



Getting the Picture

- The Benefits of Supporting Video Applications with your IT Infrastructure

Today's surveillance and broadband video applications are getting downright smart.
Consider that:

- Surveillance equipment boasting IP-addressable interfaces and remote control features offer significantly more security and flexibility than fixed analog devices
- IP-based systems record images in digital format onto servers or hard drives – rendering the use of cumbersome tapes and cassettes for video storage obsolete
- CATV (community antenna television) migrated to virtually interference-free, 100% digital broadcasting in June of 2009
- Emerging IPTV (Internet Protocol Television) technology promises an on-demand, interactive, high-definition viewing experience

These applications are no longer suitably supported by generic coaxial cabling; they require smart cabling, too.

The number of design professionals and building owners choosing to support surveillance, broadcast, and other video applications with their telecommunications cabling infrastructure is climbing rapidly. For example, according to a report from Multimedia Intelligence¹, the market for IP/networked video surveillance cameras grew nearly 50% in 2007 (to approach \$500 million worldwide) and this market segment is growing at over four times the rate of the overall surveillance market!

In addition to replacing bulky coaxial cables with slimmer and more flexible balanced twisted-pair cables, the benefits provided by utilizing a structured telecommunications cabling network to support video applications include:

- Digital image quality
- Ability to support high-definition (480i/p SDTV and 720p and 1080 i/p HDTV) applications
- Active surveillance area motion, audio, and tamper detection with advanced security alerts
- Pan, tilt, zoom and remote-powered devices eliminate the need for separate and costly power and control cables
- End-user ability to communicate and interact with "smart" video devices
- Compact and highly efficient storage and retrieval capabilities
- Convergence of voice, data, and video applications over one common infrastructure
- Full support of Standards-based cabling distances and topologies
- More effective infrastructure management, service, and scalability
- Simplified troubleshooting
- Improved asset management (via IP-addressability)
- Neater pathways and improved pathway fill ratios
- Ability to upgrade to future applications
- Lower total cost of ownership for many IP-based versus analog camera implementations

Planning for Video Applications:

Not sure if you will need to support video now? Then, the recommendation is to include additional twisted-pair channels specifically targeted for video applications in your cabling plans to accommodate future system needs. While you may not currently anticipate the need to support surveillance applications in your infrastructure, it cannot be ignored that, with increasing safety and security requirements worldwide, the surveillance industry is growing rapidly. According to RNCOS Industry Research Solutions², the global CCTV market (including both analog and IP-based CCTV) grew at a CAGR (compound annual growth rate) of 24.28% in 2007 over 2006 and is forecasted to grow at a CAGR of approx 23% from 2008 to 2012! Planning for video applications support now makes good business sense, too. According to a total cost of ownership analysis recently published by Axis Communications³, IP-based video systems always have lower implementation costs than analog-based systems if the cabling infrastructure is already present.

Transmitting Video Signals over Twisted-Pair Cabling:

All surveillance and broadband video applications (when appropriate amplification is used to boost CATV signal levels at higher frequency channels) are capable of operating over lengths of twisted-pair cabling greater than 100 meters. However, maintaining the TIA⁴ and ISO/IEC⁵ specified generic maximum 100-meter, 4-conductor horizontal channel topology has numerous benefits and is strongly recommended for video applications support. In particular, adhering to the generic topology ensures that upgrades to future video applications will occur seamlessly, while also providing the flexibility that channels originally designed for high-speed data support can be used for video if necessary and vice-versa.

Video deployment planning consists of simply bringing video-ready twisted-pair cabling, in addition to data cabling, to each work area or MuTOA (multi-user telecommunications outlet assembly). For support of surveillance applications in areas where wireless coverage is provided, it may be convenient to juxtapose video access points with wireless access points in the coverage area (see sidebar 1). The advantage to this approach is that the telecommunications outlet is conveniently located in the ceiling space where cameras reside and video equipment positioning is most flexible.

IP-enabled video devices, such as surveillance cameras, are pre-configured to accept the RJ-45 modular plug interface and offer plug-and-play capability with structured telecommunications cabling. Generic analog devices, such as CCTV (closed circuit television) cameras, monitors, and television sets, are typically configured with coaxial BNC or Type F connectors and require the use of video baluns to enable transmission over twisted-pair cabling. Examples of BNC and Type F connector interfaces are shown in figure 1.

Video baluns are used in pairs to convert a 75 Ω unbalanced (or coaxial) signal at the video equipment interface to a 100 Ω balanced (or twisted-pair) signal and then back to a 75 Ω unbalanced signal at the Telecommunications Room (TR) or Floor Distributor (FD). Video baluns are application specific (e.g. CCTV or CATV) and they may be configured as single port converters for use at the device interface, as single port converters located in breakout boxes for use at the work area, or in 8- and 16-port video distribution hubs for use in the TR. Video baluns may also be integrated into high performance category 7/7_A patch cords as shown in figure 2.

Figure 1:
Common Analog Video
Connector Interfaces



BNC Connector



Type F Connector

Figure 2:
1-Pair Category 7/7_A
TERA™ to Type F Video Balun Cord



Type F Connector

CCTV Video Surveillance Applications:

Video security can be both an effective defense in detecting threats, as well as a deterrent against future threats. CCTV solutions are simple to deploy; consisting of fixed or remote-controlled cameras, cabling, a recording device, and a monitoring device. While mandatory for highly secure environments such as government buildings, prisons, and casinos, surveillance systems are now commonplace in education, healthcare, industrial, and financial facilities.

