

**The Path to
Convergence:
Drivers, Challenges,
and Solutions for
the Enterprise**

The future of enterprise networks is IP convergence where signal transmission for networking, A/V, and building management and security systems are merged over one common infrastructure using common protocols rather than deploying separate closed, proprietary solutions. Enterprises face many challenges as they embark on deploying IP convergence, and most are just starting down the path. Throughout the next decade, enterprise networks will therefore continue to contain various cabling media, requiring performance, service and support across all building operating systems while ensuring the scalability, low risk, and seamless integration needed to eventually deploy full IP convergence.

A New World, A New Approach

The world as we know it is rapidly changing. The technological revolution that began with the transition of the typewriter to the personal computer and the telephone to the Internet has created a momentum for innovation far greater than even the industrial revolution of the late 1800s. In this new digital world, technology transitions are happening all around us. From the advent of the digital camera and mobile communication devices to the recent disappearance of analog television, one only has to blink to miss yet another transition that overcomes the limitations of out-dated analog technologies.

Now the need for moving more real-time data at faster rates, enhanced mobility and productivity, and improved communications is combining with a global effort to maximize efficiency, improve safety and security, and significantly reduce energy consumption – all of which forms a catalyst for rethinking building design, construction, and value. From financial institutions and medical facilities to college campuses, government centers, and hospitality venues, enterprises everywhere are adopting a new approach to the building networks that transport the signals for sharing mission-critical information, communicating with colleagues across the world, delivering high-quality audio/video (AV), ensuring security and life safety, and facilitating building automation and control.

With the ability to gather and transmit all types of information from all types of building operating systems over enterprise networks via advanced signaling technologies and protocols, it no longer makes sense for these systems to operate autonomously using proprietary, closed products and solutions. Effectively supporting and managing today's building operating systems through signal transmission is enabled by leveraging a common network infrastructure across applications, with structured cabling as the foundation for all networking needs.

While the convergence of building operating systems offers the potential for significant benefits, it also gives rise to the many challenges building owners and operators must face. To realize the true benefits of convergence over the life of the system, they must ensure that the supporting networks and systems are properly designed, that performance and reliability are optimized and the systems seamlessly integrated.

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Market Drivers

Many market drivers are responsible for the shift to improving performance of building operating systems through convergence. Faster networking transmission speeds, effective data center design and deployment, enhanced A/V performance, better security of people and property, and the ability to control building management systems are being driven by:

- Increasing amount of data and bandwidth capabilities to support day-to-day operations
- The need for enhanced access and mobility to drive user productivity
- Growing worldwide concern for safety and security
- New energy conservation and environmental initiatives
- Demand for operational efficiency and lower total cost of ownership (TCO)

Increased data and bandwidth demand

Gone are the days of traditional paper documentation. The sheer amount of digital data involved in maintaining daily operations has increased dramatically over the past decade and will continue to grow. In fact, experts predict that by 2011, the digital universe will grow 10 times the size it was in 2006, with compound annual growth rates of 59% for information and 88% for the number of data files.¹

Not only is more data being generated in the form of financial account information, transaction records, large-sized digital medical images, product SKU information, and research data, but that data is also being transmitted back and forth between users and networks across the world. Data transmission is further increasing due to the proliferation of Voice over Internet Protocol (VoIP), which has voice signals now being transmitted as data packets across networks. The amount of data exchanged will continue to accelerate with an annual growth rate of 46% for Internet data traffic and 29% for business data traffic.

The increased amount of data generated in today's enterprise must also be properly managed and stored via growing data center server farms and storage area networks. This has led to significantly higher port counts and additional equipment in data centers, requiring solutions that effectively manage more cables and connections in a smaller footprint, successfully handle increased power consumption, and ensure proper cooling.

As the amount of data and file sizes increase, so does the need for more bandwidth to effectively and reliably transmit that data. Since early 2000, data rates have increased rapidly from 100Mb/s to 1Gb/s, with the quest for even faster network connections now serving as the basis for the deployment of advanced networking standards like 10 Gigabit Ethernet. These increased bandwidth capabilities are driving the need for innovative copper and optical fiber cabling technologies able to ensure performance and reliability while supporting the faster data rates. Already standards organizations are developing network standards for transmitting data at rates of 40 and 100 Gb/s, which will require even more innovation at the physical networking level.

