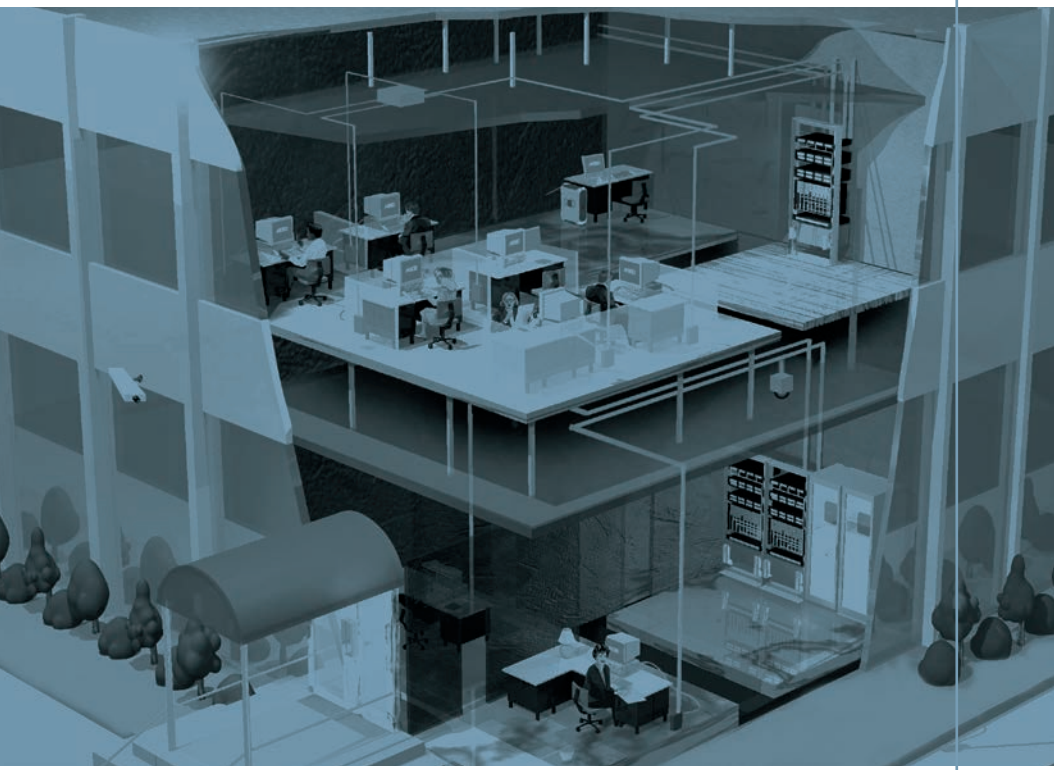
Security Infrastructure Resource Guide



Best Practices for Building a Reliable Foundation for Your Security System

ANIXTER

Anixter is a leading global supplier of communications and security products, electrical and electronic wire and cable, fasteners and other small components. We help our customers specify solutions and make informed purchasing decisions around technology, applications and relevant standards. Throughout the world, we provide innovative supply chain management solutions to reduce our customers' total cost of production and implementation.

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INTRODUCTION

When considering a security system deployment or upgrade, it's common for end users and installers to focus on the electronics at the expense of the cabling infrastructure. Many may assume that cabling infrastructure, like building plumbing, is by default adequate, and will support the security system reliably for the life of the building. Unfortunately, nothing could be further from the truth!

Whether you're planning the design and installation of a traditional analog coaxial system or a modern IP security system, your cabling infrastructure matters enormously. It can be the single point-of-failure if not planned and installed correctly. It's also essential to use the right infrastructure products for the application, pay attention to performance standards, and follow best practices.

Anixter has achieved an industry leading reputation and worldwide commercial business based on understanding cabling infrastructure. We have assisted our customers in designing and building systems that are solid, reliable, and intended to last. This guide provides an overview of what should be considered when specifying and installing a dependable and high quality security infrastructure.

CURRENT TRENDS AND BUSINESS DRIVERS AFFECTING CABLING INFRASTRUCTURE

THE BUSINESS DRIVERS

Protection

Natural disasters and terrorism have heightened awareness regarding the need for increased security. Governments and corporations want to create safer environments, increase protection of people, assets and information and provide rapid and informed disaster response. Video surveillance and access control systems are the logical solutions to meet these goals. Today's security systems must protect individuals and corporations from theft, and they must also play a major role in national security and economic, environmental and civil defense.

Prevention and Predictive Technology

IT security applications now offer more advanced benefits than legacy security systems. Modern security systems must do more than simply record an event. Predictive technology is being implemented to help prevent crimes and attacks, as well as manage even mundane events such as traffic jams. Some examples of proactive applications include an airport surveillance system that automatically detects when luggage has been abandoned, or when a car is stopped on the side of the highway in a “no standing” zone.

Integration

An effective security system should also be able to communicate and share information with other systems and various building applications. Integration can provide additional operator control, better data, faster response and reduced costs. An example might be a video surveillance camera which only records when triggered by the access control system monitoring a protected door or hallway entrance. Today, video surveillance systems can be integrated with access control, building automation and fire/burglar systems. Integration can help reduce overhead costs if the applications are being managed through one workstation.

SECTION 2

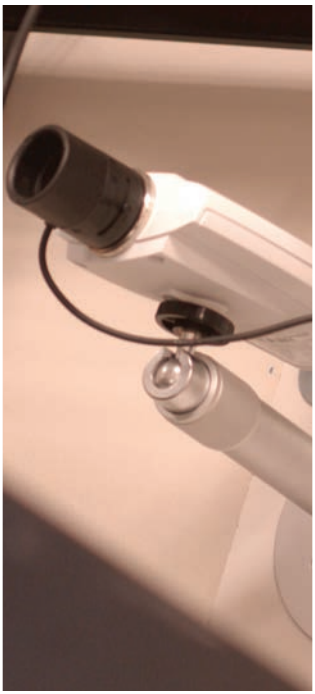
Current Trends and Business Drivers Affecting Cabling Infrastructure Decisions

Current Trends and Business Drivers Affecting Cabling Infrastructure Decisions

TECHNOLOGY TRENDS IN SECURITY SYSTEMS

One of the most widespread trends in security is systems convergence, manifested in the migration from analog to digital devices and networked systems. Ethernet LANs and the Internet Protocol (IP) allow security information (including video) to be treated like any other computer data. This approach allows authorized access to data anywhere at anytime. It also permits data to be managed, manipulated and analyzed onsite or remotely. Accordingly, business goals of event prevention and systems integration can be realized by implementing IP or hybrid devices on networked security systems.

IP networked security utilizes a standardized approach to cabling infrastructure. Currently, there are no universally accepted standards for the installation or performance of traditional coaxial, analog video surveillance systems. Ethernet networks in the data world have well established standards for design, specification, installation and performance. These standards confirm that all the components work well together, and that the infrastructure supports the network and enables consistent, reliable and superior performance.



CONVERGENCE OF SECURITY AND IT

Security systems are becoming IP-enabled. As a result, company security and information technology personnel are increasingly finding it necessary to work closer together. According to CSO Magazine, IT organizations will continue to gain more security system influence over time and they will often end up actively managing security devices and infrastructures. Accordingly, they will buy and support what they understand and are comfortable with.

It is important for security installers dealing with IT organizations to understand IT goals and concerns, and to position their value and expertise accordingly. Integrators also need to speak the language and understand the goals and challenges of IT professionals if they are to gain their trust and capitalize on participating in the rapidly evolving security market. Security integrators can bring a wealth of security industry knowledge and experience to the IT professional who may be new to security. A comfortable level of knowledge in both security and IT will differentiate a security integrator from competitors who may be falling behind the convergence learning curve.

The benefits of IT standards in the network cabling industry also apply directly to the security market. Well-designed coaxial security systems, as well as more advanced digital network systems can enable security integrators to differentiate their offer from competitors by providing quality infrastructure work and consistent system performance. Utilizing IT network wiring best practices makes good sense and increases the integrator's value to the IT customer.

IT Goals That Will Influence Security Project Decisions:

Scalability

- Add/remove devices wherever/whenever required (moves, adds, changes)
- Facilitate analog to digital and IP networked migration
- New IT growth accounted for up-front

Manageability

- Structured (vs. unstructured) approach to infrastructure design and maintenance
- Remote management and control
- Automatic alarm monitoring and troubleshooting
- Good documentation and administration (Sarbanes Oxley driven)
- Centralization and consolidation of resources
- Standards-based (ANSI/TIA/EIA, ISO, IEEE, etc.)

Availability (24x7x365)

- Reliability
- Minimal downtime
- High performance network infrastructure and support systems

SECTION 3

Current Infrastructure and the Benefits of Standards

Current Infrastructure and the Benefits of Standards

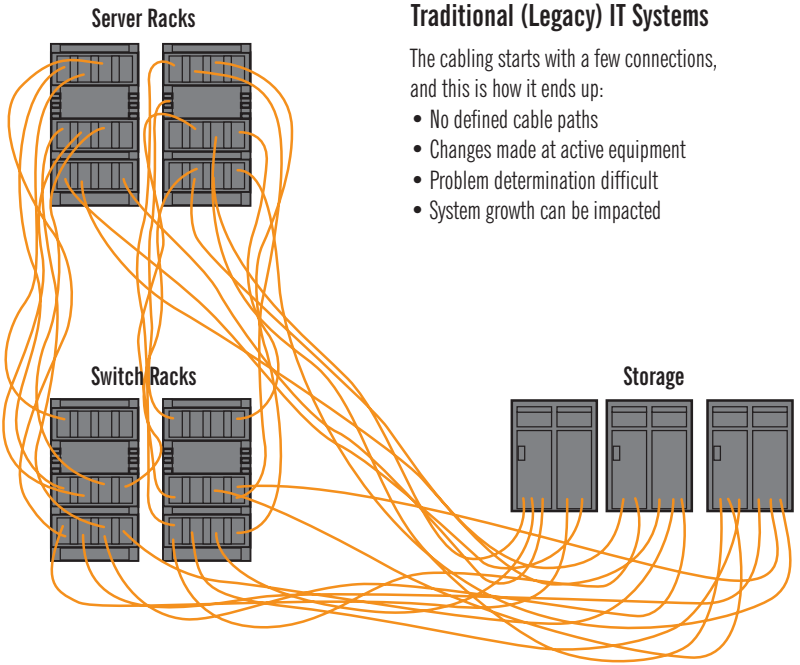
STRUCTURED CABLING HISTORY

IT organizations were not always so structured. It took more than a decade to adopt and implement the solid infrastructure foundation they enjoy today. It is very relevant for security professionals to understand how data cabling used to work, how it evolved over time and what standards were adopted to meet their needs.

Data systems, like many security systems today, ran on coax cables with each connection requiring a home run back to a computer room. Once the computer market took off, IT departments had to connect and maintain thousands of devices which made this approach very costly and difficult to manage.

In the mid 80's, all systems adopted a "hub and spoke" design or "star-wiring" method to alleviate cumbersome management and re-wiring of all the home run cabling. This approach drove troubleshooting and installation costs down dramatically. Now, a patch cord is simply added or moved from one port to another on a patch panel instead of pulling an entirely new cable to add an additional device.

Today with the digitization of video, what were once separate video, voice and data systems, can now be merged onto one common cabling infrastructure.



Traditional (Legacy) IT Systems

The cabling starts with a few connections, and this is how it ends up:

- No defined cable paths
- Changes made at active equipment
- Problem determination difficult
- System growth can be impacted

IT Challenges:

- Thousands of devices to manage
- Users expect instant response
- System uptime tied to system availability
- Constant moves, adds and changes
- Infrastructure revision control critical to support
- Interoperability of devices, networks and applications

Benefits of IT Infrastructure Standards:

- Industry standards provide infrastructure consistency, quality and measurable performance
- Guidelines for installation, maintenance and testing improve availability and reduce expense associated with downtime
- Infrastructure support and training expense minimized by utilizing one common cabling system for all communication and security systems

STRUCTURED CABLING STANDARDS

Standards have changed the look and feel of IT networks solving many connectivity, maintenance and troubleshooting challenges. The three standards relevant to IT infrastructure are the Institute of Electrical and Electronics Engineers (IEEE), the Telecommunications Industry Association (TIA) and the International Organization for Standardization (ISO).

Ethernet Standards

Institute of Electrical and Electronic Engineers (IEEE) Standards - Globally Recognized

The IEEE writes the standards for Ethernet electronic components, wireless Ethernet and Power over Ethernet (PoE). The IEEE relies on the TIA and ISO standards bodies to specify the infrastructure specifications.

