BELDEN

SENDING ALL THE RIGHT SIGNALS

Belden's IBDN® System 10GX®

**10GX: The Most Advanced
End-to-End UTP Structured
Cabling System — Designed for
Beyond 10G Performance**

Belden: The Brand You Rely On

Belden's IBDN Systems represent networking leadership at every turn, providing IT professionals with top-performing structured cabling systems and components for either copper or optical fiber installation. To make the IT professionals' job easier, we also provide all the data and support necessary to help them with the right decision for their intended application – plus we ensure proper installation of their system through use of our Certified System Vendors (CSVs), backed by a strict System Certification and Warranty Program.

Belden offers the most advanced structured cabling systems in the marketplace – now including the IBDN 10GX Solution.

The IBDN 10GX Solution

The IBDN System 10GX is Belden's copper UTP solution for 10G applications. It was the first Category 6A structured cabling system in the marketplace to verify error-free performance for 10GBASE-T during a live, 3rd party demonstration of the performance capabilities for 10GBASE-T technology. The validation trials were performed on a 100-meter 10GX channel in a worst-case, 4-connector channel configuration (as specified in the TIA Category 6A standard). A real-life example of what this means would be the difference of transmitting high resolution pictures (600 dpi) at 20 per minute at 1 Gb/s, versus 200 per minute at 10 Gb/s.

The market's need for 10G performance is chronicled on the following pages, along with a detailed discussion of the enabling technologies that make the IBDN 10GX Solution the top 10G Technology System in the marketplace today.

True 10G performance is achieved with the IBDN 10GX Solution.

Why 10 Gigabit Ethernet?

IBDN System 10GX:
Solving the Alien
Crosstalk and high
frequency problems inherent
in 10G transmissions.

The Evolution of 10G

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-TX and 1000BASE-T cable plants.

In consideration of the market's needs, the technology's potential and the economies offered by UTP cabling, both IEEE and TIA/EIA have published standards for 10 Gigabit transmission over copper — with distances up to 100 meters over Category 6A cabling.

Some manufacturers may have been able to "stretch" their specs for mitigated Category 6 to meet 10GBASE-T requirements of a 55 meter run. But few — if any — can meet the more demanding transmission requirements of TIA Category 6A and ISO Class EA for worst-case short-channel configurations less than 20 meters and long-channel configurations up to 100 meters.

You need to consider both circumstances — you need the assurance that your 10 Gigabit system is truly a quantum leap over the TIA Category 6A/ISO Class EA 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's 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 high-resolution video become commonplace they will require extended bandwidth and reliable, error-free transmission. 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?
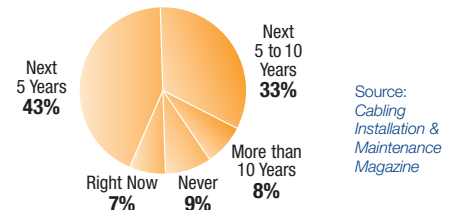
Relative Economics of 10GBASE-T vs. 1000BASE-T
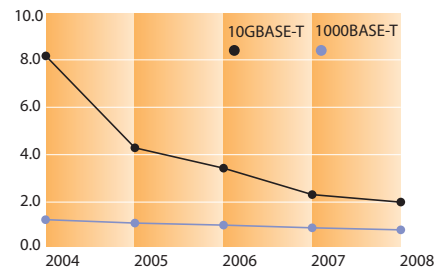
The 10x3 rule specifies that a new technology must be at least 10 times as fast at no more than 3 times the cost to justify standards consideration — 10 Gigabit Ethernet meets this criteria.

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 remedy for this type of crosstalk since the active equipment used for 10 Gigabit Ethernet transmissions 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 32 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.
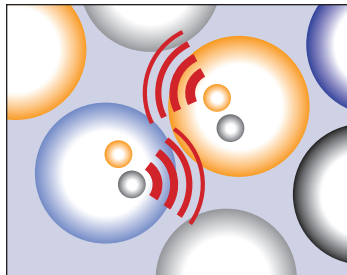
Alien Crosstalk is the potential 10G "killer."