Enhanced access and mobility

Because we now live in a digital world, working people everywhere must have access to information and the ability to communicate no matter where they are. At the same time, the movement of goods and services must be effectively tracked and managed in coordination with the day-to-day transactions that now exist in the form of digital data. Wireless capabilities are not appearing just in laptops and personal digital assistants (PDAs), but are popping up in

security devices, inventory tracking systems, and even patient monitoring systems.

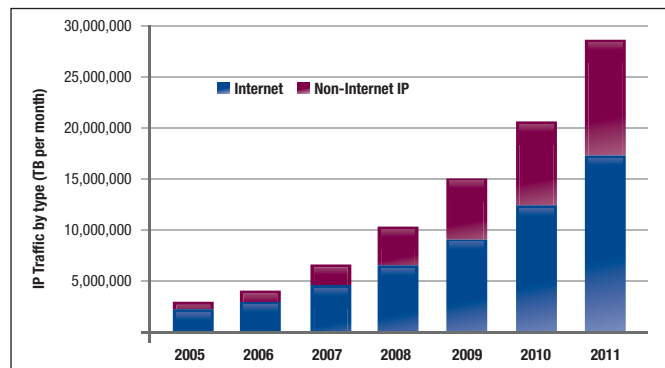
The IEEE 802.11 wireless standards have evolved significantly since their 1997 inception, improving in bandwidth, quality of service, and security. Significantly increasing from the 54 Mb/s supported by 802.11a, the upcoming 802.11n standard is expected to reach speeds beyond 150 Mb/s, and wireless products are already available.

Continued improvement in wireless standards and technologies that address new applications, usage scenarios, and deployment costs will increase enterprise wireless adoption. As enterprises deploy high-performance wireless networks as a key component of their building operating systems, they must deliver similar performance as wired networks to reliably send information to and from devices while ensuring access and mobility for user productivity and scalability to support future wireless technologies and standards.

Safety and security concerns

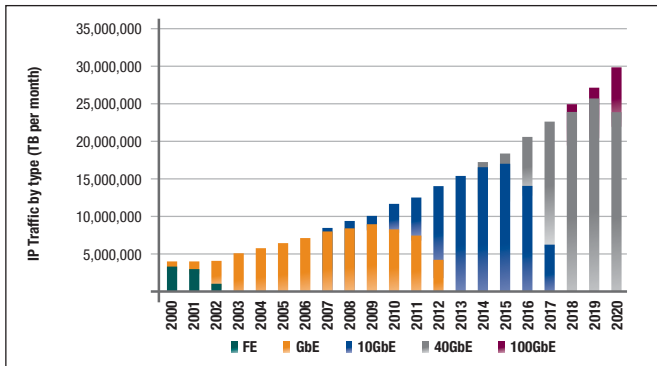
The growing need to protect people and property is likely one of the most significant movements of our time. In recent years, attacks around the globe have ramped up the deployment of security and life safety systems to where enterprises will spend over

Global IP Traffic 2005-2011



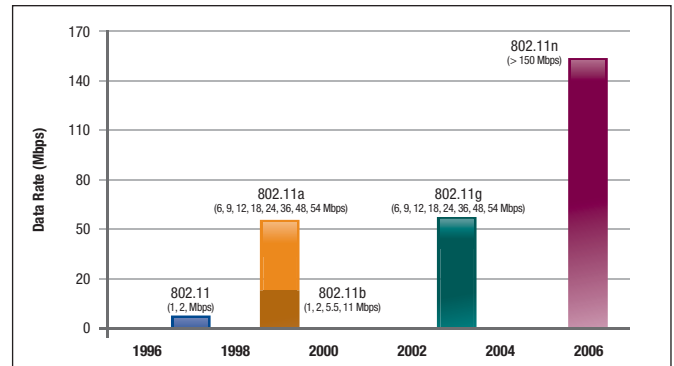
Source: Cisco, 2008

x86 Server Forecast by Ethernet Connection Type (40G & 100G)



Source: Intel & Broadcom, April 2007

Evolution of IEEE 802.11 Wireless Standards



Source: Tropos Networks

\$200 billion annually on physical and logical security products and services. From financial and medical institutions to college campuses and airports, systems like access control, video surveillance, intrusion detection, EVAC, and fire alarm and life safety systems are being installed or upgraded. New government regulations and directives are underway that will further increase deployment and improvement of these systems.

