High Speed Data Transport Solutions

PANDUIT®

building a smarter,
unified business foundation

Connect. Manage. Automate.

Panduit's Unified Physical Infrastructure (UPI)

A unified approach to physical and logical systems architecture is imperative for solutions to fully address the need for availability, agility, integration, and security.

Panduit has developed the industry's most comprehensive and holistic approach to a Unified Physical Infrastructure and can help enterprises align, converge, and optimize critical systems – communication, computing, control, power, and security – to build a smarter, unified business foundation.

Mitigate Risk – Efficient physical infrastructure management enables seamless integration to reduce risks that can occur throughout core systems.

Lower Cost – Panduit physical infrastructure solutions drive financial advantages to reduce energy and occupancy costs, and help secure competitive advantage.

Increase Agility – A high level of integration within the physical infrastructure enables flexibility and improved business agility.

Enhance Sustainability – UPI-based solution offerings enable organizations to meet sustainability goals by driving resource and energy efficiencies across the physical infrastructure.

Unified Physical Infrastructure

High Speed Data Transport Solutions

High Speed Data Transport (HSDT) Solutions are a set of complementary copper and optical fiber technologies for mission critical data center applications, spanning storage and compute requirements and leading edge architectures.

Based on an understanding of today's vital business and technology challenges and how they impact data centers, Panduit has created best-in-class physical infrastructure solutions for HSDT. Panduit provides the broadest offering of end-to-end HSDT solutions supporting all data center architectures. Designed for high-density/high-speed applications, Panduit HSDT solutions are backed by comprehensive research and development programs to ensure high network performance, systems reliability, energy efficiencies, and seamless integration.

Evolving Data Center Environment

Today's data centers have become far more than information processing sites. Evolving network requirements such as processing, managing, and storing ever-increasing volumes of data heightens the need for integrated, high-speed media. Data centers must be equipped to accommodate a broad array of rapidly changing demands.

Consolidation → Higher Density Implementations

Organizations are implementing network consolidation techniques to untangle the sprawl of applications and equipment by:

- Reducing the number of IT assets, such as servers, storage units, and switches
- Leveraging those assets more efficiently
- Lowering real estate costs by reducing both the footprint of the physical infrastructure and the total number of data centers in use
- Reducing the number of networks and lowering WAN/ISP costs

Although the trend towards consolidation certainly has its benefits, one of the side effects is the increasing density of equipment in racks and cabinets. This makes moves, adds and changes increasingly more complicated and error prone.

Server and Desktop Virtualization

Virtualization reduces the number of physical devices dedicated for any one application with the goal of increasing server utilization which lowers capital costs. If not properly planned for, virtualization could greatly strain your LAN and SAN infrastructure. Each virtual machine running on a physical server still needs the same amount of network bandwidth that it did prior to being virtualized. This means that the bandwidth demands on a server supporting virtualization increases proportionally to the number of virtual machines it is hosting.

Not only does the bandwidth demand by a server hosting virtual machines increase, the reliability of the network connection becomes that much more critical. If a link to a server hosting virtual machines fails, this one point of failure now affects access to multiple virtual servers.

Impact of Panduit's HSDT Solution

Panduit HSDT solutions improve your network's throughput, latency, and availability. The superior Bit Error Rate (BER) of Panduit's HSDT solutions means a lower Packet Error Rate (PER) for your network. This means fewer packets need to be retransmitted, conserving valuable network bandwidth.

In addition, Panduit HSDT solutions reduce latency and improve availability. Retransmitting a packet means that whatever action that packet was to support will be delayed and in some industries, that additional delay can put an organization at an expensive competitive disadvantage. Also, a more efficient network with higher throughput and lower latency means improved availability.

"...bandwidth demands on a server supporting virtualization increases proportionally to the number of virtual machines it is hosting."

Panduit High Speed Data Transport (HSDT) Integrated Fiber and Copper Solutions

Panduit understands today's vital business and technology challenges and how they impact data centers. With best-in-class physical infrastructure solutions, Panduit provides the broadest offering of end-to-end HSDT solutions: optical fiber, direct attach copper cable assemblies, and twisted pair copper cabling.