- 802.3, Ethernet
  - Both copper and fiber media types
  - 10/100/1GBase-T (Gigabit)
  - 10GBase-T (10Gbps over twisted pair, 802.3an)
- 802.3af, Power over Ethernet
  - The standard for injecting power over Ethernet cabling
  - PoE Plus is newest project to date (802.3at)
    - PoE Plus is the higher watt standard (>30 watts standard for PoE)
  - Expected completion date in 2008
- 802.11, Wireless
  - 802.11b, 11 Mbps, 2.4 GHz
  - 802.11g, 54 Mbps, 2.4 GHz
  - 802.11a, 54 Mbps, 5 GHz
  - 802.11i, Wireless LAN Security Standard
  - 802.11e, Wireless QoS Specification
  - 802.11k, Radio Resource Management Standard
  - 802.11n, 100 Mbps

Telecommunications Industry Association (TIA) Standards

The TIA writes standards for North American cabling infrastructure including Unshielded Twisted Pair (UTP), fiber optics and coaxial systems. Cabling component and system performance is covered as well as installation practices.

The system components covered by TIA standards include:

- Connectors
- Outlets
- Jacks
- Cable
  - Twisted pair copper
  - Multi-mode and single-mode fiber
  - Coaxial cable
- Patch panels
- Patch cables
- Raceways and pathways
- Support products

For more detailed information on networking standards, order Anixter's Standards Reference Guide (Anixter Part No. 251937) or log onto anixter.com/standards.

TIA North American Standards

- TIA/EIA-568
  - B.1 – General cabling infrastructure requirements
  - B.2 – Balanced twisted pair cabling components
  - B.3 – Optical fiber cabling components
- TIA/EIA-569-B - Telecommunications pathways and spaces
- TIA/EIA-606-A - Administration for commercial telecommunications infrastructure
- TIA/EIA-J-STD-607-A - Commercial building grounding and bonding requirements for telecommunication
- TIA/EIA-942 - Data centers

International Organization for Standardization (ISO)

ISO writes standards for cabling system and component performance and installation practices used primarily in Europe. The proposed ISO standard for 10 Gigabit Ethernet cabling infrastructure is more stringent than the TIA's. Because we serve multi-national and international businesses, Anixter's Enterprise Cabling and Security Labs test to these tougher ISO global requirements for 10 Gigabit Ethernet cabling.

National Fire Protection Association (NFPA)

Two new standards have recently been signed by the National Fire Protection Association (NFPA). These will greatly affect the way all security systems are designed and installed in the future.

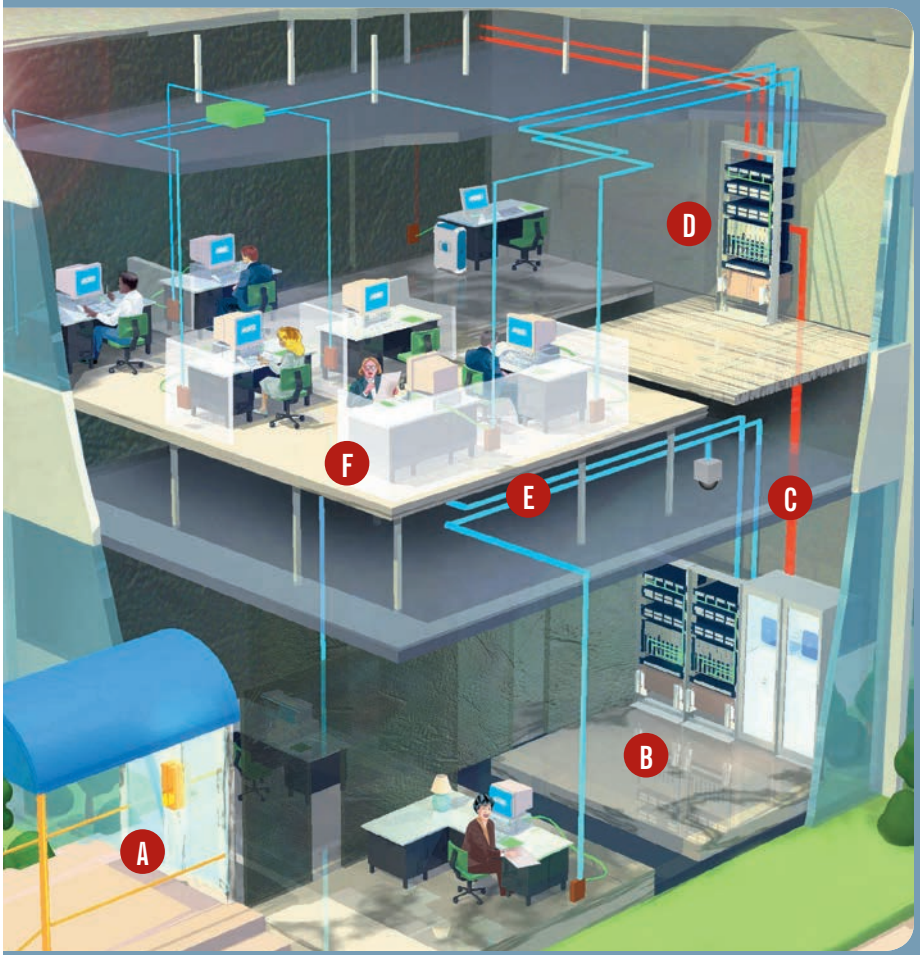
- NFPA 730, Guide for Premises Security, describes construction, protection, occupancy features and practices intended to reduce security vulnerability to life and property. It covers security plans, interior protection, exterior protection, security guards, special events and security measures for occupancies.
- NFPA 731, Standard for the Installation of Electronic Premise Security Systems, covers the application, location, installation, performance, testing and maintenance of physical security systems and their components.

TODAY'S IT INFRASTRUCTURE

TIA/EIA-568-B.1 Subsystems of a Structured Cabling System

The TIA/EIA-568-B.1 standard has defined the following six subsystems of a structured cabling system: (See diagram on opposite page).

- **A** Building Entrance - The demarcation point or service "hand off" from the telecommunications carrier. Voltage and surge protection and cable cross connect and termination points are found here.
- **B** Equipment Room - Large electronic equipment is found here (i.e. computer mainframe). It's the main distribution and cross-connect point to the building or campus backbone.
- **C** Backbone Cabling - Carries information between floors, equipment rooms and between buildings. Often fiber is the main media used in the backbone.
- **D** Telecommunications Room - Where cross-connect occurs between backbone and horizontal cable. Some electronic equipment may be found here (i.e., data switches).
- **E** Horizontal Cabling - Cable from telecommunications closet to user information outlets in work areas.
- **F** Work Area - End termination point of cabling system in information outlet. Patch cables provide modular connection to devices (i.e. PCs, phones etc.)



Structured IT Infrastructure Drawing Key:

- **A** Building Entrance
- **B** Equipment Room
- **C** Backbone Cabling
- **D** Telecommunications Room
- **E** Horizontal Cabling
- **F** Work Area

BENEFITS OF STRUCTURED CABLING STANDARDS

Standards allow data networks to become what IBM in the late 80's dubbed "the 4th utility."

The key benefits of a utility are predictability, availability and repeatable, reliable performance. When you plug an electrical appliance into an outlet, you expect to get electricity to power your device. It's not something you even think about - it's just there and you expect it to work every time.

Similarly, when you plug a jack into an information outlet, you're connected to the network via a standards-based structured cabling infrastructure, and it works.

In addition to convenience and availability, other advantages of structured cabling standards include easy moves, adds and changes (MACs), efficiency and cost-effectiveness. They also provide a single system that the IT organization can support and supply data, video and power distribution to IP devices as well as one system to train support personnel.

Another issue addressed by the standards is thermal management. In equipment rooms, headends and data centers, there is added cable density and more equipment in smaller spaces than ever before. This is creating more heat in closets and data centers for several reasons. The more compact advanced electronic devices become, the hotter they get. An unstructured, unmanaged cabling plant creates air dams that block airflow, increasing the heat around sensitive equipment. Following cable management and data center design practices will ultimately increase the life and availability of expensive electronic equipment such as servers and digital video recorders.

Current Infrastructure and the Benefits of Standards

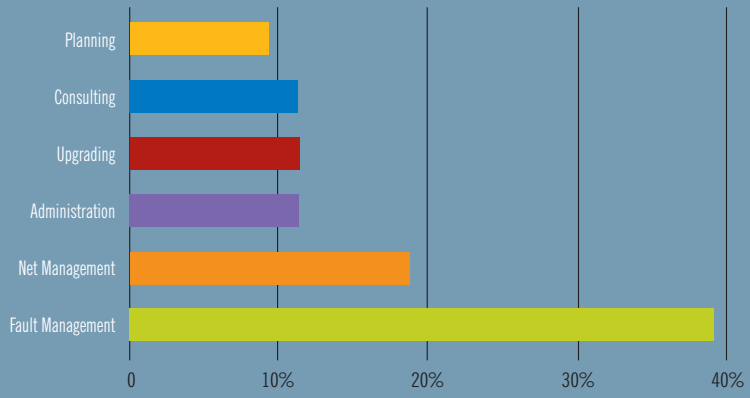
Some people believe that cabling is a commodity, so why spend more than just the minimum in terms of money, time and effort? As long as the infrastructure meets the minimum standards, why invest more?

Since the early 90's, Anixter has promoted the virtue of installing cabling infrastructure that not only meets standards, but also exceeds them from an electrical performance standpoint. Network cabling manufacturers have also endorsed Anixter's position of installing higher quality cabling and components engineered to work together as a tuned system.

A properly designed and installed cabling system that reduces faults can increase productivity for an IT department.

Possibly, the greatest benefit is the time and money saved troubleshooting each interconnection. When you install structured cabling, poor installation practices and unexpected environmental variables can reduce the performance of the system. If the cabling system is minimally compliant to begin with, then it may fall below the minimum threshold needed for transporting data.

Anixter lab tests and industry studies have shown that the cabling system can cause significant network performance problems. Since fault management can be a major drain on IT resources, investment in a high performance cabling system can yield substantial savings in time and money.



MEDIA TYPES

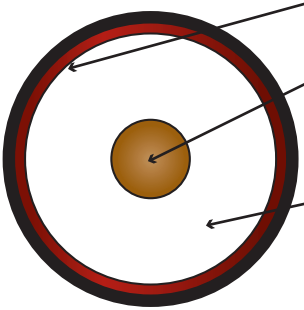
Coax

Coax cable has performed well for decades. It is a powerful media and has exceptional bandwidth.

Surprisingly though, there are no universal standards governing the specification, installation and termination of a coaxial-based security infrastructure, and testing is not typically required to certify video transmission performance at job completion.

While coaxial solutions can be a great choice for legacy video surveillance, some of the drawbacks include an inability to support the newer IP network-based security applications, difficulties in troubleshooting, and in some cases, the physical space required for termination and in pathways.

Coaxial Cable Construction



Shield (signal ground)
Typically 95% bare copper or tinned copper braid

Center Conductor (+ signal)
Typically solid copper for CCTV and copper clad steel for CATV
22-20 AWG for RG59
18 AWG for RG6
14 AWG for RG11

Dielectric
Can be solid nylon or polyethlene foam

Note: There is a wide variable in constructions for the various coax cables available on the market today, and these differences can dramatically affect the quaility of the video image.

Pros and Cons of Coax

Pros

- Baseband and broadband video support
- Easy termination
- Good noise rejection if installed correctly
- Coax will always outperform UTP at similar distances
- Troubleshooting

Cons

- Lack of standards governing installation
- No laboratory or field testing procedures established
- No migration path to IP-based applications
- Increased pathway space required
- Overall cost of installation is high

Unshielded Twisted Pair (UTP)

The Bell Telephone System originally used UTP. When data networks started popping up, many different cabling schemes were used including coaxial and twinaxial cables, shielded twisted pair (STP) and unshielded twisted pair (UTP). Interest in UTP arose because of its small diameter, excellent noise cancellation, lower cost and ease of use and installation. The original telephone grade UTP was not built for carrying high-speed data, but over the years as Ethernet became the dominant LAN technology, the design of UTP was continually tweaked to support Ethernet and its incremental speed improvements. Today, the latest UTP cables are capable of supporting sustained data rates of up to 10 Gigabits per second.

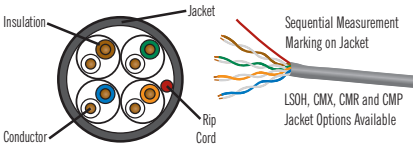
Like coax, UTP is also rated in terms of its frequency carrying ability. The frequency rating corresponds to its ability to handle complex digital encoding schemes while at the same time being able to effectively reject noise and control inductive coupling between pairs. Today's cable construction and high quality materials have resulted in several categories of high performance standards-compliant UTP.

A minimum Category 6 cable and components are recommended for CCTV and IP video applications.

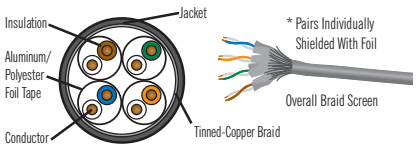
Categories of Twisted Pair Media

- Category 5e/Class D - 100 MHz
- Category 6/Class E - 250 MHz
- Augmented Category 6/Class E_A - 500 MHz
- Class F - 600 MHz
- Class F_A - 1,000 MHz (pending)

UTP Cable Construction



S/FTP* Cable Construction



Pros and Cons of UTP

Pros

- Universally standardized for Ethernet and IP-based applications
- Supports baseband CCTV
- Easy to test and troubleshoot
- Flexible, multi-platform support
- Delivers power to Ethernet devices from central source
  – Phones, cameras, wireless access points
- Moves, adds and changes (MACs) are easy

Cons

- Limited to 100 meters for IP-based applications
- Limited distance support for CCTV
- Typically requires use of isolated power for cameras

Application Support

Network application requirements will dictate the level of performance needed by the network infrastructure. As an example, a purely data-centric network can contend with low levels of frame loss or delay and still operate with little effect on the end user experience. A user downloading a file from a server still gets their file. While it may take longer to transfer the file on a network operating with operational inefficiencies, the application still completes its function.