Environmental initiatives

Commercial institutions in the U.S. account for 76% of electrical energy consumption, which doubled between 1989 and 2005 and continues to rise². As the rising cost of energy takes center stage in our global economy, initiatives like ENERGY STAR and LEED that improve energy efficiency and reduce waste are fast becoming a key component of building design and construction. Through technologies that monitor, manage, and control consumption, enterprises are able to significantly reduce energy costs.

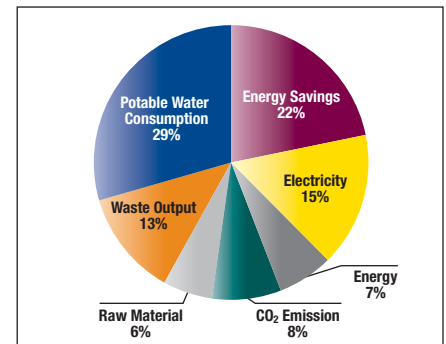
In addition to energy consumption concerns, recent "green" initiatives are impacting the entire approach to building design and construction. From recycled materials and better lighting to practices that decrease pollution and improve air quality, many enterprises strive

to create comfortable, healthier working environments. These actions can increase occupant productivity by an average of 5%, or up to 15%³, which is one of the largest potential economic benefits to constructing a green building. Overall, green buildings designed and constructed to conserve resources improve energy efficiency and create healthy working environments have the potential for huge savings and facility sustainability.

Efficiency and lower Total Cost of Ownership (TCO)

While the aforementioned key drivers are extremely significant in the movement toward converged networks for building operating systems, no other driver has quite the substantial impact as the need to lower TCO. TCO is calculated as the combination of total costs of products, installation, operation, and maintenance. Because operational costs account for 50% of a building's TCO over an estimated 40-year life span, any means of reducing that cost has a considerable impact. On the other hand, construction costs account for only 11% of TCO. Today's enterprises would therefore be wise to strategically invest in the design, products, and systems that ensure reduced operating costs and achieve a sizeable return on investment (see graphs - page 4).

Potential Resource Consumption Savings from Green Buildings



Source: US Green Building Council and Frost & Sullivan

Converged Networks

Considering all the market drivers, the ultimate solution could be a shift to converged networks that support building operating systems by successfully merging signal transmission needs for a variety of networking applications like high-speed Ethernet, VoIP, Power over Ethernet, and broadband video. In a converged network, networking applications will transmit their signals over a common infrastructure using structured cabling rather than separate closed, proprietary solutions.

Convergence can start at a lower level where the various networks transmit signals over a variety of cabling media while sharing conduit and pathways and reaping the benefits of one central management and operations center. For example, data from the corporate LAN may be transmitted on twisted-pair copper in the same pathway as coax that is transmitting video from security cameras. Both systems can then be managed from one data center where head-end equipment for each system can coexist, communicate, and take advantage of shared resources such as storage area networks, power distribution and cooling systems. This is also the point where information from each type of building operating system can be transmitted over the Internet to remote locations.

At a higher level of convergence, building operating systems can be deployed using Internet Protocol (IP) to transmit system information as IP data packets over one Ethernet network using routers and switches. Ethernet has become the most widely deployed network technology for transmitting IP data signals between two hosts across packet-switched networks. In recent years, Ethernet and IP have advanced to the point where it can now be used to transmit voice, video, security, industrial control, and building management information as data signals across the network.

Total IP convergence will allow several building operating systems to operate as open networks that use the same cabling media and send data signals using a common protocol. Data from various systems can then be centrally managed from one interface vs. separate equipment and more easily shared between applications for even more simplified and efficient building operations. With IP convergence, a network login can more easily interface with the security access control system to make sure the user did in fact enter the building. Security personnel can check surveillance cameras from anywhere on the network, or even wirelessly from remote locations. Critical alarms and notifications from life-safety systems can interface with the corporate LAN and phone system to send alerts to PCs, pagers, and even cell phones of those responsible for facility management. Lights can automatically go on in an evacuation situation, and air-handling units can automatically shut down when smoke is detected. The possibilities are endless.