Direct Attach Copper Cable Assemblies

Direct Attach Copper (DAC) twin-ax cables provide the lowest latency and power consumption of the three media types used within a data center. The other advantage of DAC cable assemblies is that they share the same footprint as both SFP+ and QSFP+ optical modules. This means that equipment using those two interfaces can use either DAC cable assemblies or fiber optic modules and optical fiber. DAC cable assemblies are ideally suited for top of rack and some end of row applications.

Twisted Pair Copper Cabling

Twisted pair copper cabling using Category 6 and 6A RJ45 connectors offers the second longest reach of all three copper media types and is the lowest cost to install. Along with optical fiber, it can be a part of a structured cabling deployment within the data center and enterprise. Another advantage of twisted pair copper cabling is that can be field-terminated.

Deploy Independently or in Combination

Panduit HSDT solutions can be deployed independently or in various combinations. For example, Panduit® QuickNet™ Fiber Cassettes can be used in the same patch panels as QuickNet™ Copper Cassettes. This gives data center architects and managers maximum flexibility in the design, layout, and implementation of their data centers.

Multimode Optical Fiber

Multimode optical fiber supports the widest range of data center architectures and applications. It offers low latency, low power consumption, and the longest reach of the three media types. Multimode optical fiber also offers the highest density possible, using either QSFP+ or SFP+ optical modules, or multiple strand optical trunk cables terminated with MPO/MTP* connectors. Multimode optical fiber also supports your future migration path by enabling 40/100 Gb Ethernet and 8/16 Gb Fibre Channel.

Panduit Advisory Services can ensure your site is ready for High Speed Data Transport with our Physical Infrastructure Evaluation and Data Center Infrastructure Design Services. For more information, visit www.panduit.com/Services.

*MTP is a registered trademark of US Conec Ltd.

High Speed Fiber Optic Cabling Systems

Panduit's comprehensive fiber optic system includes a full line of innovative, high performance products designed to meet the demands of today's requirements and provide the capacity to accommodate tomorrow's applications. These systems offer the industry's highest patch-field density and superior cable management to deliver unmatched network design and layout flexibility.

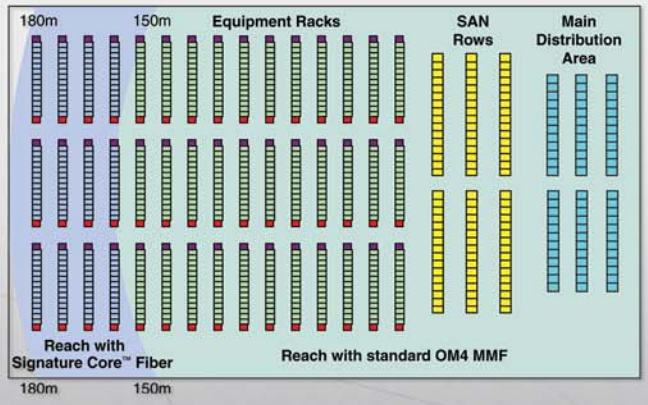
Signature Core™ Fiber Optic Cabling System

The Panduit® Signature Core™ Fiber Optic Cabling System integrates multimode fiber, low loss MTP* and single fiber connectivity solutions with ultra high performance laser-optimized, dispersion compensated multimode fiber. This delivers the ultimate in design flexibility, verified optical performance and signal integrity far beyond the requirements for 10/40/100 Gb Ethernet, and 8 and 16 Gb Fibre Channel, ensuring consistent performance and reliability of critical systems.

The foundation behind the Signature Core™ Fiber Optic Cabling System solves the problem of poor correlation between fiber bandwidth and system performance that industry experts have been wrestling with for many years. By incorporating the effects of chromatic dispersion with the effects of modal dispersion, the total system bandwidth now can predict system performance. This new understanding combined with real world analysis of today's optical transceivers enables a cabling system designed to deliver the ultimate bandwidth and system performance. The Signature Core™ Fiber is the next generation of multimode fiber that is backwards compatible with OM4 multimode fiber, and is the only multimode fiber that corrects for both modal and chromatic dispersion. Depending on the length of the link, the Signature Core™ Fiber Solutions can provide a 10% improvement in throughput, over standard OM4 multimode fiber.