However, real-time applications like voice and video are different. Packet/frame loss and network delay will have a detrimental effect on IP-based voice and video applications. Since data is transferred in real-time and is using a connectionless or best effort delivery protocol (UDP), any lost data will translate into a much poorer end user experience. The net effect will be corrupted video and voice transmission. The table below summarizes the network design criteria for supporting various applications:

Application Requirements

	Data File Transfer	Data Interactive Application	Real-Time Voice	Real-Time Video
Response Time	Reasonable	Within a Second	100 ms of Delay with Low Jitter	Minimum Delay and Jitter
Throughout / Packet Loss	High/Medium	Low/Low	Low/Low	High/Minimum
Reliability (Downtime)	Reasonable	Low	Low	Minimum

Source: Cisco Systems

Zero -downtime for mission-critical applications

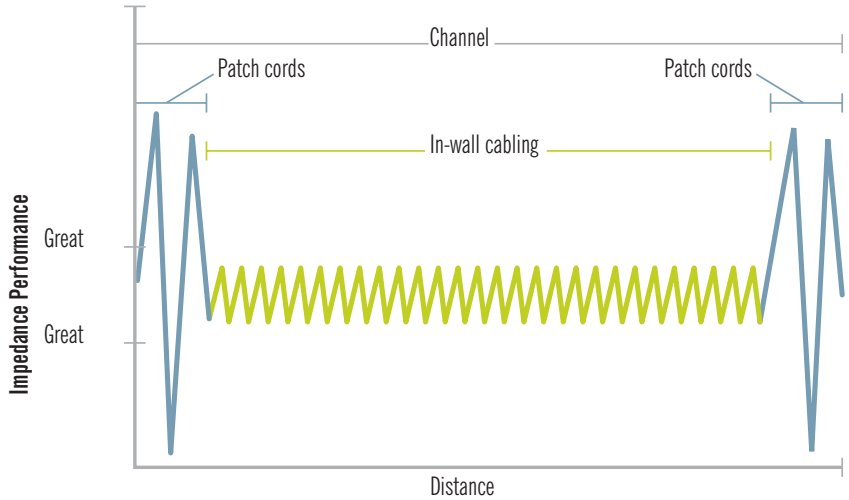
OPTIMIZED CABLING PERFORMANCE

Industry standards provide the minimum guidelines that should be followed to confirm that the network will operate properly. If components on the network fail to meet the minimum performance criteria defined by the standards, the robustness of the network cannot be guaranteed. Therefore, it is always recommended to design and build additional performance tolerance into a network in order to confirm that it will operate with a minimum amount of degradation and downtime. From a cabling system perspective, systems designed with individual components that have been electrically optimized to interoperate with each other offer a higher degree of performance than systems designed to meet the minimum standard requirements. An example of component optimization in a cabling system is properly matching the patch cords, the short cables that run from the wall outlet to the PC or from the patch panel to network switch, to the in-wall cabling. Poorly matched patch cords create electrical variations in the cabling system that can degrade both network and video performance.

For organizations desiring the highest degree of reliability and speed on their network, adopting a systems philosophy when selecting their network cabling would be recommended.

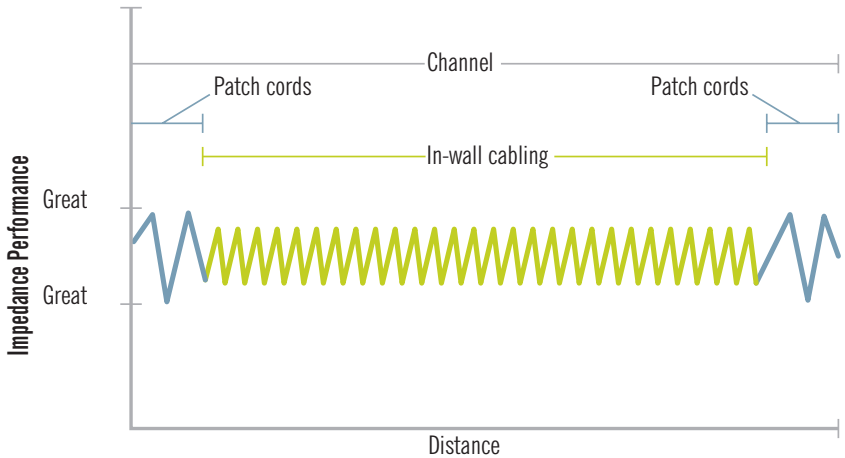
See the test results for a Tuned System vs. Non-Tuned System on the following page.

Typical Patch Cords



Source: Anixter Enterprise Cabling Lab

Tuned System Patch Cords



Source: Anixter Enterprise Cabling Lab

Fiber Optic Technology

Fiber optic technology is a well-understood media among IT professionals. They typically use it as the communications backbone in most buildings between floors and between buildings in a campus environment. A few fiber strands can replace columns of copper UTP or coax cable, and the fiber is completely immune to electromagnetic interference (EMI). AWD RFI fluorescent lighting and electric motors are common sources of EMI and Radio Frequency Interference (RFI). Perhaps the greatest advantage of fiber optic cable is the effective distance it provides. It is virtually unlimited, and maintains quality transmissions. It provides the greatest bandwidth for all applications. It is also used by government and other high-secured organizations because it is virtually impossible to tap.

Pros and Cons of Fiber

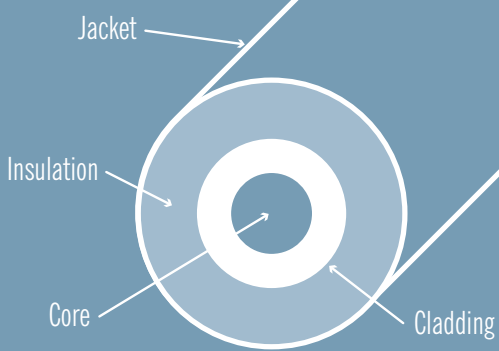
Pros

- Supports high data rates
- Virtually unlimited distance support
- Easy to test and troubleshoot
- Immune to EMI noise and RFI

Cons

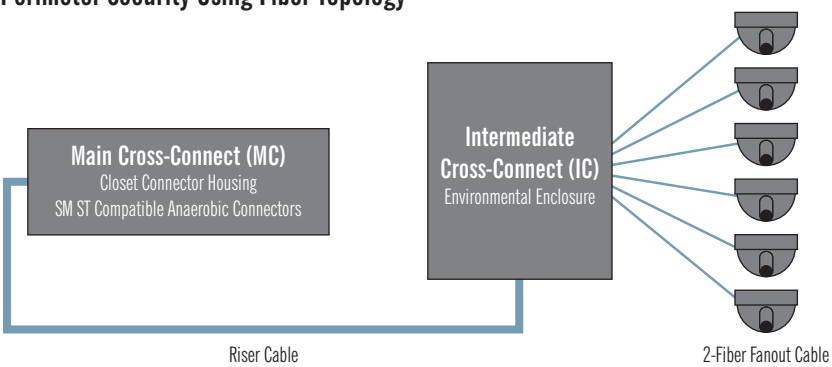
- Can't take advantage of Power over Ethernet (PoE)
- Higher electronic costs when compared to copper
- Installation more demanding

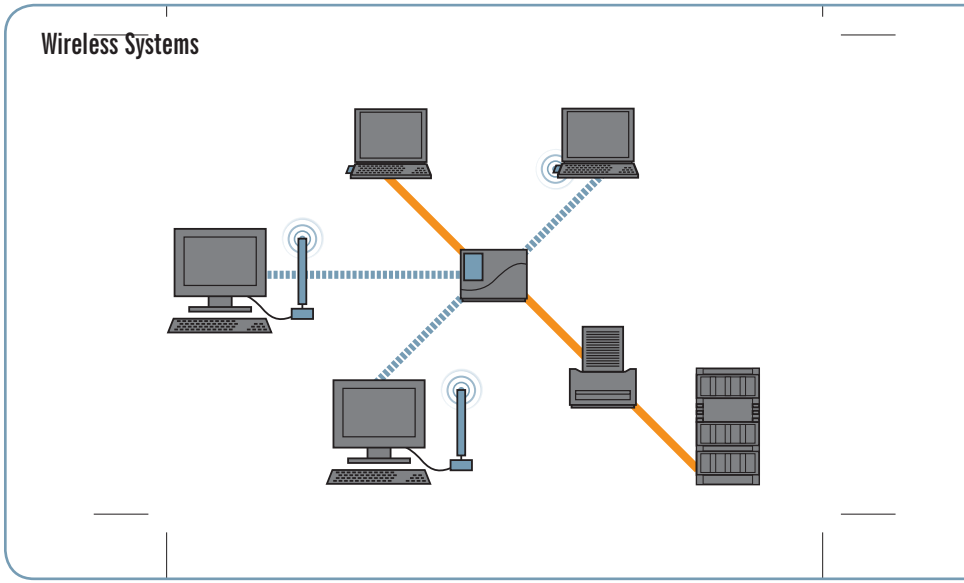
Fiber Optic Media



When setting up cameras at the perimeters of a large parking area or campus, distance may become a major problem. A fiber infrastructure is often the best choice. The fiber from the cameras can be run to an environmental enclosure (protecting the connections from the elements) and then run back to a main cross-connect in the building.

Perimeter Security Using Fiber Topology





Wireless Systems

Wireless is another networking innovation that is maturing rapidly. It provides many advantages to businesses and has valuable applications in security including mobile vehicle or wireless handheld surveillance monitoring. Understanding wireless pros and cons can help you present powerful solutions while remaining cognizant of the IT organization's position.

Wireless can provide ever-present access within an enterprise. Wireless bridging technologies can also extend the wired infrastructure, however, there are perceived security vulnerabilities.

To address these concerns, the new IEEE 802.11i wireless security standard works in combination with 802.1x authentication methods. With these new standards, a wireless network is considered by many to be just as secure as a traditional "wired" network.

Wireless can help solve common problems for IT including right-of-way obstacles and the costs of trenching to provide redundant cable routes.

At sites where installing conventional cabling would be impossible or cost prohibitive, wireless links using IEEE 802.11 technologies can be a solution. With multiple antennas, redundant links can even be configured to automatically switch over when one fails.

Pros and Cons of Wireless Systems

Pros

- Untethered mobile access
- Business flexibility
- Standardized technology (IEEE)
- Connects to structured cabling infrastructure
- Widespread use and growing
- Innovative applications for security market

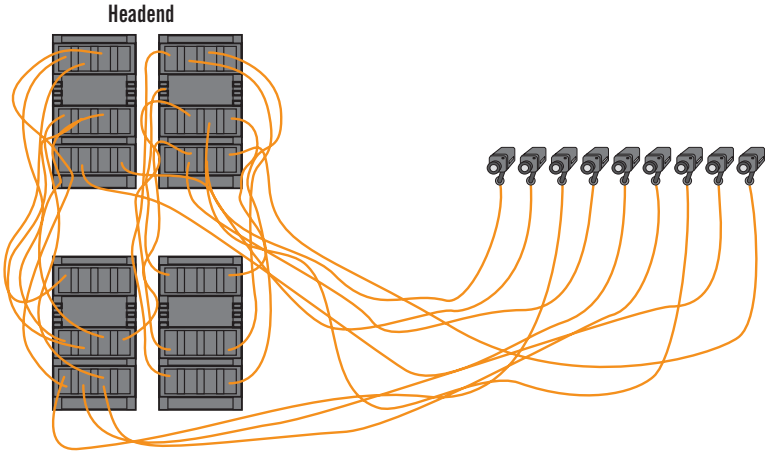
Cons

- Limited bandwidth when compared to a traditional "wired" infrastructure
- Perceived security vulnerabilities

SECTION 4

Best Practices and Cabling Infrastructure for Security Systems

TRADITIONAL LEGACY CCTV SYSTEMS



Similar to the networking world of the mid-80's, traditional coaxial infrastructure employed an unstructured home run cabling system. With this approach, there are no clearly defined cable paths or interconnectivity points making fault location difficult, and unused cable is often abandoned in walls and ceilings. Unstructured coaxial systems are fine for small business applications, but don't scale or adapt well to the changing organizational needs of larger companies.

Moving, replacing or adding cameras can be time-consuming and cumbersome.

The CCTV industry is following an evolutionary path similar to the early computer industry. Security applications are in much greater demand than they once were. More devices need to be attached and managed, so moves, adds and changes (MACs) have become more difficult and costly. Adapting CCTV to a data-like standards-based infrastructure approach is the next logical step.