Through total IP convergence, building operating systems can work together to ensure maximum data transmission performance and bandwidth capabilities, enhanced access and mobility, improved safety and security, reduced energy consumption, and better working environments – all of which ultimately result in simplified building operations and lower TCO.

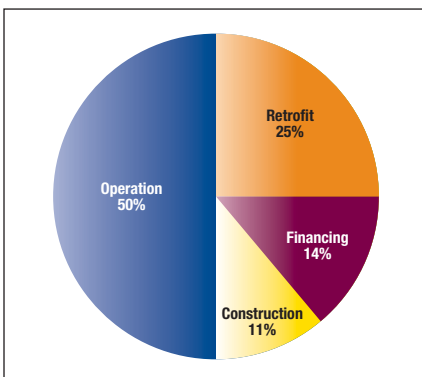
Levels of Convergence

While total IP convergence ultimately connects more systems and has the potential to provide the maximum benefits of integration, many enterprises are just starting down the path to convergence. Not every enterprise is ready to adopt the IP protocol for all building operating systems, and not every enterprise is ready to run building operating systems over one common network.

The level of convergence that enterprises deploy depends on several key factors such as cost of new equipment, the applications being supported, networking expertise within specific departments, and the overall environment. For example, if an enterprise has existing, working video equipment and a well-functioning security department with expertise in coax cabling and related standards, it may not be cost effective to move to video over IP and replace cameras and head-end equipment until the existing equipment requires replacement.

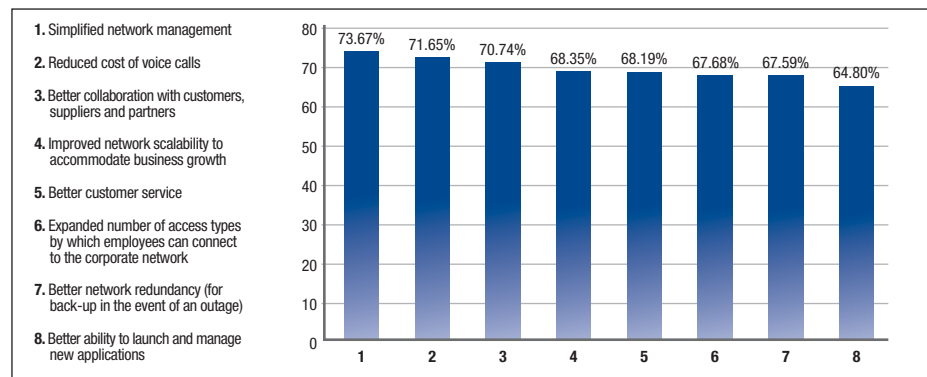
Some enterprises may also be reluctant to deploy IP convergence due to network security concerns. Some government facilities may require separate secure networks for certain building operating systems, preventing that system from residing on a common network. Others may simply be concerned about potential viruses and hackers gaining access to confidential

A Building's Life Cycle Costs Over 40 Years



Source: ASHRAE

How valuable are these benefits of network convergence to your business? (Share responding "important" or "critical")



Source: Economist Intelligence Unit/AT&T Survey, June 2006

information through the increased number of possible entry points to the network that occurs with IP convergence. Adequate network security measures must be properly implemented throughout the entire IP convergence deployment process. Fortunately, software vendors are continuing to develop better network security solutions such as data encryption, firewalls, and traffic regulation. Despite security concerns, the many benefits of IP convergence have caused the number of enterprises moving towards some level of IP convergence to remain high.

The path to convergence can begin on many levels from just trial convergence in small, localized systems to complete enterprise-wide deployment with all systems reaching total IP convergence. Enterprise customers should seek a level of convergence that meets their unique needs, facility and applications. Regardless of the level of convergence, this new approach to the networks that support all building operating systems can provide significant benefits to meet the needs of today's enterprise. The signals transmitted across networks to and from the devices and sub-systems of each building's operating systems can now be transmitted through common pathways and controlled from one central location, reducing the expense associated with deploying and operating multiple independent building systems in separate pathways and locations.