Highest System Performance Possible – Exceeding All Other Distance Claims

The Panduit® Signature Core™ Fiber Optic Cabling System can save data center owners significant capital expenditures. The Signature Core™ Fiber extended reach means that multimode fiber can now be used in applications where singlemode fiber would have been used. For example, several rows of servers may be located very far from the Main Distribution Area (MDA), beyond the 150m reach of conventional 40/100 GbE systems. In one such application, more than 400 multimode fiber optic ports were implemented using the Signature Core™ Fiber Optic Cabling System, resulting in a savings of more than $280,000.



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Flexibility

The reach of various types of media is one factor in the decision process of which architecture to implement. For example, if the data center is large enough, one may have to use singlemode fiber links to connect servers to the LAN or the SAN. To avoid that expense, one could architect the data center so that those servers that need SAN connectivity are located closest to the Main Distribution Area (MDA); however, that may be difficult and cost prohibitive. Another choice would be to use SAN switches in those racks/rows that are beyond the reach of typical multimode fiber to avoid the expense of installing singlemode.

With the extra reach provided by the Signature Core™ Fiber, the enterprise architecture team can implement the design that meets their business needs at the lowest cost.

Future Proof – Extra Headroom Allows Migration to 40/100 Gb Ethernet and 16 Gb Fibre Channel

The reach of 40 and 100 Gb Ethernet and 16 Gb Fibre Channel is significantly shorter than previous generations, this is an important consideration when planning a data center today with an eye toward the future. The Panduit® Signature Core™ Fiber Optic Cabling System provides the extra reach and performance one needs to be assured that the network you deploy today can carry you into the future.

OM3 and OM4 Multimode Fiber

Integrated cutting edge fiber technology and comprehensive pre-testing ensure ultra high performance and seamless integration of 10 Gb Ethernet and 16 Gb Fibre Channel network capabilities and beyond, to minimize physical infrastructure risk. Panduit's OM3 and OM4 multimode optical fiber feature:

- MTP*, duplex, and single fiber connectivity solutions
- Low loss and premium grade high performance laser optimized fiber
- Extended 550m reach with OM4 fiber for 10 GbE infrastructure

10 to 40/100 Gb Ethernet Migration

To support the changing and fast-growing bandwidth demands of data centers, the IEEE ratified standard for supporting 40 and 100 Gb Ethernet, known as IEEE 802.3ba. Panduit actively participated in the development of this standard by leading the effort to include OM4 fiber optic cabling as a physical layer option.

Both the 40 and 100 GbE standards employ parallel optics: 40 GbE is implemented using 4 lanes of 10 GbE with 8 fibers and 100 GbE is implemented using 10 lanes of 10 GbE with 20 fibers. The connectors used are the 12-fiber MTP* for 40 GbE and the 24- fiber MTP for 100 GbE. This means that when one migrates to 40 or 100 GbE, MTP-based backbone optical cable can still be used, but LC patch cords and LC cassettes will need to be replaced with MTP patch cords and adapter panels. When making the replacement, one will need to pay close attention to the polarity and gender of the MTP patch cords and trunk cables.

Both 40 and 100 Gb Ethernet can be deployed using DAC twin-axial cable assemblies for lengths up to 7m. 40 Gb Ethernet uses standard QSFP+ cable assemblies while the pending 40 Gb Ethernet standard is planning on using a 4 x 25 Gb/s cable with the existing QSFP+ interface. There is currently no standard for implementing 40 or 100 Gb Ethernet over twisted pair copper cabling.

Contact your local Panduit sales representative for more detailed information and recommendations when migrating to 40 or 100 GbE.