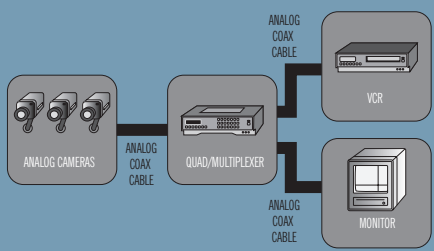
Traditional Legacy CCTV Systems

Pros

- High quality images
- Latency not an issue
- Good noise rejection

Cons

- Requires point-to-point wire connection
- Difficult to troubleshoot large installations
- No standardization for MACs
- No audio capabilities
- Distance limitations
- Difficulty supplying system-wide power and good ground reference



BEST PRACTICES FOR TRADITIONAL COAXIAL SYSTEMS

It is possible to adapt a legacy CCTV system to make it more like the structured cabling systems IT professionals are used to. A more structured approach to CCTV should include the following:

- BNC patch panels used whenever possible
- Organized and consolidated home runs in common raceway/pathways
- Bundled cables (i.e Siamese and/or SpeedPull, Anixter's value added cable bundling service)
- Labeling and documentation
- IT-friendly racks and cabinets for electronics
- Removal of unused coax
- Determine DVR storage and management options
- Hybrid solutions where appropriate

ANALOG

Exterior Camera

The analog camera in the schematic to the right is an outdoor PTZ camera connected to the exterior face of the building. Connections going from the camera to the inside of the building require surge protection in the event of a lightning strike. In this case, the camera is connected to the surge protector with an RG-59 coax, 18 gauge/2-conductor power cable and 18 gauge/1-pair control cable. The surge protector is connected to the building ground using a 6 gauge ground wire. The protected side of the surge protector is sending the video, power and control signal back to the headend using RG59, 18 AWG*/2C and 18 AWG/1P, respectively. All terminations at the surge protector for coax use BNC connectors, and the 18 gauge cables are terminated via screw terminals. The cables are run through the ceiling in ladder racking to keep them orderly. The ladder racking sections need to be bonded together using an 8-inch, 6 gauge insulated stranded copper conductor ground wire attached at both ends with two hole compression lugs. The bonding on the ladder racking is used to protect the signals from interference that can occur within a building such as fluorescent lighting, vibration, etc. The cables continue to run through the ladder racking all the way back to the headend where the coax is terminated at the DVR, the power cable is terminated at the power supply and the control cable to the joystick keyboard or appropriate electronics. Cable ties are used throughout to maintain organization of cables being pulled together and labeled where terminated.

Interior Camera

The analog fixed-dome camera in this schematic is mounted in a drop ceiling and terminated using a BNC connector and Siamese cable. The Siamese cable consists of RG59 for video and a 20 AWG/2C for power. The Siamese cable is used to alleviate some of the labor costs associated with pulling multiple cables. This cable is pulled through the ceiling ladder racking and brought back to the headend for termination. The RG59 is terminated with BNC connectors to the DVR and the 20 gauge/2-conductor cable uses screw termination to connect to the power supply.

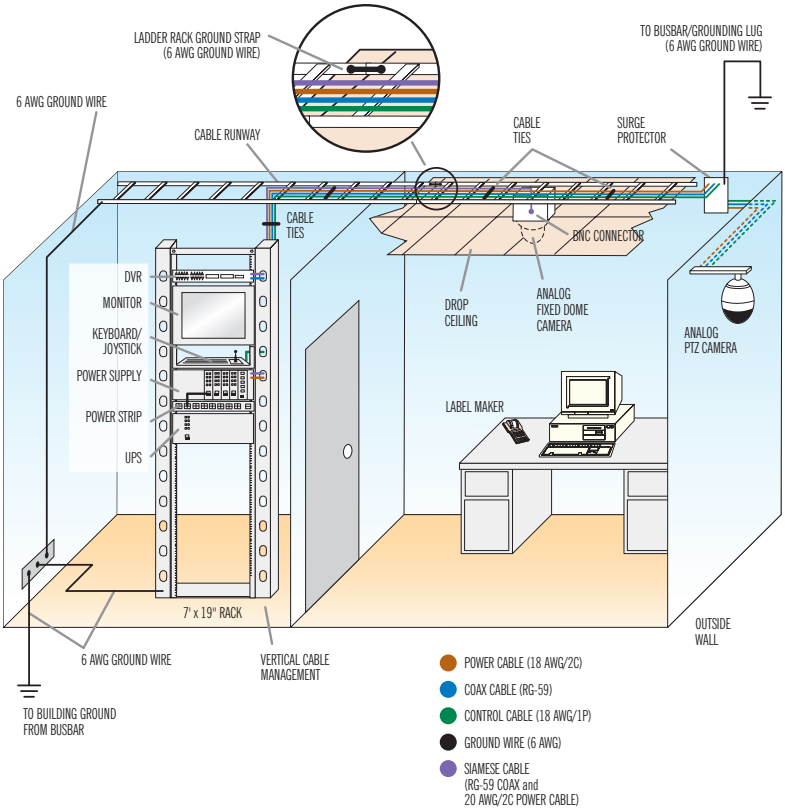
Cable ties are used throughout to maintain organization of cables being pulled together and labeled where terminated.

Headend

The ladder tray and rack (or cabinet) is connected to a busbar using 6 gauge ground wire, which is then connected to a building ground. Proper grounding is used to provide a common electrical reference level for all electronic equipment. The building ground absorbs unexpected interference from all sources of noise, whether it's the power supplies, DVR, or the fluorescent lighting, etc. In our picture, we have shown everything mounted in a 19" x 7' rack. Working from

* Note: "AWG" = gauge, "C" = conductor and "P" = pair.

Best Practices for Coaxial Systems



* Note: "AWG" = gauge, "C" = conductor and "P" = pair.

the bottom up, the uninterruptible power supply (UPS) provides power in the event of electrical loss, similar to a battery back up. The UPS is connected via the power strip, which also distributes power to the DVR, monitor, keyboard, and the camera power supply. We have mounted the camera power supply next, which provides power through the 18 gauge/ 2-conductor power cable to the camera. In the schematic on page 23, we have added a shelf mounted joystick keyboard to control the PTZ camera. Above that, a monitor displays the images from the cameras. The monitor is directly connected to the DVR, and both are rack-mounted. The DVR records and stores all the video from both cameras. Cable ties are used throughout to maintain the organization of cables that are pulled together and labeled where terminated.

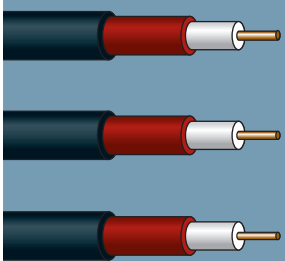
While there are no universal standards for cable performance in video surveillance applications, the camera and headend manufacturers specify the proper types of coax required for different applications. The main message: larger gauge sizes have lower signal loss and a better video signal.

Best Practices for Coaxial Systems

Coaxial Cables

These are the "classic" rules of thumb for distance limits.

- RG59 = 1000 ft B&W or 700 ft for color
- RG11 = 2000 ft B&W or 1300 ft for color
- RG6 = 1500 ft B&W or 1000 ft for color



Connectors

Similar to cable, universal standards do not exist today for BNC connectors. It's a small piece of the system, with up to 50 percent of the problems linked to poor termination. Crimping and compression types make the best connections and proper tools are required to terminate these correctly.

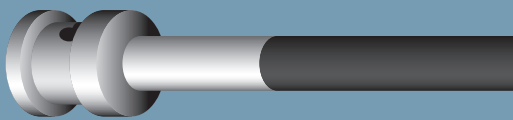
Pros of Using Crimped Connectors:

- More surface area between cable and connectivity
- Tighter connections – connectors don't come apart

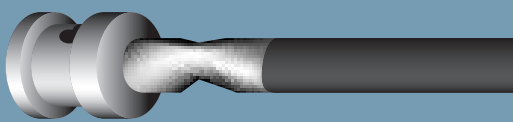
Cons of Not Using Crimped Connectors:

- Poor electrical connectivity
- Hard to troubleshoot
- Loose connections – connectors will come apart

Non-Crimped Connection



Crimped Connection



ANALOG/DIGITAL HYBRID SYSTEM

In many cases, it's just not financially or physically possible to jump right into Ethernet-based security networks (commonly referred to as IP Security Networks). The existing electronics investment and the cost to install new equipment can make a forklift upgrade impractical.

An excellent option in many cases is a hybrid system that takes advantage of existing analog equipment while adding the benefits that digital IP networks can provide. One way to create a hybrid system is to keep existing analog cameras in place and add a digital video recorder (DVR), video encoder or video server to convert the analog video into digital. Once the signal has been digitized, the Ethernet connection on the DVR, encoder or video server can be used to connect to an Ethernet network switch. Either UTP or fiber optic cable can be used.

Once on the network, the star-wired topology will treat anything connected to it like any other node on the network. PCs with the proper video management software (VMS) can now be used for viewing, sharing and storing images as well as controlling cameras and DVRs.

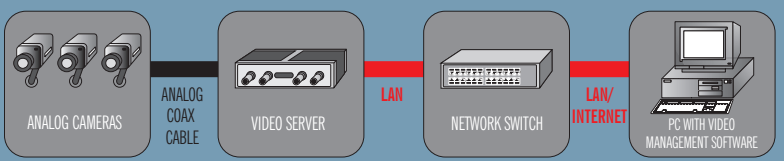
Analog/Digital Hybrid Systems

Pros

- Utilize existing infrastructure and cameras
- Monitoring via network computers

Cons

- Image degradation
  - By adding connection points
  - By signal conversion



BEST PRACTICES FOR INSTALLING ANALOG/DIGITAL HYBRID SYSTEMS: HYBRID SYSTEM – OPTION 1

The Hybrid System in Figure 1 on page 27 allows a customer to preserve their existing infrastructure while taking advantage of all the benefits of an IP solution, such as remote storage, the network infrastructure and utilization of existing corporate technology components.

Exterior Camera

The analog camera is an outdoor PTZ camera connected to the exterior face of the building. Connections going from the camera to the inside of the building need to be protected in the event of a lightning strike. In this case, the camera is connected to the surge protection with an RG-59 coax, 18 gauge/2-conductor and 18 gauge/1-pair. The surge protector is connected to the building ground using a 6 gauge ground wire. The protected side of the surge protector is sending the video,

power and control signal back to the headend using RG59, 18 AWG*/2C and 18 AWG/1P, respectively. All terminations at the surge protector for coax use BNC connectors, and the 18 gauge cables are terminated via screw terminals. The cables are run through the ceiling in ladder racking to help maintain organization. The ladder racking sections need to be bonded together using an 8-inch, 6 gauge insulated stranded copper conductor ground wire attached at both ends to two hole compression lugs. The bonding done on the ladder racking is used to provide a common ground reference throughout the entire infrastructure support system. The cables continue to run through the ladder racking all the way back to the headend where the coax and control cable are terminated into the video server using BNC connectors. The power cable is terminated into the power supply using screw termination. Cable ties are used throughout to maintain organization of cables being pulled together and labeled where terminated.

Interior Camera

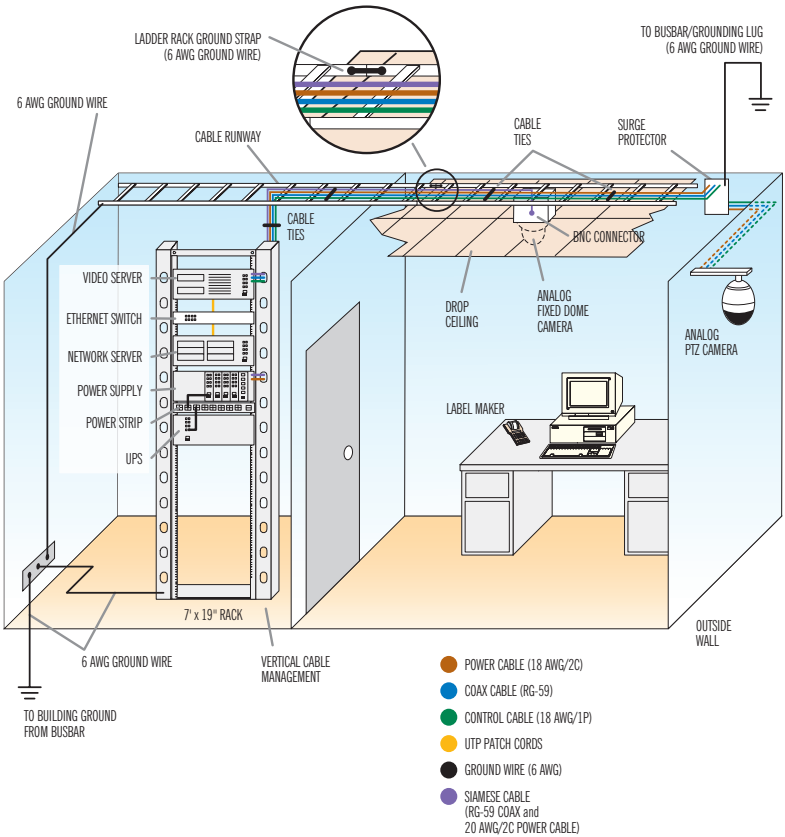
The analog fixed dome camera in this schematic is mounted in a drop ceiling and terminated using a BNC connector and Siamese cable. The Siamese cable consists of RG59 for video and a 20 gauge/2-conductor for power. The Siamese cable is used to alleviate some of the labor costs associated with pulling multiple cables. This cable is pulled through the ceiling ladder racking and brought back to the headend for termination. The RG59 is terminated with BNC connectors at the video server and the 20 gauge/2-conductor uses screw termination to connect at the power supply. Cable ties are used throughout to maintain the organization of cables being pulled together and labeled at the termination points.