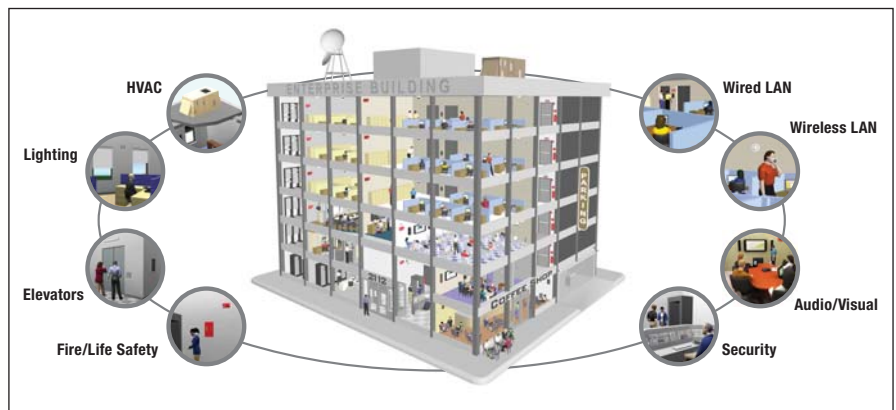
Deployment Challenges

Converged building operating systems are ideal for today's enterprise facilities, but deployment gives rise to many challenges. While technology to ease convergence continues to evolve and advance, several solutions exist that enterprise customers can consider to help them overcome the challenges when starting down the path to convergence.

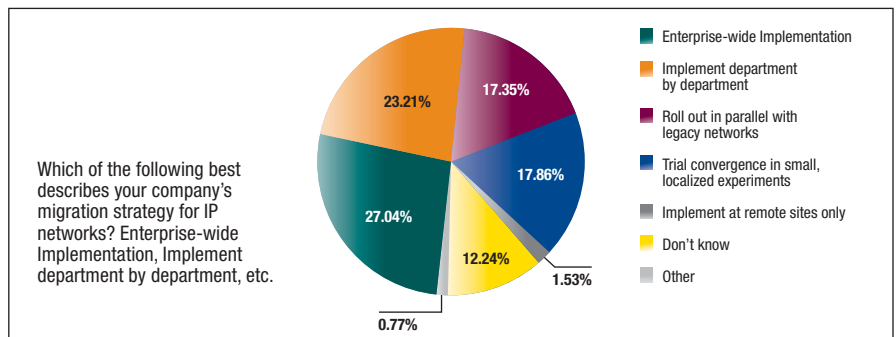
Challenge 1: Properly designing the system to support current and future technologies

The first challenge of deploying converged networks is to determine the right level of convergence and proper design based

Single IP Network vs. Multiple Proprietary Networks



Migration Strategy for IP Networks



Source: Economist Intelligence Unit/AT&T Survey, June 2006

on the unique needs of the environment. The design of the networks and data center where all systems come together must also ensure security of information and scalability for future expansion and technologies, as well as support for moving to a higher level of convergence. Enterprise facilities have a typical lifespan of more than 10 years between major retrofits, and without scalability and future support, an enterprise could be looking at huge expenditures down the road.

Solution:

With technology still rapidly evolving and the shift to total IP convergence just starting, enterprises must seek out partners with the expertise and range of products to properly

design and implement all levels of network convergence for building operating systems based on unique needs, applications and the type of environment. From commercial buildings, data centers, and campuses to financial institutions, hospitals and municipalities, every environment has unique needs, and enterprises should never get locked into choosing a single solution for a specific application, but should be able to choose from various solutions, such as having access to both coax and twisted-pair from the same supplier for transmitting video signals. At the same time, networks should enable interoperability and easy upgrades to systems without having to alter the supporting cabling infrastructure or experience downtime,

even when new equipment displaces old. Because no one knows what the future of convergence will look like, products that go into building networks should also be backed by a vendor with the financial strength, leadership, and expertise to develop new solutions and innovative technologies.

Challenge 2: Ensuring maximum performance and reliability of a myriad of systems

With so many building operating systems, many of which are critical to health and human safety, system failures are unacceptable now more than ever. While many corporate LANs have achieved 99.999% (Fiber “Nines”) reliability, maintaining that same performance for all networks that support an entire building is a significant challenge.

Solution:

Ensuring maximum performance and reliability starts with networks that are comprised of products tuned to work together, such as an end-to-end structured cabling system with guaranteed performance versus individual components. Each system should also ensure unparalleled signal integrity across all building operating systems and provide ample bandwidth and reliability to avoid failures.