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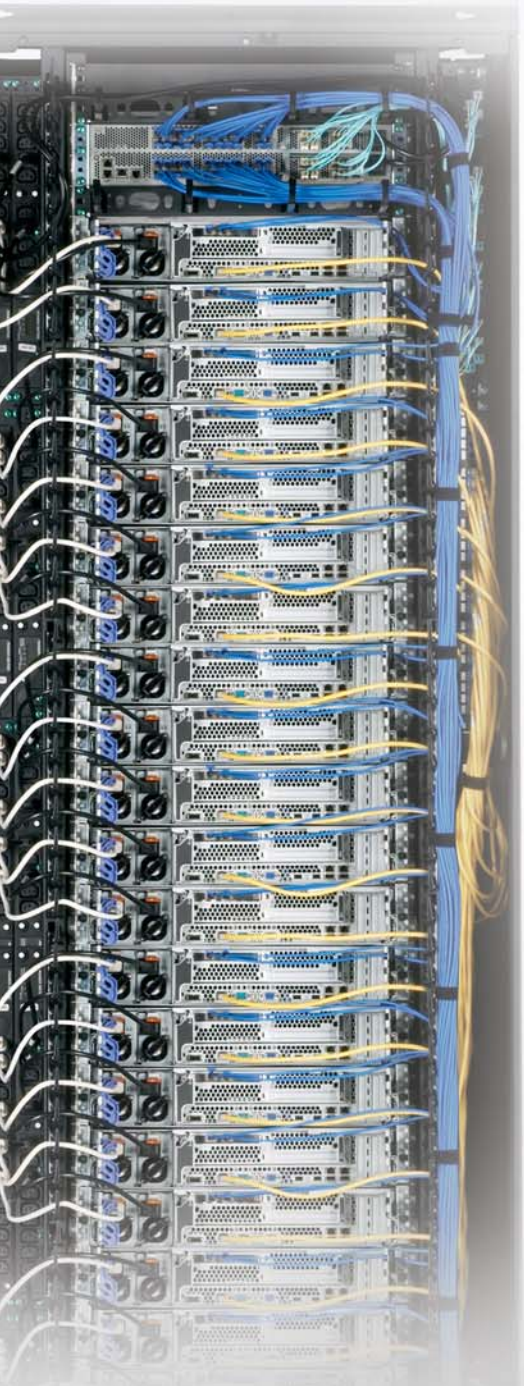


Direct Attach Copper Cable Assemblies

Panduit's comprehensive HSDT Direct Attach Copper (DAC) cable solutions includes a full line of innovative, high performance products designed to meet the demands of today's requirements, and provide the capacity to deliver tomorrow's applications. The product line comprises SFP+ and QSFP+ cables.

The advantage of using this modular approach within a data center is that DAC cable assemblies provide the lowest latency and the lowest power dissipation because there is little signal processing needed for these high bandwidth cable assemblies. Low latency is especially important for mission critical, compute intensive, and financial applications.

SFP+ Products – Direct Attach Copper Cable Assemblies

Panduit's SFP+ 10Gig™ DAC cable assemblies are a perfect choice to connect servers to top of rack access switches when deploying 10 Gb Ethernet. Two versions are offered; passive and active. The active SFP+ DAC assemblies contain electronics that amplify and condition the electrical signal to improve the reach beyond that provided by passive DAC assemblies.

The features and capabilities of Panduit's SFP+ DAC cable assemblies include:

- Available lengths: 0.5m to 15m
- Robust, easy to use latching mechanism
- Superior performance margin assures data integrity and throughput
- 100% production tested
- SFF-8431 compliant

QSFP+ Direct Attach Copper Cables

Panduit's QSFP+ DAC cable assemblies are used to connect servers to top of rack access switches or for switch-to-switch connections when using 40 Gb Ethernet. One QSFP+ DAC link is equivalent to 4 SFP+ cable links, providing a 3X increase in density.

Panduit is the only structured cabling supplier who manufactures its own QSFP+ cable assemblies. Each QSFP+ DAC cable assembly is 100% production tested to meet or exceed industry requirements to ensure superior performance.