Headend

The ladder rack and equipment rack or cabinet is connected to a busbar using 6 gauge ground wire which is then connected to a building ground. Proper grounding is used to provide a common electrical reference level for all electronic equipment. The building ground absorbs unexpected interference from all sources of noise, whether it's the power supply, video server, Ethernet switch, fluorescent lighting, etc. In the schematic on page 27, we have shown everything mounted in a 19" x 7' rack. Working from the bottom up, the UPS provides power in the event of electrical loss, essentially performing battery back up. The UPS connects to the power strip, which also distributes power to the video server, Ethernet switch, network server and the camera power supply. Working from the top down, the video server receives analog signals from the cameras and converts them to a digital Ethernet stream. This Ethernet stream flows into an Ethernet switch via a UTP patch cord and onto the network. In our picture, the network server is receiving Ethernet streams from the video server via the Ethernet switch for recording, storage and management. Cable ties are used throughout to maintain organization of cables which are pulled together and labeled where terminated.

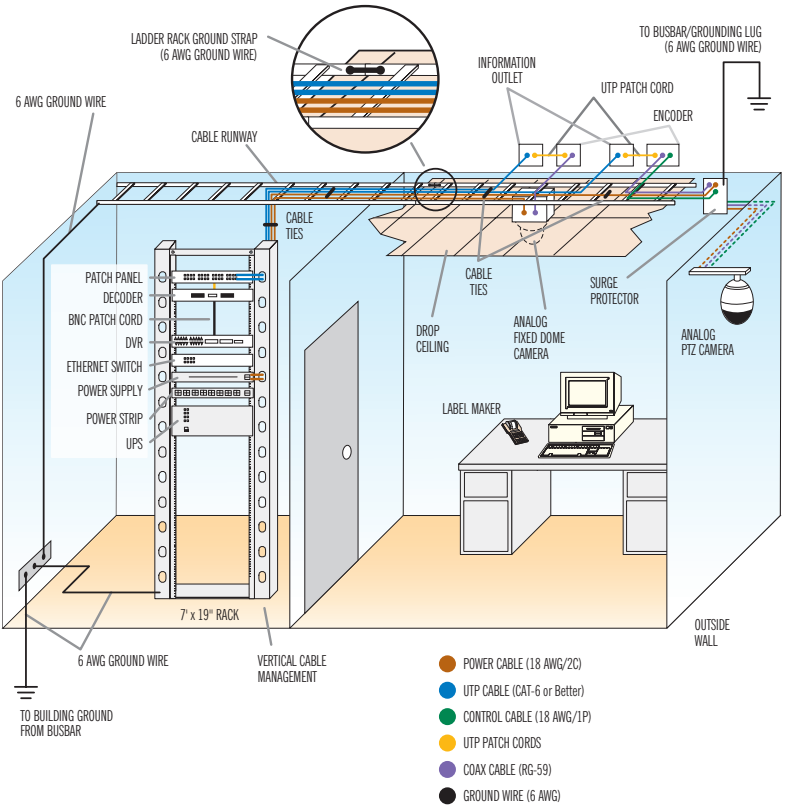
* Note: "AWG" = gauge, "C" = conductor and "P" = pair.

Best Practices for Installing Hybrid Systems - Figure 1



* Note: "AWG" = gauge, "C" = conductor and "P" = pair.

Best Practices for Installing Hybrid Systems - Figure 2



* Note: "AWG" = gauge, "C" = conductor and "P" = pair.

HYBRID SYSTEM – OPTION 2

The Hybrid System in Figure 2 allows a customer to use the Ethernet network while utilizing their existing analog cameras, DVR and other headend equipment. Instead of pulling additional coax for new cameras, however, the UTP cable infrastructure is used.

Exterior Camera

The analog camera is an outdoor PTZ camera connected to the exterior face of the building. Connections from the camera to the inside of the building need to be protected from surge and lightning strikes. In this case, above the ceiling, the camera is connected to the surge protection with an RG-59 coax, 18 gauge/2-conductor power cable and an 18 gauge/1-pair control cable. The surge protector is connected to the building ground using a 6 gauge ground wire. The 18 gauge/2-conductor power cable is brought directly from the surge protector back to the headend power supply. The protected side of the surge protector connects to the encoder using the RG59 coax, and the 18 gauge/1-pair control cable. The encoder has analog inputs and Ethernet outputs. All coax connections are terminated using BNC connectors and the control cable is screw terminated. The encoder converts the analog signal to an Ethernet stream, which travels to an information outlet via a UTP patch cord. The information outlet connects to the headend patch panel with UTP horizontal cable. The cables are run through the ceiling in ladder racking to keep them orderly. The ladder racking sections need to be bonded together using an 8-inch, 6 gauge insulated stranded copper conductor ground wire attached at both ends to two hole compression lugs. The bonding on the ladder racking is used to provide a common ground reference throughout the entire infrastructure support system. Cable ties are used throughout to maintain organization of cables being pulled together and labeled where terminated.

Interior Camera

The interior analog fixed dome camera in this instance, is mounted in a drop ceiling and terminated using a BNC connector with RG59 and 18 gauge/2-conductor power cable. The encoder converts the RG-59 analog signal to a digital Ethernet stream, which travels through an information outlet via a UTP patch cord. The information outlet connects to the headend patch panel with UTP horizontal cable. The 18 gauge/2-conductor power cable is brought back to the headend and terminated at the power supply. The cable ties are used throughout to maintain organization of cables being pulled together and labeled where terminated.

Headend

The ladder tray and rack or cabinet is connected to a busbar, which is then connected to a building ground. Proper grounding is used to provide a common electrical reference level for all electronic equipment. The building ground absorbs unexpected interference from all sources of noise, whether it's the power supply, DVR, Ethernet switch, decoder, or the fluorescent lighting, etc. In our schematic on page 28, we have shown everything mounted in a 19" x 7' rack. Working from the bottom up, first the UPS provides power in the event of electrical loss, effectively providing battery back up. The UPS connects to the power strip, which also distributes power to the DVR, Ethernet switch, decoder and the camera power supply. Now working from the top down, the UTP patch panel connects the decoder to the network via a UTP patch cord. The decoder converts the signal back to analog for transmission and input into the DVR with a BNC patch cord. The DVR stores and records the video signals. The video can be seen on the network through the Ethernet switch connected to the DVR providing all the advantages of an Ethernet system. Cable ties are used throughout to maintain organization of cables pulled together and labeled where terminated.

ETHERNET/INTERNET PROTOCOL (IP) SYSTEMS

So why not leverage IT infrastructures for security? IT cabling infrastructures provide a migration path to the many enhanced features and benefits of computerized security.

A UTP and fiber optic cable plant can support analog or digital technology simultaneously allowing for both growth and modernization while protecting existing investments.

Networked (Ethernet/IP) cameras have their own internal computer and Web server. These cameras are typically plugged into a ceiling level outlet (Ethernet port) with a UTP or fiber patch cord. Today, some networked cameras even have a wireless card that communicates with wireless access points connected to network switches residing on a UTP LAN.

Ethernet / IP Systems

Pros

- Video encryption available
- Firewalls and security devices on the same network
- No signal conversions
- Availability of Power over Ethernet (PoE)

Cons

- Bandwidth concerns
- Shared or parallel networks
- IP cameras investment
- Additional education required

Equipment and technology standardization allows interoperability and backward compatibility between traditional and IP-enabled devices on the network, reducing long-term infrastructure costs.

The ability to deliver power through network cabling to cameras and other devices (such as access points and VoIP phones) reduces installation and maintenance costs since centralizing power reduces the amount of conduit runs and AC outlets required.

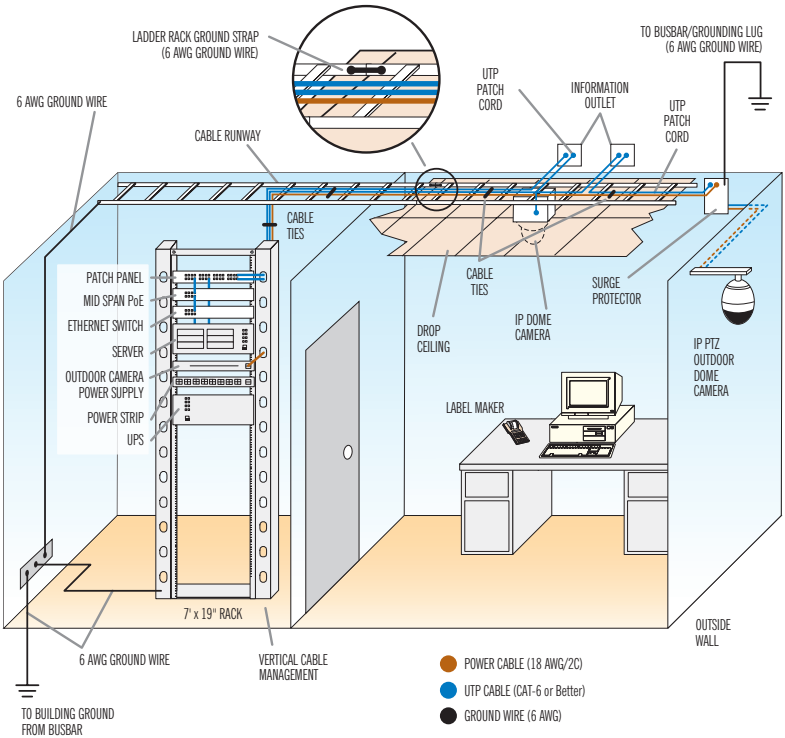
Since signals are digitally encoded at the camera, they do not have to be converted back to analog. Therefore, no additional signal conversion costs are incurred.

BEST PRACTICES FOR ETHERNET/IP SYSTEMS

Exterior Camera

The IP camera is an outdoor PTZ camera connected to the exterior face of the building. Connections going from the camera to the inside of the building need power surge and lightning protection. In this case, the camera is connected to the surge protection with a UTP patch cord, 18 gauge/2-conductor power cable for extra power to the heater and blower. The surge protector is connected to the building ground using a 6 gauge ground wire. The protected side of the surge protector is sending the power and Ethernet signal back to the headend using the 18 gauge/2-conductor power cable and UTP cable, respectively. The cables are run through the ceiling in ladder racking to keep them orderly. The ladder racking sections need to be bonded together using an 8-inch, 6 gauge insulated stranded copper conductor ground wire attached at both ends with two hole compression lugs. The bonding on the ladder racking is used to provide a common ground reference throughout the entire infrastructure support system. The cables continue to run through the ladder racking all the way back to the headend where the UTP is terminated on a patch panel and the power cable is terminated

Best Practices for Installing Ethernet/IP Systems



* Note: "AWG" = gauge, "C" = conductor and "P" = pair.

at the power supply. Cable ties are used throughout to maintain organization of cables pulled together and labeled where terminated.

Interior Camera

The IP fixed dome camera in the schematic on page 31 is mounted in a drop ceiling and terminated using a UTP patch cord at the information outlet. The information outlet is connected via the UTP infrastructure cable, which is laid in the ceiling ladder racking and brought back to the headend for termination. In this case PoE (Power over Ethernet) provides the power through Category 6 or better UTP cabling. Cable ties are used throughout to maintain organization of cables pulled together and labeled where terminated.