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

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.

How Can We Measure Alien Crosstalk?

In order to measure Alien NEXT and Alien FEXT 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. The intent of the Category 6A cabling standard is that Alien Crosstalk requirements are met by design in a worst-case "6 around 1" bundled cable configuration. Alien Crosstalk testing is performed on a limited number of worst-case channels to verify the design and installation. TIA standards provide some guidelines on selecting worst-case channel configuratons for Alien Crosstalk testing.

Belden is working together with test manufacturers to discover the best methods of testing the 10G requirements.
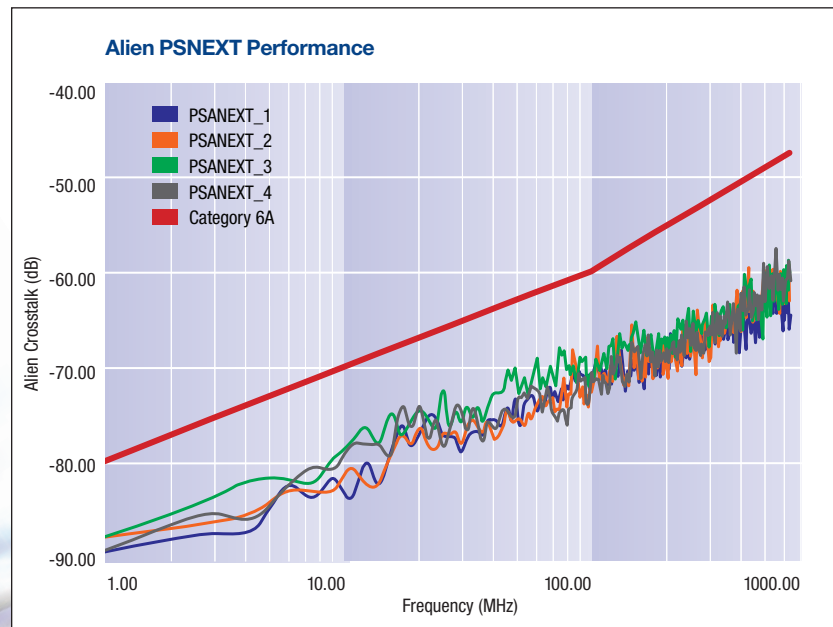
What Makes the IBDN 10GX Solution the Most Advanced 10G Technology System in the Marketplace?

High-end applications benefit from the unparalleled performance of the 10GX Solution.

The engineering strength and depth of Belden can truly be seen in the creativity and performance of the 10GX Solution.
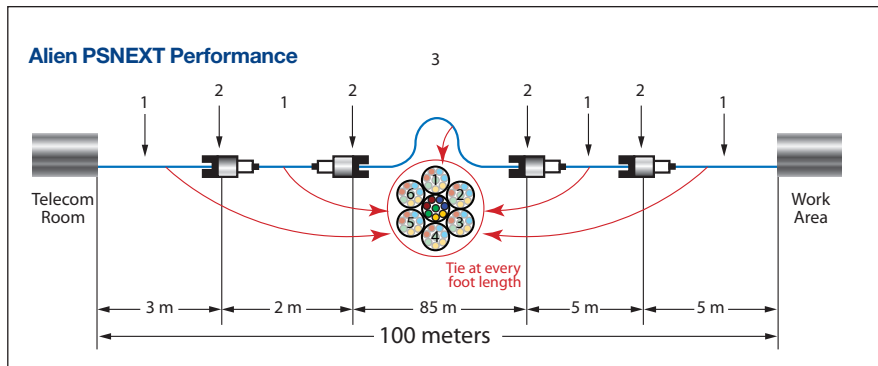
Belden engineers and researchers have come up with innovative, robust cabling technologies that deliver guaranteed performance well beyond the 10GBASE-T standards. Whereas most manufacturers have done their best to push their existing Category 6 systems to their limit, Belden's 10GX solution is blasting 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 Intertek on every single, critical parameter beyond the specified 500 MHz range to the guaranteed throughput of 625 MHz, 10GX is by far the most advanced 10 Gigabit Ethernet solution available today.