The features and capabilities of Panduit's QSFP+ DAC cable assemblies include:

- Standard lengths from 1m to 7m – custom lengths are available
- Robust easy to use latching mechanism
- Compatible with both QSFP and QSFP+ ports
- Hot swappable
- Compliant with all relevant standards
  - SFF-8436 and SFF-8472
  - IEEE 802.3ba 40GBASE-CR4
  - InfiniBand QDR

QSFP+ to 4X SFP+ Hydra Direct Attach Copper Cable Assemblies

The move from 10 to 40 Gb Ethernet will be a gradual one. It is very likely that one may deploy top-of-rack switches that have 40 Gb Ethernet ports while the servers still have 10 Gb Ethernet ports. For that situation, Panduit has developed the QSFP+ to 4X SFP+ hydra copper cable assembly. This cable assembly allows a 40 Gb Ethernet port to be used as four independent 10 GbE ports thus providing increased density while permitting backward compatibility and a phased upgrade of equipment.

Panduit – Cisco – Intel 10GBASE-T Ecosystem

Technology leaders in their respective product systems of server adapters, physical media infrastructure, and switching fabric – Intel, Panduit and Cisco – have joined together to provide an end-to-end 10 Gb/s networking system solution. The Cisco, Intel, and Panduit solution offers users a cost-effective, high-performance, and highly available 10 Gigabit Ethernet network.

The value that the Cisco – Intel – Panduit Ecosystem brings to you:

- Ensures users a cost effective, high performance, and reliable 10 Gb Ethernet network
- Provides an end-to-end solution through interoperability and validation testing
- Provides users with an optimized solution as well as design and deployment best practices
- Provides users complete confidence in their ability to operate at 10 Gb/s data rates to support virtualization, consolidation and automation application

"The backwards compatibility of 10GBASE-T means upgrades from slower data rates can be deployed gradually, one end at a time."

Twisted Pair Copper Cabling Systems for 10GBASE-T Applications

10GBASE-T is the newest generation of the IEEE standardized copper twisted pair Ethernet technology. All of the IEEE BASE-T standards utilize RJ45 connectors and twisted pair cabling to provide 10 Mb/s, 100 Mb/s, 1 Gb/s, and 10 Gb/s data rates, with the higher data rates being backward-compatible with previous generations. This compatibility means that upgrading from one generation to the next can occur over time as needed. This allows for an incremental improvement of network speed that minimizes capital expenditure and utilizing the existing cabling infrastructure.

Based on the IEEE 802.3an standard, 10GBASE-T is a crucial technology for designing next-generation data center architectures. It is:

- A cost-effective solution – less than optical and direct attach copper cable links
- Industry standard RJ45 interface provides a quick and easy plug and play connection
- Exceptional design flexibility – supports "top-of rack", "end-of-row" and "switch-to-switch" data center architectures
- Able to auto-negotiate line rate – provides migration path from 1 Gb/s to 10 Gb/s Ethernet

Panduit offers one shielded and two UTP Category 6A copper cabling systems

- TX6A™ 10Gig™ Shielded Copper Cabling System – 100m applications
- TX6A™ 10Gig™ UTP Copper Cabling System with MaTriX – Technology – 100m applications
- TX6A-SD™ (Small Diameter) 10Gig™ UTP Copper Cabling System with MaTriX Technology – 70m applications

TX6A™ 10Gig™ Shielded Copper Cabling System

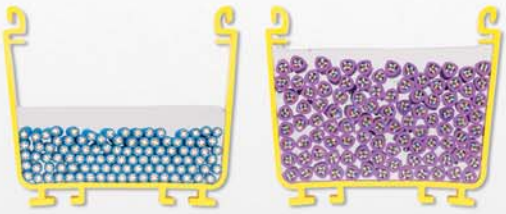
TX6A™ 10Gig™ Shielded Copper Cabling System is designed for optimum network performance, design flexibility and reliability to protect network investments well into the future. In addition, this shielded system includes a seamless termination method of grounding and bonding the complete system for more consistent EMI and RFI protection. This system provides users with headroom assurance that will exceed ANSI/TIA-568-C.2 Category 6A and ISO 11801 Edition 2.1 Class E_A standards.

TX6A™ 10Gig™ UTP Copper Cabling System with MaTriX Technology

Panduit's Category 6A UTP copper cabling system utilizes patent pending MaTriX Technology in the cable and patch cords along with advanced connector compensation techniques to achieve channel bandwidth performance above industry standard requirements. Fully compliant up to 100m, the cabling system significantly reduces cost of ownership by eliminating the need for field testing for alien crosstalk, improving energy efficiencies with better airflow management, and allows for the implementation of advanced Power over Ethernet (PoE) applications. The complete Category 6A cabling system offers both reliable 10 Gb Ethernet performance and the highest density infrastructure solution available.