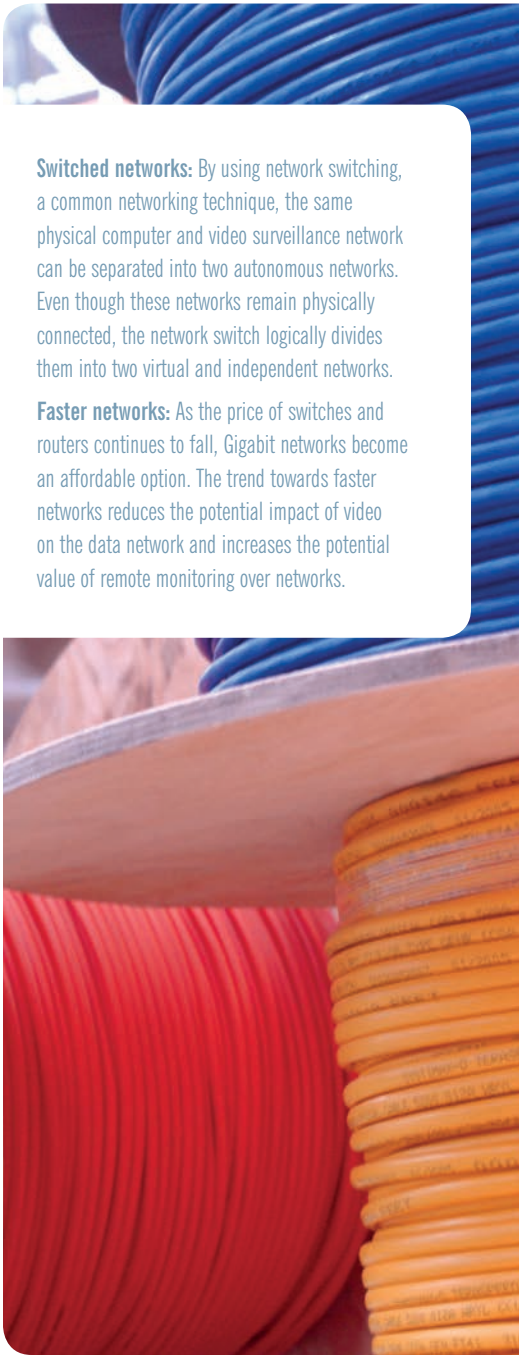
Headend

The ladder rack, equipment rack (or cabinet) is connected to a busbar, which connects to a building ground. Proper grounding is used to provide a common electrical reference level for all electronic equipment. The building ground absorbs unexpected interference from noise sources, whether it's the power supply, midspan power insertion device, Ethernet switch, network server, fluorescent lighting, etc. In our picture on page 31, we have shown everything mounted in a 19" x 7' rack. Working from the bottom up, the UPS provides power in the event of electrical loss, essentially providing battery back up. The UPS connects to the power strip which distributes power to the midspan PoE device, Ethernet switch, network server and the camera power supply (for exterior camera only). Now working from the top down, the patch panel terminates the UTP cabling runs from both the indoor and outdoor cameras. A UTP patch cord runs from the patch panel to the midspan PoE device for the indoor camera power, thus another power cable is not required. The midspan PoE device connects to the Ethernet switch for the data signal via a UTP patch cord.

In the schematic on page 31, the network server is receiving Ethernet streams from the cameras through the Ethernet switch for recording, storage and management. The outdoor camera data signal passes through the patch panel to the Ethernet switch. A midspan PoE is not required because of the extra power cable used to run back to the power supply. From the Ethernet switch, the signals are received by the network server for recording, storage and management. Cable ties are used throughout to maintain organization of cables pulled together and labeled where terminated.

As security permeates into the IT world, data managers will want it to be another technology they can understand, manage, and control. There are a lot of advantages to networking security devices as well as a few potential objections. The biggest objection may be that IT may not want video on their "production" network because of bandwidth concerns. Education on compression techniques and network segmentation can help alleviate these fears.

Compression techniques substantially reduce the size of the images to be transmitted and new, more efficient compression standards are being developed and tested all the time. Segmentation is a method for segregating security data (i.e., streaming video) from other data and controlling where it can and can't travel. This is accomplished using Virtual LANs (VLANs) routing techniques and subnetting – all terms that are familiar to IT professionals. In other words, video can co-exist with mission critical data as long as the requirements are understood and the network configured accordingly. Creating a parallel network for security is also an option that can be accomplished using the same cabling infrastructure. This method entails using spare cable runs and spare ports at patch panels, switches and information outlets. It is how voice and data coexist today while utilizing the same cabling system.

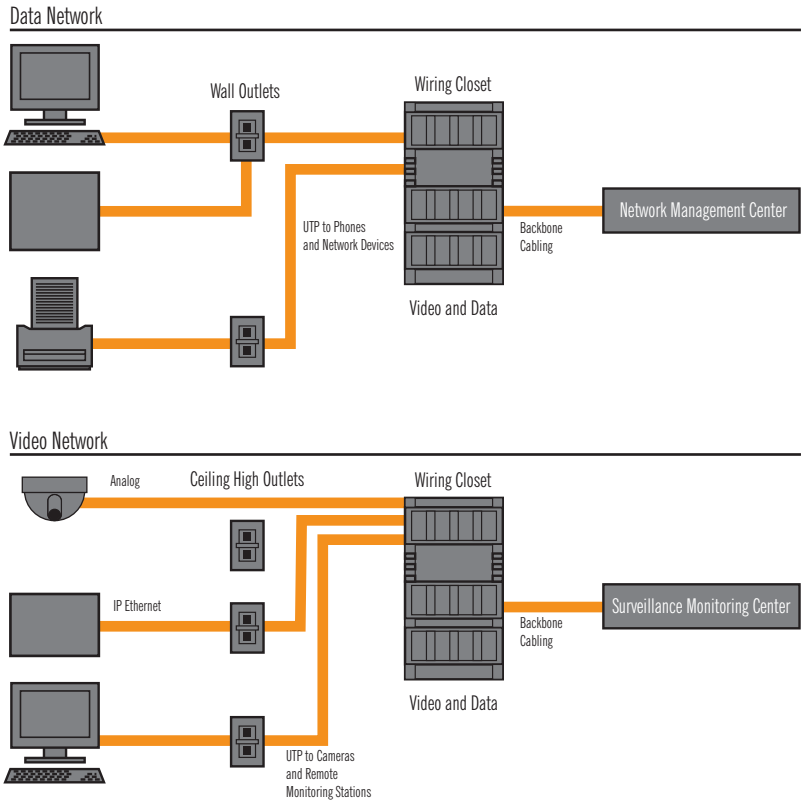


The following networking options can improve bandwidth management capabilities when deploying IP video solutions:

Switched networks: By using network switching, a common networking technique, the same physical computer and video surveillance network can be separated into two autonomous networks. Even though these networks remain physically connected, the network switch logically divides them into two virtual and independent networks.

Faster networks: As the price of switches and routers continues to fall, Gigabit networks become an affordable option. The trend towards faster networks reduces the potential impact of video on the data network and increases the potential value of remote monitoring over networks.

CCTV Utilizing IT Infrastructure Standards



To utilize an existing voice/data standards-based IT cabling infrastructure to support video surveillance, you can simply switch out the end devices. There may be a need for some adapters too, but essentially, the end devices are simply Ethernet nodes that perform different functions.

Both fiber and copper media are allowed in the horizontal cabling runs. For video applications, the UTP 90-meter limit from the camera to the wiring closet may be restrictive, so fiber would be the best choice when cable runs exceed 90 meters.

Using UTP or fiber in the backbone for video applications reduces the pathway space requirements when compared with coax. Ongoing infrastructure costs may also be reduced since additional cabling runs can be provisioned very cost effectively at the time of installation and not used until needed.

SECTION 5

Key Considerations and Best Practices for All Security Infrastructure

OTHER IT DESIGN CONSIDERATIONS

Neat and Manageable

Both telecom and IT industry professionals pride themselves on neat and manageable cabling systems. They use several types of cabling management tools and products to "dress" cable runs to and from equipment, cabinet to cabinet, overhead and underfloor. They always run cables at right angles (while respecting bend radiuses) and never diagonally. They coil extra (slack) UTP or fiber in walls and ceilings in case they suffer a broken or cut connection that requires a quick repair. They use ties and wraps, cable runway or raceway, cable trays and ladders as well as other tools. In fact, TIA standard 606 is devoted solely to cable management and labeling. IT equates neatness with productivity and system uptime, and expects to spend more time and money up front to prevent or minimize potential dollars lost through outages or repair delays.

Cable Management, Labeling and Documentation

Labeling and documenting a cable system makes moves, adds, and changes (MACs) easy. It also makes it easier to troubleshoot a fault in a system. There are many labeling tool products and software for managing a structured cabling system. Proper use of pathways and raceways is also important. Products and techniques are available to route cables overhead, underfloor, in trays, wire baskets and PVC channels. Every rack, cabinet and connectivity manufacturer provides innovative products to make cable management, labeling and documentation easy and effective. (See TIA Standard 606.)

Pay Attention To Thermal Issues In Racks And Cabinets

Excessive heat is a killer of electronic equipment such as servers, switches and DVRs. Proper planning of a closet or data center can help mitigate thermal management issues. Cable routing, use of blanking plates, planned cabinet population and a neat closet will all help prevent airdams and promote effective cooling.

Proper Grounding and Bonding

The grounding system is not just an insurance policy against lightning; it is an active system that provides protection for personnel and sensitive electronic equipment.

Some Facts About Improper Grounding of Communication Systems:

- Causes $500 million per year of damage to property and equipment due to lightning. (Source: PANDUIT)
- 27-33% of damaged equipment is caused by electrostatic discharge. (Source: PANDUIT)
- IEEE states, the typical AC third prong ground is almost never sufficient to prevent damage to network equipment.
- Poor grounding can also contribute to ground loop noise resulting in poor video quality.

There's more science and technique to proper grounding than meets the eye. A floating ground or ground loop can cause many problems with electrical gear that can be hard to pinpoint or isolate and often go undetected until the damage is done. A best practice is to do the job right at installation and test regularly. (See TIA Standard 607 for details.)

Use Quality Cable and Components

Finally, the long term benefits of using quality cable, connectors, and installation materials cannot be overstated. System performance testing and documentation is essential to data voice, video and access control systems alike. The "weakest link in the chain" analogy still applies. Inferior product specifications should never be the cause of a costly system outage for IT or an unpleasant event for security personnel.

As there are no widespread standards for traditional security systems, best practices would require close adherence to manufacturers' performance recommendations to remain on the safe side. In the cabling world, it's called "headroom" and is an investment that seldom fails to yield dividends in the days, months or years following an installation. Dividends are paid in reduced system downtime, superior performance, clearer video images, loss-prevention and even saved lives.

Signal Performance Testing

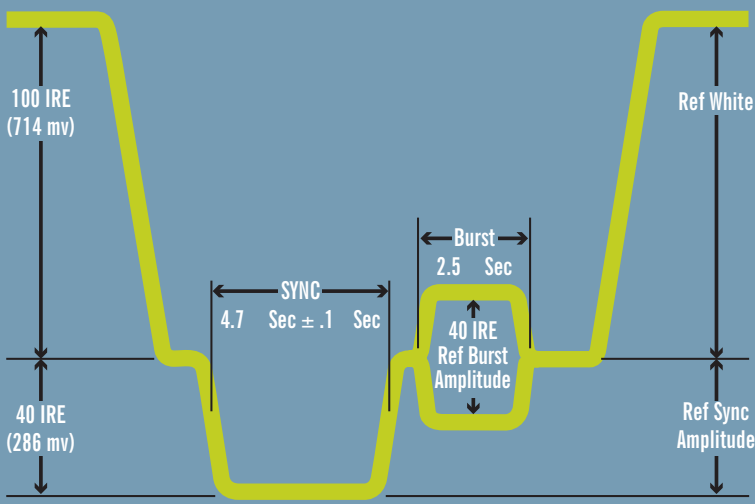
Troubleshooting an installed CCTV system can be particularly challenging since a number of variables related to both the quality of the installation and the components used can affect the performance of the system. Understanding the characteristics of video signaling and its delivery across various transmission media (such as coaxial and unshielded twisted-pair cabling) may help alleviate some of the frustration associated with troubleshooting and maintaining video surveillance systems.

The two key factors affecting video performance are the quality of the video being generated by the camera and the cabling media used to transmit the video from the camera to the end device (e.g. multiplexer, recording device). Although there are no universal standards that specify performance of an "ideal" CCTV video signal, we can use the EIA RS-170A reference standard that was established by the motion picture and television industry in 1957. The RS-170A is the generally accepted standard by which all NTSC (National Television Systems Committee) video origination equipment is tested.

Composite NTSC video signals typically have nominal amplitudes of 1 volt peak-to-peak. Amplitudes are also

Standard NTSC Video Signal

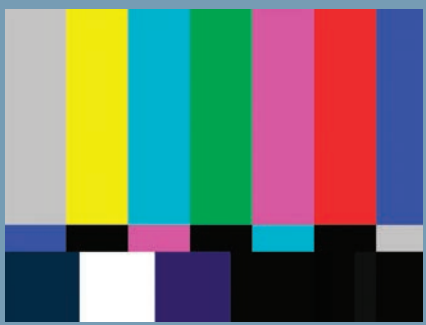
The National Television Systems Committee developed the standard for color video signal in 1953. It remains the standard today.



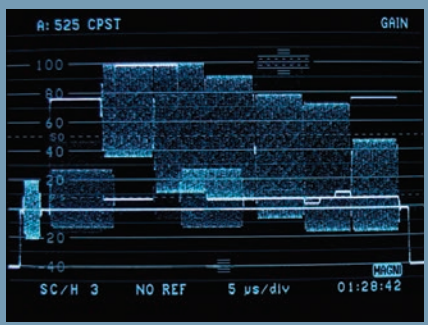
sometimes described in terms of the IRE scale defined by the Institute of Radio Engineers, which divides the video signal into 140 equal parts. In terms of voltage, 1 IRE unit is defined as an absolute unit equal to 1/140 of 1 volt (100 IRE = 714 mV). Signals that are too large may be clipped or distorted and signals that are too small will suffer from degraded signal-to-noise performance. The pulse width and amplitude for an RS-170A color signal are defined by the following figure. Amplitude measurements are typically measured in a lab using a waveform monitor.
By using a known video signal such as SMPTE (Society of Motion Picture and Television Engineers) color bars, a waveform monitor can determine whether the video equipment is accurately reproducing the original video image.