Challenge 3: Maintaining low financial risk and high ROI

While convergence has clear life-cycle cost benefits, many enterprise customers are concerned about proving the value of initial investments, requiring careful risk assessment. Because reduced operational costs have the most impact on ensuring lower TCO, evaluating how specific products and solutions will ultimately simplify and improve building operations is a key part of ensuring a high return on investment (ROI).

Solution:

Regardless of the level of convergence, enterprises can reduce risk and achieve high ROI by selecting systems and products designed with features that provide ease of deployment, seamless integration, and cost-effective management over the life of the systems.

Challenge 4: Meeting codes, regulations, and standards

When embarking on converged building operating systems, each system will still need to comply with applicable local and national codes, regulations, and standards. As security and life safety concerns increase, and more environmental initiatives get underway, the amount of standards and regulations that enterprise customers need to meet could continue to increase in the near future. Higher-education facilities, for example, are already being targeted for regulations that require better evacuation systems.

Solution:

Access to a variety of solutions for each type of building operating system and comprehensive knowledge of their related codes and standards is the first step in achieving proper compliance. Partnering with vendors that offer a broad range of products, have close ties with standard-making organizations and have achieved the global presence to address diverse needs across all locations, can go a long way in making sure that every applicable code, regulation, and standard is met when deploying converged networks for various building operating systems.

Challenge 5: Locating qualified design and installation partners

One issue facing enterprise customers is the need to find qualified design and installation partners with the knowledge and experience to deploy individual systems while understanding how to best address all levels of convergence and provide support for moving to total IP convergence.

Solution:

Because every enterprise is different, those that design and install converged networks must have a keen knowledge of and the flexibility to deploy products and systems to meet a variety of unique needs and environments — from data centers, financial institutions, and healthcare facilities to college campuses, municipalities, and a variety of commercial and hospitality venues. Today's enterprise must also select design and installation partners with access to an efficient supply chain network that allows them to more easily and effectively acquire the right products and solutions for each system.

Challenge 6: Ensuring on-going service and support for the life of the network

Many enterprise customers are wary of embarking on a significant technology deployment like converged networks and fearful of getting left in the dark if maintenance, upgrades, or just advice is required in the future.

Solution:

Equipment and component vendors and design and installation partners that offer a complete suite of value-added services can help ensure on-going service and support for the life of the network. These services should address initial concept, design, and deployment, followed by post-installation service, long-term maintenance programs, warranty assurance, and a total commitment to customer satisfaction.

Why Belden Total Enterprise Networks?

Belden understands that the path to convergence is just that – a path – and every enterprise is at a different location along that path, and there is no one right answer to all installations. Belden is uniquely positioned to help enterprises design and deploy networks based on the level of convergence that best fits their individual needs and applications while ensuring the scalability and support to continue along the path to total IP convergence.

Experience

In today's world, building a solid foundation for converged networks takes more than just a 'supplier' – it takes a partner with proven experience and credentials. Belden delivered its first products more than 100 years ago and has evolved to become one of the industry's leading manufacturers of signal transmission solutions for building operating systems. Belden's experience is deep and proven and spans virtually all sectors including finance, health, high technology, education, government, and energy.

Expertise

Today's building operating systems must support a staggering array of devices, users, protocols, and architectures. Belden has the expertise to address all diverse signal transmission needs through one of the industry's most comprehensive product portfolios, organized into solutions for virtually all enterprise applications including wired and wireless data networking, industrial networking, audio/visual and security networking, and building automation and management.

Corporate strength

Enterprise networks are long-term investments that must provide many years of reliable service while fully supporting the increasing demands of each new generation of systems and applications. As a multi-billion dollar public corporation with more than 100 years of continuous operations, Belden has a clear record of financial strength and operational excellence and is well positioned to grow and expand even in today's challenging economic conditions.

Global presence

One of the keys to successful enterprise-wide convergence lies in developing and standardizing on reliable solutions, and then replicating those proven solutions throughout the enterprise. Belden operates on a true global basis with sales, service, and support operations throughout the Americas, Europe, Africa, and Asia/Pacific. Belden's design, distribution, and installer network has the experience and proven processes necessary to ensure the successful deployment of networks across the world.