Alien PSNEXT Performance

Legend:
- PSANEXT_1
- PSANEXT_2
- PSANEXT_3
- PSANEXT_4
- Category 6A

Y-axis: Alien Crosstalk (dB)
X-axis: Frequency (MHz)

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

Alien PSNEXT Performance

System 10GX outperforms other solutions even under the worst-case "6 around 1" test configuration.

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 RoundFleX design that serves to reduce Alien Crosstalk by optimizing the pair lays and the pair position 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 Alien Crosstalk and the 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 Category 6A standard, or Beyond 10G

- The four enabling technologies that provide controlled performance up to 625 MHz:
  - RoundFle**X** cable design
  - Matri**X** IDC technology
  - **X**-Bar control device
  - Fle**X**Point PCB technology

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

The IBDN 10GX Solution has been completely redesigned to ensure top quality, reliable 10G transmission.

The 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 backward 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's use of RoundFleX technology increases and randomizes the distance between a cable and its neighboring cables, so both the ANEXT coupling and RL channel characteristics of the cable are improved. In fact, Belden 10GX Cables were tested in a worst-case scenario — a "6 around 1" cable environment — and still exhibited performance well over the Category 6A standard.

In addition, this unique 10GX Cable design is smaller, more flexible and more installer-friendly than other Category 6A cables.

10GX Cable Design
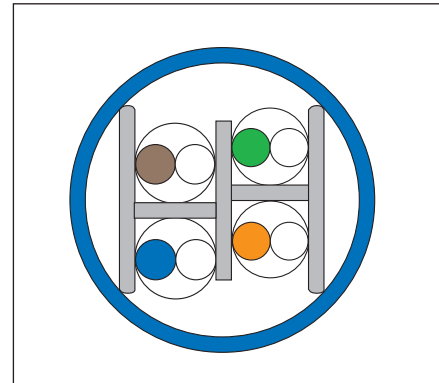
Belden's small OD 10GX cable features RoundFleX Technology, an internal H-web construction that keeps Alien Crosstalk at an exceptionally low level.

Statistically Controlled Modular Cord Manufacturing

To achieve consistent high performance, Belden 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
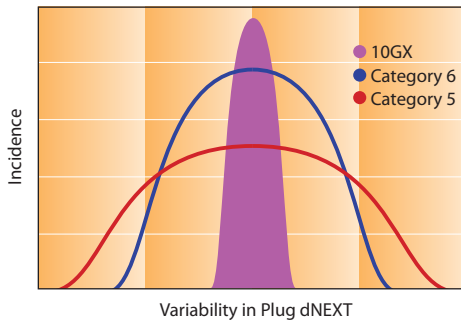
Using statistical process control techniques allows the 10GX Modular Cord to be optimally mated with the modules for excellent 10 Gigabit performance.

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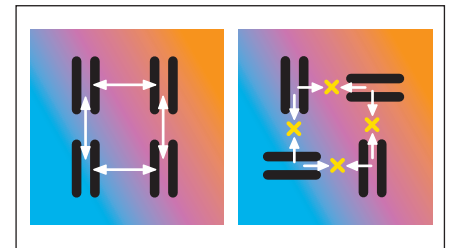
By altering each pair's contact position by 90 degrees (right drawing), the "antenna" effect is effectively cancelled.

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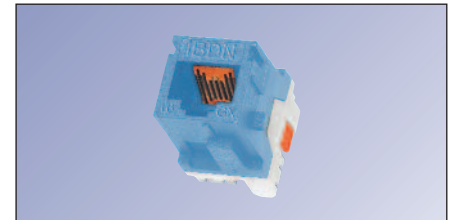
Use of proven technology from very demanding applications such as in the military and medical industries represents a revolution in the science of 8-pin modular connectivity.

Designed to Perform

Belden is alone in
its ability to provide
after-installation
assurance. It's called
Installable Performance®.