4 Basic Video Signal Performance Levels:
There are four parameters you should test your video signal for to confirm proper performance.

- Sync level = 40 IRE units +/- 5
- White level = 100 IRE units +/- 5
- High white level = 120 IRE units +/- 5
- Color burst level = 40 IRE units +/- 5



SMPTE Color Bar

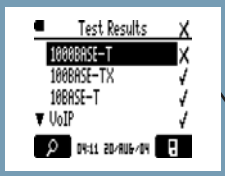


Waveform Monitor Color Bar Output

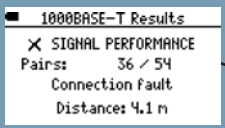
Handheld IRE meters are available in the market that are easy to use, accurate, and cost effective.

It may be cost prohibitive for most installers and integrators to conduct video measurements in a customer installation using a waveform monitor. Luckily, handheld IRE meters can be obtained that are easy to use, accurate, and cost effective. The handheld IRE meter will assist in verifying that the cameras installed at a customer site are performing within the required specifications.

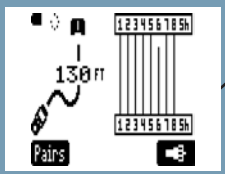
Handheld Cable Network Analyzer



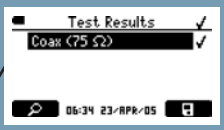
Qualify UTP cables for Ethernet



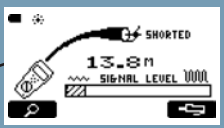
Troubleshoot performance faults



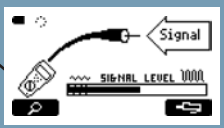
View wiremap faults graphically



Qualify coax for video/security



Troubleshoot coax continuity faults



Detect video signal on coax cables

System Performance Testing

Verification of the cabling system performance can be accomplished by using a handheld cable network analyzer. When selecting a handheld cabling network analyzer, confirm that it has the ability to qualify the performance of coaxial, UTP, and optical cabling. It is also useful if the handheld tester has Time Domain Reflectrometry (TDR) capability. TDR functionality facilitates troubleshooting by pinpointing the location of poor terminations or connection points on the cabling system.

The IT industry is used to quality component testing and certifying performance. Even if you are testing a traditional coaxial system, there is still value in it since doing so will allow you to identify faults in the installation and proactively replace components. By handing over a test report with each visit to your customer, they will come to expect it. This will help differentiate you from other integrators who may not verify their signal quality or cabling infrastructure performance.

How Anixter Can Help With Security Infrastructure Decisions

Familiarity with IT standards will help security integrators earn the respect and business they deserve from IT organizations taking on increased responsibility of security systems. Over the last decade, voice systems have become digitized and telecom departments have merged with IT. The same advantages of voice digitization and networking are emerging in the security industry at a greater pace due to the security threats that our nation has faced since 9-11. Security and IT professionals are collaborating in new and exciting ways to leverage their combined experience. Networked IP video surveillance and access control will be widely used before long just as the Internet has all but replaced the traditional phone book and newspaper. The benefits are powerful and the technology mature. Integrators who command the knowledge and expertise to design, install and maintain the traditional and IP-networked systems will be the partners businesses look to when upgrading or replacing their security systems.

Anixter is uniquely qualified to support our integrator partners with a legacy of leadership in standards for voice, data and video technologies, ongoing education in technology and applications and a solid foundation of core distribution and Supply Chain Solutions. Anixter is the only distributor committed to supporting our design and installation partners with a dedicated team of security professionals, a highly trained sales force, superior service and unparalleled resources. Together, we can provide our customers with world-class solutions for analog, digital, IP-networked and hybrid security applications.

SECTION 6

Key Considerations When Deploying Security Infrastructure Solutions

SUPPLY CHAIN SOLUTIONS

The foundation to an efficient security deployment is having a fundamental distribution network that you can leverage for product inventory and coordinated deliveries. Fundamental distribution services should include:

- The ability to view and allocate inventory in any warehouses in the nationwide network
- A significant investment in a diverse breadth of inventory
- IT systems that provide customers real time information
- Predictable (e.g. next day ground service) delivery times to help you plan your projects.

Anixter takes fundamental distribution a step further by applying the "best practices" of supply chain principles to our industry and the reality we face everyday with technology deployments.

Our common goal is to help you:

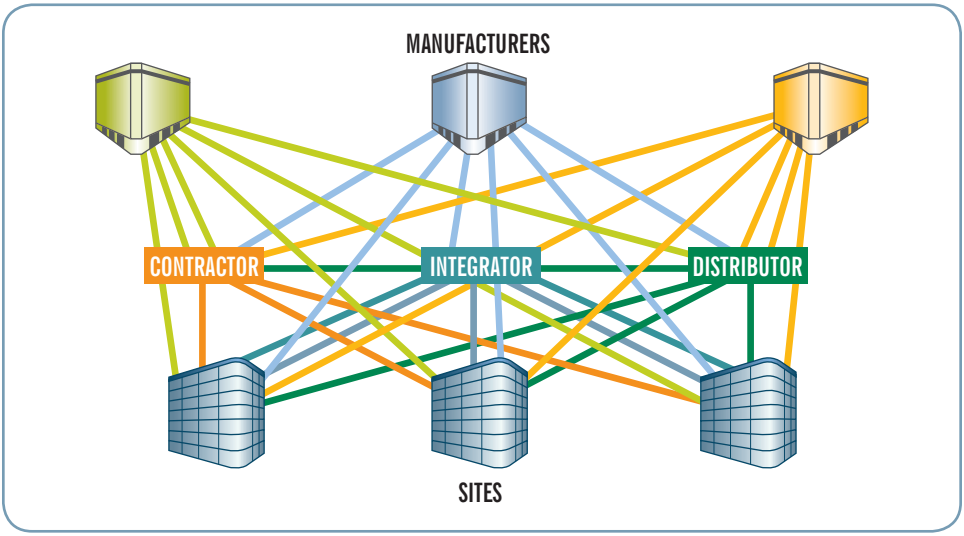
- Reduce costs
- Save time
- Improve productivity
- Improve efficiency
- Enhance financial performance
- Mitigate risk
- Create scalable and repeatable services

While a significant amount of time is spent on the product side of the project, we believe that an additional conversation needs to happen regarding the process side of the project. Identifying the variable costs associated with material management is important. Taking those costs out of the business can be the competitive advantage you need to win the deal and improve your customer's satisfaction.

"It is estimated that reducing the cost of your supply chain by 1 percent can be the equivalent of increasing revenues from 4 to 12 percent."

Scott Stevens, CTO for the Supply Chain Council

Challenges in Technology Deployments: Managing Multiple Sources and Delivery Points



This model represents typical challenges we see with security integrators when faced with supplying materials for their technology deployments.

These include:

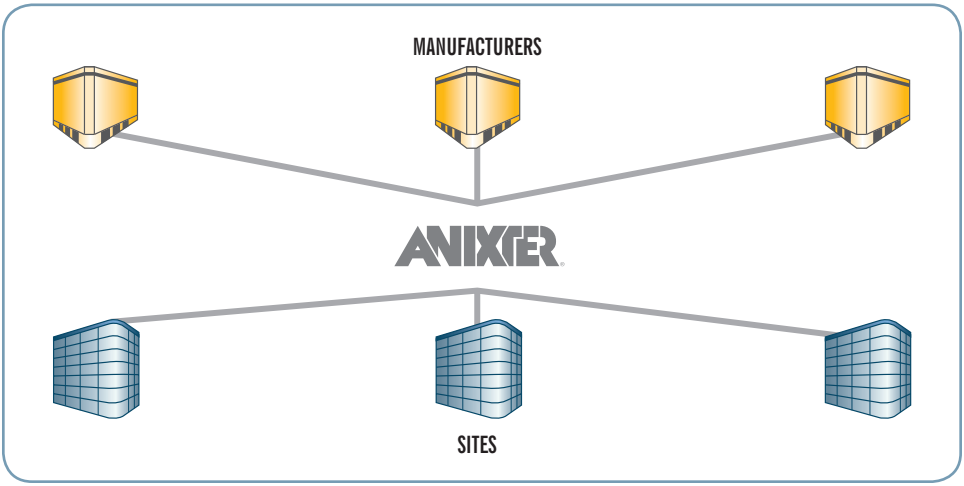
- Multiple OEM manufacturers are part of the systems solution
- Multiple ways to get product to the job site
- Multiple aggregators (sub-contractors, integrators, distributors, etc.) involved

The model gets stressed when you add more components (manufacturers, sites or floors, etc.). A complex situation like this one cannot seamlessly scale to meet the project demands. In fact, if the project demands increase, bottlenecks in service, support and expense become evident.

Every line on this diagram represents a point of risk, expense, coordination and/or failure. Anixter's Supply Chain Solutions minimize the risk involved with technology deployment by coming up with a plan to:

- Deliver the right products, right place, right quantity, right condition, right time, every time.
- Efficiently coordinate the processes: materials, vendors, multiple sites, etc.
- Maximize installation productivity (minimize delay/wait time)
- Eliminate disruption to regular operations

Supply Chain Solutions: Minimize Process and Cost



Material management matters. To improve on-time completion of the project, it's important to have an effective material management strategy. Putting a supply chain partner in the middle allows you to effectively manage the materials for one or multiple projects and scale to meet your customer's demands. A supply chain partner enables you to focus on your core competency of design, integration and construction of security systems.

Anixter can work with you to develop a well-defined program to minimize added costs while maximizing efficiency and reducing risk:

- Evaluate all processes involved with material procurement, inventory management and project deployment
- Determine specific areas to streamline order entry, material management, vendor consolidation, deliveries, material management at the job site, etc.
- Create a customized solution for your surveillance or access control systems project
- Improve your cash flow by delaying the cost of ownership, minimizing freight costs and re-deploying your corporate assets into revenue generating activities

The Supply Chain Model: Scalable and Repeatable

Supply Chain Definition: The efficient flow of goods, services and related information from the point of origin to the point of consumption.

To define the Supply Chain Solution for technology deployments, we recommend you define key steps in the process. The baseline model above illustrates six key components a supply chain partner should address when building an effective solution for you. To scale to the project's demands, the model needs to be addressed as the whole, not just the parts.

Let's take a moment to define each step:

Sourcing – It's important to identify the product specifications at the beginning. It is just as important to identify all the products that will need to be supplied for the project. Anixter has product and technical expertise to help during this step of the process to support the breadth of OEM supplier relationships needed for the overall security solution.

Logistics – This step in the process is primarily concerned with lead time management of the products into our distribution facility. As with any project, there are multiple manufacturers and products per manufacturer. One of Anixter's core competencies is to effectively manage the volume of work associated with inbound logistics to our warehouse to make sure we have the product available when and where you need it.

Inventory Management – This is the heartbeat the supply chain offers. Anixter's ability to manage piece part detail and inventory is the basis of our fundamental distribution model. Anixter currently stocks $900 million of products throughout our warehouse network. The inventory management system throughout our warehouse footprint is a single platform and can be customized to catalog the products specific to your project. Anixter's investment allows integrators to leverage our experience to create a scalable, repeatable, cost effective solution for their customers.

Product Enhancement and Packaging – Here's the question: what can we do at the warehouse (prior to shipment) that can make material management at the job site easier and more cost effective? Anixter services include: kitting, pre-assembly, labeling, special packaging requirements, etc. We can work with you to define the scope of work to support your customer.

Deployment – The product has been sourced, inventoried and packaged. Now it's time to assess the deployment schedule. What are the delivery requirements? How will we build this piece of the model to scale to the project demands? Anixter can leverage its current relationships with transportation companies to meet your customer's expectations.

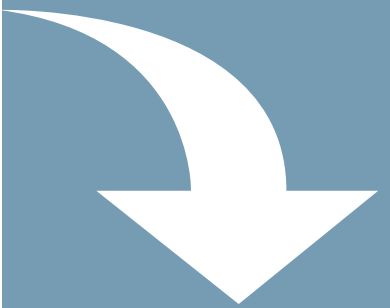
eBusiness – Every process needs visibility. We can provide you with a unique view of key events in the supply chain model. Think of this as your view into our warehouse network, inventory and shipping information. Additionally, anything on our system can be "mined" from the database to provide you key measurements and reports.

Addressing Cash Flow Challenges in Technology Deployments

Cash flow is a challenge for any business. Delaying your cost of ownership of product to the closest point of consumption can allow you to use your cash to improve your business.

