectively cancelled.

FLEXPOINT PCB TECHNOLOGY



Use of proven technology from very demanding applications such as in the military and medical industries represents a revolution in the science of 8-pin modular connectivity.

**THE X-BAR ELIMINATES
 CRAFT-RELATED TERMINATION VARIANCES**



The X-Bar assures Installable Performance by eliminating the possibility of a termination error.

**Error-Free Termination Practices
 (Installable Performance®)**

Since structured cabling systems for Category 6 and beyond are extremely sensitive to installation practices, the 10GX System mitigates and simplifies installation issues to ensure overall system performance.

To ensure optimum termination of the cable to the module, a new patent-pending technology called the X-Bar was developed. The X-Bar is a plastic device that affixes to the module to ensure that each UTP pair is consistently positioned for termination on the 10GX Module's IDC pins. The X-Bar also controls the amount of unjacketed cable, plus it maintains the conductor twist lays during installation to prevent untwisting.

With this consistent termination feature, the superior NEXT and ANEXT performance achieved through use of the system's innovative component designs will remain stable – and

won't deteriorate due to handling and positioning of the cable in the outlet box or routing of the cable in the rack. We call this after-installation assurance Installable Performance.

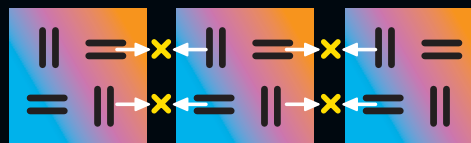
**The 10GX Patch Panel
 With 10GX Modules**

Alien crosstalk control within a patch panel is critical to the success of the system. The high density environment of a patch panel can be subjected to crippling amounts of Alien crosstalk. The unique design of the 10GX Module's IDC, and its ability to cancel the "antenna" effect between modules eliminates the Alien crosstalk issue.

Because superior ANEXT performance is assured by the module-related technologies, this allows the patch panel ports to be in line. There is no need to compromise on density, and labeling and cable management features are greatly improved.



THE IDC LAYOUT IN THE PANEL CANCELS OUT KILLER ANEXT



Due to the 10GX Module's IDC design, neighboring modules in the 10GX Patch Panel exhibit greatly improved Alien NEXT performance.



The Belden IBDN System 10GX Is Supported by the Industry's Strongest Warranty Program

Belden CDT Networking is committed to providing no-nonsense warranties that guarantee system performance and product quality. Today more than 27,000 Belden IBDN Certified Systems have been installed worldwide, supporting the critical networking needs of thousands of companies and millions of users every day.

The Belden IBDN Certification Program surpasses conventional product warranties by adding important new guarantees that go beyond end-to-end system performance and full compliance with cabling industry standards specifications.

25-Year Component Warranty

Should any Belden IBDN component fail due to defects in materials, design or workmanship, Belden CDT Networking and your Certified System Vendor (CSV) will repair or replace the component, including labor, at no cost to the customer.



Lifetime Application Assurance Program

Your System is guaranteed to operate any application (current or future) that is designed to run on the category of cabling system installed. If your Belden IBDN Certified System is unable to

support such an application, Belden CDT Networking and your CSV will correct the failure – including parts and labor – at no cost to the customer.

Each Belden IBDN Certified System is guaranteed to comply with applicable industry standards such as the dual IEEE and TIA/EIA Category 5, Enhanced Category 5, Category 6, and proposed Augmented Category 6 channel specifications. In addition, all systems meet Belden CDT Networking's enhanced performance specifications which exceed industry standards.

Certification of your Belden IBDN Structured Cabling System is a powerful tool that guarantees performance, standards compliance, as well as component and installation quality of your cabling infrastructure. Specifying and installing a Belden IBDN Certified System will protect your investment in the future, while simplifying your cabling decisions and reducing your risk today.





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