Error-Free Termination Practices (Installable Performance)

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

To ensure optimum termination of the cable to the module, a new patented 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 the 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 X-Bar Eliminates Craft-related Termination Variances
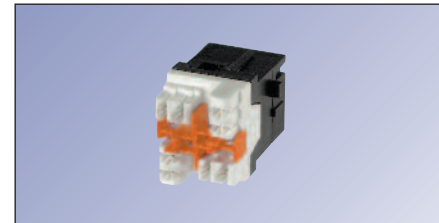
The X-Bar assures Installable Performance by eliminating the possibility of a termination error.

The IDC Layout in the Panel Cancels Out Killer ANEXT
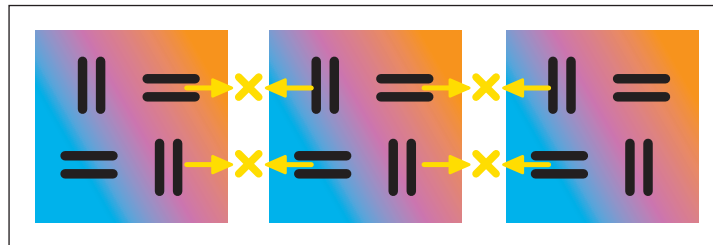
Due to the 10GX Module's IDC design, neighboring modules in the 10GX Patch Panel exhibit greatly improved Alien NEXT performance.

Supported by the Industry's Strongest Warranty Program

Belden is committed to providing no-nonsense warranties that guarantee system performance and product quality. Since first introducing the concept and benefits of IBDN System Certification, Belden's global network of CSV partners have registered tens of thousands of IBDN Systems under the IBDN System Certification Program. These projects now total close to ten million horizontal and backbone channels, supporting the critical networking needs of thousands of companies and millions of users every day.

Belden's 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 component within an IBDN Certified System fail due to defects in materials, design or workmanship, Belden 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 IBDN Certified System is unable to support such an application, Belden and your CSV will correct the failure — including parts and labor — at no cost to the customer.

Each IBDN Certified System is guaranteed to comply with applicable industry standards, including Category 6A channel specifications. In addition, all systems meet Belden's enhanced performance specifications which exceed industry standards.

Certification of your 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.

All the Right Reasons

Considering all that Belden offers in signal transmission technology leadership, including its Belden IBDN networking systems – copper and optical fiber – and the thoroughly innovative, top-performing System 10GX detailed here, shouldn't you call 1.800.BELDEN.1 today? Or, go to the web site at www.belden.com for more complete information on the wealth of Belden products and systems available.

Belden offers the most advanced structured cabling systems in the marketplace.

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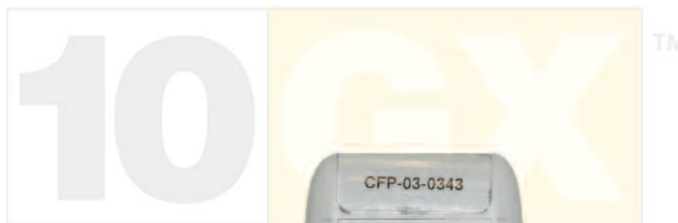
GLOBAL LOCATIONS

Customer Service:
800-BELDEN-1 (800-235-3361)

See www.belden.com for a complete listing
of Belden locations.

UNITED STATES

Division Headquarters–Americas

2200 U.S. Highway 27 South
Richmond, IN 47374
Phone: 765-983-5200
Inside Sales: 800-235-3361
Fax: 765-983-5294
info@belden.com
web: www.belden.com

LATIN AMERICA and the CARIBBEAN ISLANDS

Regional Office

6100 Hollywood Boulevard
Suite 110
Hollywood, Florida 33024
Phone: 954-987-5044
Fax: 954-987-8022
salesla@belden.com

CANADA

National Business Center

2280 Alfred-Nobel
Suite 200
Saint-Laurent, QC
Canada H4S 2A4
Phone: 514-822-2345
Fax: 514-822-7979