TX6A-SD™ 10Gig™ UTP Copper Cabling System with MaTriX Technology

Panduit's small diameter Category 6A UTP Copper Cabling System with MaTriX Technology is a cost effective, cabling system that is fully compliant up to 70 meters. This high performance cabling system is comprised of unshielded twisted pair horizontal cable and patch cords which utilize 26 AWG copper conductors and patent pending MaTriX Technology to suppress alien crosstalk. Panduit® TX6A-SD™ Cabling requires 50% less routing space than standard Category 6A cables making it an ideal solution for cable intensive data centers.



Panduit's Small Diameter Category 6A Cabling vs. Industry standard Category 6A Cabling

QuickNet™ Copper Cabling System

Panduit® QuickNet™ Optical Fiber and Copper Cabling System is a custom pre-terminated cabling solution designed to meet unique structured cabling requirements. Easy to install, these high-density solutions provide consistent network reliability and reduce initial on-site rework. These leading-edge systems deliver ensured performance for the lowest total cost of ownership.

Pre-terminated cabling systems can be installed in 75% less time than field-termination methods, eliminating the need for on-site bundling, terminating, and testing. Moves, adds, and changes can be made immediately by local on-site network professionals, increasing productivity relative to traditional field installations. This is critical for areas that require high security and limited access, as changes to the network can be made without scheduling outside personnel.

MaTriX Technology

The patent pending MaTriX Technology embedded in the TX6A-SD™ 10Gig™ Copper Cabling System is constructed of discontinuous metallic elements that provide a very high degree of alien crosstalk suppression. This system for unshielded twisted pair cabling rivals the performance of a shielded system without the need for bonding and grounding and eliminates the concern for shield current flow arising from ground potential differences. The resulting channel performance eliminates the time and cost associated with cumbersome alien crosstalk field testing, providing an optimized alternative for deploying 10GBASE-T channel links up to 70 meters.

MaTriX Tape Technology

Real-World Solutions

With a proven reputation for excellence and innovation, Panduit and our partners work with you to overcome challenges and implement real-world solutions that create a competitive business advantage. Panduit offers the broadest range of solutions, from data centers and intelligent buildings to manufacturing operations, to help you build a ***smarter, unified business foundation.***

Technology Leadership

Panduit develops innovative physical infrastructure solutions that meet the rapidly changing needs of our clients, from hardware and software to advisory services. This commitment is supported by investment in advanced research, solutions-focused product development, world-class manufacturing, and collaboration with customers at the forefront of technology.

Partner Ecosystem

Our best-in-class partner ecosystem offers a comprehensive portfolio of services that span the project lifecycle, from planning and design to delivery, deployment, maintenance, and operation. Panduit business partners – distributors, and certified architects, consultants, engineers, designers, system integrators, and contractors – are qualified to help you achieve your objectives and realize predictable and measurable results.

Strategic Alliances

Panduit cultivates long-term strategic alliances with industry leaders, including Cisco Systems, EMC, IBM, and Rockwell Automation, to develop, optimize, and validate solutions for our customers. This investment in people and resources helps solve our customers' greatest business challenges.

Global Business Commitment

Panduit is committed to delivering a consistently high level of quality and service the world over. With a presence in more than 100 countries, local Panduit sales representatives and technical specialists offer guidance and support that bring value to your business. Our global supply chain, which includes manufacturing, customer service, logistics, and distribution partners, provides prompt response to your inquiries and streamlines delivery to any worldwide destination.

Sustainability

With a commitment to environmental sustainability, Panduit develops and implements solutions that protect, replenish, and restore the world in which we live. This commitment is demonstrated by Panduit's LEED Gold certified World Headquarters, leveraging the Unified Physical Infrastructure℠ approach to enable convergence of critical building systems to drive energy efficiency and ongoing operational improvement.

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 Printed in the U.S.A. SA-CPCB91 (Replaces SA-CPCB88) 4/2012

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