Would you like to:

- Simplify material management at the job site
- Simplify on-site storage requirements
- Confirm product specification
- Increase speed of deployment
- Reduce damaged, lost or stolen material at the job site
- Reduce packaging waste at the construction site
- Simplify project management
- Minimize will calls, go backs and set-up time
- Increase productivity
- Decrease the total cost of deployment?



Anixter can work with you to improve your cash flow, leverage your spending by supplier and develop predictable delivery time for your products to your facility and job site.

READY! DEPLOYMENT SERVICES BY ANIXTER

READY!℠ Deployment Services by Anixter maps our distribution and Supply Chain Solutions to the construction or deployment process of any technology project. We combine sourcing, inventory management, kitting, labeling, packaging and deployment services to simplify and address the material management challenges at the job site(s). READY! Deployment Services by Anixter will help you improve the speed to deployment, lower your total cost of deployment and deliver the customer's product specification are delivered as planned.

Case Study: Anixter and IBM Help Secure A Large U.S. City

Customer Challenge

IBM Global Services secured an assignment to develop and implement a security system for a major metropolitan city. The challenge: not just deploy surveillance cameras throughout the city's business district – one of the largest in the U.S. – but also seamlessly integrate them into the recent beautification efforts without sacrificing security. The initial phase of the security project called for installing over 260 cameras on existing light poles. As it often does, IBM turned to an alliance partner, Anixter, for assistance with the complex infrastructure required.

Anixter Solution

Customized cameras, camera housings and wireless infrastructure were required for this project. In addition to providing all of the necessary products for the project, Anixter worked with IBM to better understand the installation build out process. By doing so, Anixter was able to leverage its READY! Deployment Services to develop a customized, value-added services plan that ensured a smooth installation process while meeting the city's deadline. Among the benefits that READY! Deployment Services offers are simplified project/material management; a reduction in lost, damaged or stolen materials from a job site along with reduced packaging waste; and more accurate product specification.

The deployment plan for the security cameras included sourcing and inventorying the product, coordinating with multiple manufacturers and subcontractors, managing lead times as well as providing Kitting and Pre-Assembly services for the READY! Camera kits in our local warehouses. As a result, Anixter was able to decrease the time it took the installers to install the cameras and make them fully operational.

Program Results

To minimize disruption to local businesses, the project was completed after business hours, and within a few days of installation, the cameras went "online." Prior to the system's implementation, it was not possible to keep a watchful eye on as many potential "hot spots" that now have an added layer of protection.

At the end of the day, Anixter was able to deliver a unique, customized solution to the city and IBM on time and on budget. "Working on such a high profile project requires the expertise and professionalism that we have come to count on from Anixter," said Rich Jacob, IBM Technology Solutions Architect. "More than just a partner, in many ways they operate as an extension of our technology adoption area by anticipating our needs and providing sensible, cost-effective solutions."

READY! Camera by Anixter is a kit that includes the camera, lens, housing and ancillary products to complete the installation, delivered as one part number.

READY! CAMERA BY ANIXTER

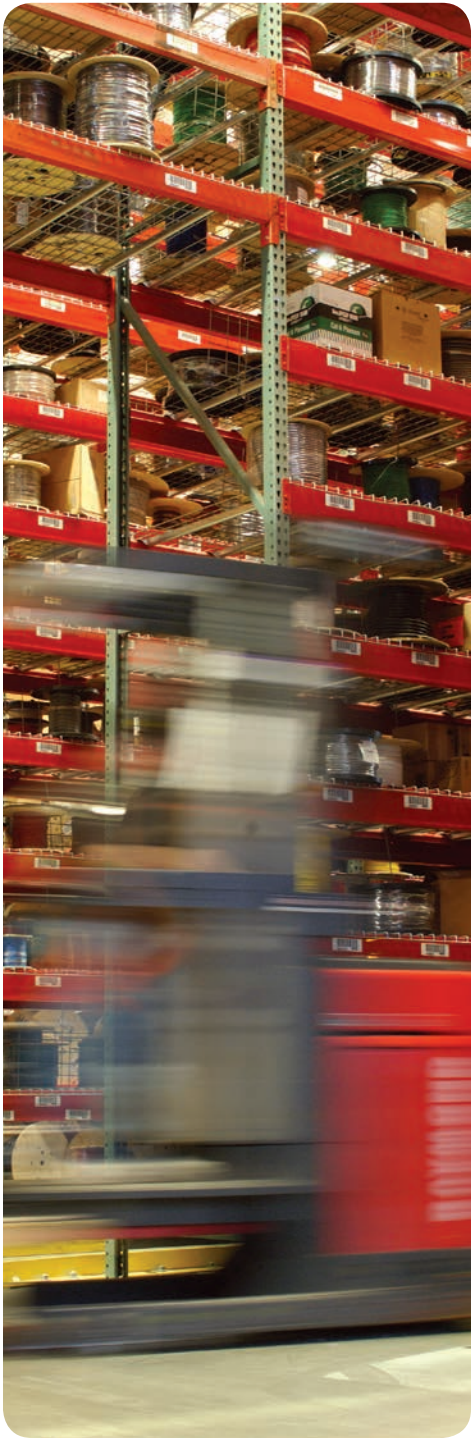
Addressing Earnings Leaks in Technology Deployments

Earnings leaks are issues in every technology, surveillance or access control system deployment. Many of those leaks can be addressed when you build your supply chain model. Here are some common challenges we see in the industry:

Material management at the job site: Often times, there is limited space at the job site and bulk shipments run the risk of being damaged, lost or stolen. Some jobs have strict delivery requirements that must be met (timeframes, elevators, etc.) Anixter can work with you to mitigate the risk inherent to material management at the job site and store and stage the materials at our facility until you need them.

Labor productivity: Bulk shipments need to be inventoried and distributed throughout the job site. Anixter can stage and package the products by floor or wing. We label the delivery and our whole order delivery service means you don't have to manage multiple inbound shipments to your facility or to the job site. Also, based on the structure of the supply chain, you can minimize the non-productive labor hours spent managing material at the job site and maximize the hours spent producing revenue for your business.

Lead time management: Multiple suppliers, multiple products mean that one missing piece can delay the completion of the project. Having one company manage the lead times of multiple suppliers can help minimize your transactional costs and lower your overall freight cost – both inbound and outbound. Additionally, we can help you with your discretionary spending to identify areas that will allow you to leverage your OEM manufacturer relationships. The goal here is to help you make your business become more profitable.



Summary

Fundamental distribution and Supply Chain Solutions can take costs out of your business, improve your customer satisfaction, leverage each company's core competency and can become a competitive advantage. Anixter can customize a solution to fit your needs. We want to work with you on your technology deployments by helping you understand the technologies (existing and emerging), product and system solutions and the best process to deploy them.

The Anixter Difference

We're proud to serve more than 95,000 customers across 46 countries every day with our world-class inventory, global capabilities, technical expertise and Supply Chain Solutions. Our three specialized sales forces focus on Enterprise Cabling & Security Solutions, Electrical/Electronic Wire & Cable and Fasteners.

- We stock more than 350,000 items from the world's premier manufacturers and move them cost effectively through our global distribution network that encompasses more than 5.5 million square feet of distribution space.
- We view technical know how as an essential part of our value to our customer. Whether you're dealing with our Enterprise Cabling & Security Solutions, Wire & Cable, or our Fastener division, you can count on Anixter for reliable up-to-date technical advice and assistance.
- With a wide variety of Supply Chain Solutions to choose from, we provide our customers the opportunity to save money by increasing their ability to be efficient and to avoid costly delays.

Our Global Capabilities

We are very proud of the quality products we distribute (more than 350,000 items from the best manufacturers in the industry) but the reason our customers count on us day in and day out isn't just about world-class, quality products.
Our customers know they can count on Anixter to deliver consistent, superior service and support around the world. And when we say we're global, we mean it. We don't just ship products from the U.S. to various countries. We stock inventory in each country and we are specialists at moving inventory across borders efficiently and cost effectively.
We're physically located in 46 countries around the globe, and our sales specialists in-country are familiar with the trends and needs in the local market, as well as the local currency, standards and customs. We speak 30 different languages, to serve our customers' diverse needs.

Our Products:

It seems simple enough: you need something, you call a distributor and buy it. Unfortunately, nothing is really that simple. In the real world, there are complicated systems, small parts, and constantly changing technical developments and requirements. Just determining what you need can be an all-consuming process, one that is only aggravated by hard to find or out of stock items. Missing a crucial component can significantly add costs and delays to your projects.

At Anixter, we take the worry out of just-in-time product availability. We maintain more than $900 million in our global inventory, and the product expertise you need to make sure you get the right product, when and where you need it.

Anixter is the distributor to call on if you need products and systems for:

- Network cabling (copper and fiber)
- Security (video surveillance, access control)
- Electrical wire & cable (power cable)
- Electronic wire & cable (coax, multi-pair, multi-conductor cable, etc.)
- Networking, wireless, and voice electronics
- Fasteners and other small components ("C" Class)

Our Supply Chain Solutions

The purchase price of a product is not the only place to look to reduce costs in your business. Effective management of your supply chain process will give you the greatest cost benefits.

Anixter's Supply Chain Solutions were developed to respond to our customers' needs for a business partner, not simply a product provider. To service each customer's unique needs, our Supply Chain Solutions are focused on the complete supply chain process – from sourcing to delivery – rather than just the product purchase.

Our Supply Chain Service Offering

Our modular service approach allows us to customize our Supply Chain Solutions to fit your specific needs.

- **eBusiness Solutions:** Anixter's superior eBusiness capabilities are available for integration with your own supply chain systems, to provide real-time transactions and information and unmatched visibility to all aspects of the supply chain.
- **Sourcing:** Our product knowledge and vendor management services can reduce the time and resources you spend while we secure the products you need.
- **Logistics:** Your material handling and transportation management responsibilities can be optimized with our logistics services.
- **Inventory Management:** Our Supply Chain Solutions customers realize a reduction in investment, space and personnel needed for receiving, storing and managing inventory.
- **Product Enhancement and Packaging:** Maximize the use of specialized labor by eliminating product preparation and non-essential, on-site assembly.
- **Deployment:** We coordinate all materials and enhancement processes for on-time delivery in one or multiple locations, to let you focus on your core business.

Our Technical Expertise

Across the world, we have more than 2,600 sales specialists who support our customers. We have three specialized sales forces that focus on enterprise cabling and security systems, electrical and electronic wire and cable, and fasteners. These sales specialists have years of experience in specifying products and solutions for customers. Our salespeople are well-trained to truly identify and understand your needs and requirements.

In every part of our business, we welcome the opportunity to support our customers' purchasing decisions. You can rely on our technical experts to keep you current on the latest products, applications, industry trends, standards and emerging technologies.

The Anixter Infrasructure Solutions Lab

Anixter's Infrastructure Solutions Lab allows us to actively demonstrate the best practical technology solutions from best in class manufacturers in the area of enterprise cabling solutions, video security and access control systems for our customers. Our mission for the lab is simple – educate, demonstrate and evaluate.

- Educate customers on the latest security and networking best practices, standards and technologies being deployed in the networking and security market.
- Demonstrate the latest enterprise cabling and security solutions available from our manufacturer partners.
- Evaluate our network infrastructure and security solutions to confirm that our customers are selecting the right systems for their specific needs.

We are continually testing products in our lab to confirm:

- Quality products are recommended and delivered to our customers.
- Consistency of performance across product lines and within systems.
- Interoperability of products and systems to confirm customers can integrate systems and follow the trend towards convergence.

THE LAB
ANIXTER'S INFRASTRUCTURE SOLUTIONS LAB

You can count on Anixter for our products, technical expertise, global distribution network and Supply Chain Solutions. We'll get you the products you need, when and where you need them.

You can find a comprehensive listing of these products in our print or on-line catalogs. Order a copy of our print catalogs at anixter.com/literature or visit our on-line catalog at anixter.com/catalog.

Anixter can assist you with all of your infrastructure needs to support your traditional, hybrid and digital IP security solutions:

- Access Control Products
- Batteries
- Cable Ties / Cable Management Products
- Cameras
- Coax and other Low-Voltage Cables
- Copper UTP Cable and Connectivity
- DVRs
- Electronic and Electrical Wire & Cable
- Fiber Cable and Connectivity
- Fire Stop
- Grounding / Bonding Products
- ID Products
- Intrusion Products
- Labeling
- Lenses
- Monitors
- Networking Products
- Outside Plant Products
- PoE (Power over Ethernet)
- Racks, Cabinets, and Cable Management
- Software
- Test Equipment
- Tools
- UPS and Power Protection
- Voice and Sound Products
- Wireless Products

Electrical and Electronic Wire & Cable • Enterprise Cabling & Security Solutions • Fasteners

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Anixter is a leading global supplier of communications and security products, electrical and electronic wire and cable, fasteners and other small components. We help our customers specify solutions and make informed purchasing decisions around technology, applications and relevant standards. Throughout the world, we provide innovative supply chain management solutions to reduce our customers' total cost of production and implementation. A NYSE listed company, Anixter, with its subsidiaries, serves companies in more than 50 countries around the world. Anixter's total revenue approximated $6.1 billion in 2011.

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