The Belden Total Enterprise Networks Approach

Belden has a real approach to converged networks from the ground up. It all starts with a remarkable set of innovative enabling **technologies** that provide maximum performance, enhanced access and mobility, improved safety and security, better control and efficiency, and lower TCO across building operating systems.

These groundbreaking technologies then allow Belden to specifically engineer, manufacture, and verify a breadth of high-quality **products**, like Belden's Bonded-Pair Cables, that support the various systems.

Belden technologies and products are only as good as the people who design, install, and service the applications they support. That is why Belden invests heavily in evaluating, training, and qualifying only the best design and installation **partners** for each building operating system.

Through innovative technologies, quality products, and qualified partners, Belden delivers a full range of high performance copper, fiber, and wireless network infrastructure **systems** to successfully transmit signals throughout the enterprise.

Belden combines leadership, product and system offerings, and expert service and support to provide any enterprise with the **solution** for converged networks – **Total Enterprise Networks**.



Breadth of product line

Every enterprise has unique installation requirements for converged networks. With more than 250,000 product part numbers available, Belden has the product portfolio to ensure that enterprises won't get locked into a single technology. Belden provides enterprises with access to a broad and deep portfolio of components that seamlessly integrate into reliable, high-performance networks for a variety of building operating systems signal transmission needs. So whether it's twisted-pair, fiber, or coax needed to transmit a video signal, Belden has the products and expertise to help customers make the right choice for their unique needs.

Solution provider philosophy

Individual components are of little value until they are installed as a network, and enterprises need to invest wisely and not risk mixing and matching products. A recognized industry leader in bringing a solutions approach to the infrastructure technology segment, Belden delivers end-to-end solutions rather than just supplying individual components. Whether it's transmitting the voice and data signals for daily operations and communications, managing high-density cabling in the data center, ensuring productive video conferences, controlling the air-handling units, evacuating a building, or helping in the detection of a fire, Belden has the signal transmission solution for virtually every building operating system.

Strong business partner network

The value and effectiveness of converged networks requires more than just the supply of high quality, high performance products and systems – it requires the resources and services of established, fully-trained professional business partners who will optimize the design, installation, service and logistical supply of

systems wherever and whenever needed. Belden offers one of the industry's strongest networks of professional business partners with proven histories and extensive experience in the markets they serve and the technologies they support, having mastered every aspect of their respective building operating systems to provide superior guidance, flexibility, and performance when designing and deploying converged networks.

Support and service

Understanding and assessing unique signal transmission needs, providing consultative support, and delivering comprehensive client service are critical for meeting the needs of today's enterprise as they embark on the path to convergence. Belden offers a complete suite of value-added services that support customers from initial concept and design through to post-installation service and long-term maintenance. All Belden systems are backed by a series of warranty programs to best suit the needs and expectations of enterprise customers.

R&D innovation

Improving performance, reliability, manageability and ease-of-use are driven by innovation through a commitment to R&D investment and vision. With more than 600 current patents or patents pending, Belden has a proven track record of product and technology innovation and industry-firsts spanning virtually all aspects of enterprise signal transmission, including innovative cable design and connection technologies for better performance, improved flexibility, and easy installation. Belden continues to invest in R&D to ensure that customers' networks remain at the forefront of current technology and are well positioned to adopt and adapt the technologies of the future.

Industry leadership

To ensure that building operating systems comply with codes, regulations and standards while meeting tomorrow's inevitable changes in technologies, Enterprise customers need a partner who is truly an industry leader. Few companies can match Belden's commitment to the advancement of the networking industry through participation in a wide spectrum of industry initiatives. By working closely with domestic and international standards organizations, industry associations, user groups and technology alliances, Belden is able to remain abreast of current and future directions in technologies and applications.

Only From Belden

When going down the path to convergence and deploying the networks that transmit the signals to and from enterprise building operating systems, Belden provides a proven solution. Belden Total Enterprise Networks offer superior performing products/systems designed and installed by the best partners in the industry under a total quality approach – all fully supported by the best warranty program that will likely never have to be used.

As data rates get faster, people become more mobile, threats become more serious, environmental initiatives expand, and costs continue to rise, Belden is the brand that customers can count on for the best performance and reliability, expert care and advice, and lower TCO for converged networks of all levels.

Call **1.800.BELDEN.1** or visit the web site at www.belden.com/enterprise for more information on the products and solutions that make up Belden Total Enterprise Networks.

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