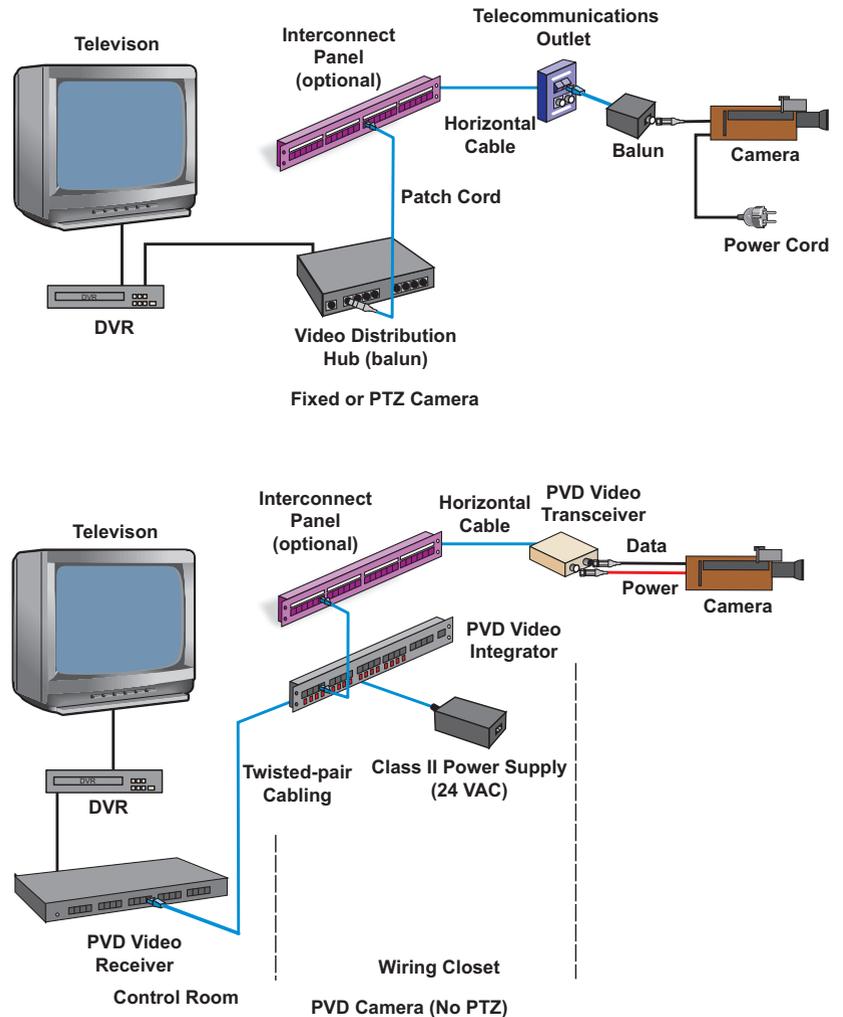
Historically, CCTV systems were static and deployed as analog systems supported by coaxial cabling. Enhancements, such as the availability of cost-effective baluns and IP-addressable devices, now make surveillance solutions the perfect application for operation over twisted-pair cabling. IP-based surveillance systems have the added advantage that they are significantly more flexible and “intelligent” than traditional analog CCTV systems. As shown in *table 1*, a wide range of structured cabling solutions supports video surveillance applications.

Table 1: Structured Cabling for Video Applications			
Application	Recommended Cabling		
	Minimum	Better	Best
Analog (Balun-Based) Surveillance	Category 5e UTP	Match the grade of the network cabling: This approach supports greater infrastructure flexibility.	Category 6A F/UTP: Screened systems offer improved heat dissipation for powered applications and ensure that video signals do not couple onto 10 Gbps-ready data cabling.
IP-Based Surveillance	Category 5e UTP	Match the grade of the network cabling: This approach supports greater infrastructure flexibility.	Category 6A F/UTP: Screened systems offer improved heat dissipation for powered applications and ensure that video signals do not couple onto 10 Gbps-ready data cabling. IP-addressable video solutions may require 10GBASE-T speeds in the future.
Broadband Video (including SDTV and HDTV)	Category 5e UTP	Match the grade of the network cabling: This approach supports greater infrastructure flexibility.	Category 7/7 _A S/FTP: Fully-shielded systems are the only solutions characterized over the full broadband video spectrum up to 900 MHz and is the only media assured to exhibit stable and linear high-frequency response for support of digital broadband video with the least amount of amplification compared to other twisted-pair media types.
IPTV	Category 5e UTP	Category 6A UTP or F/UTP: It is reasonable to assume that IPTV applications will eventually need 10GBASE-T throughput capability.	Category 7/7 _A S/FTP: Fully-shielded systems have significantly improved propagation delay skew between pairs, which may result in improved image quality.

Analog Surveillance Systems: The simplest analog video CCTV configuration is a static system consisting of a fixed camera, twisted-pair cable, a pair of video baluns, and a recording device such as a DVR (digital video recorder). The video baluns are BNC/RJ-45 connectorized devices that transmit back & white or color images over one pair (the pair terminated on pins 7-8) of the twisted-pair cable. Optional pan, tilt, and zoom (PTZ) capability supports the remote-controlled operation of the camera and offers more flexibility than fixed camera systems. Adjusting the focus, angle, and field of view without being actually present at the camera site are all benefits of a PTZ-enabled system. This functionality is easily supported by structured cabling using PTZ-enabled video baluns that also use just one pair (the pair terminated on pins 7-8) to transmit both video and PTZ commands. Because these solutions operate over only one pair of a 4-pair cable, they represent an excellent opportunity to take advantage of the cable sharing capability⁶ of the Siemon category 7/7_A TERA™ solution.

Note that power needs to be provided locally to each camera in both traditional coaxial and balun-based twisted-pair CCTV camera deployments. Depending upon the camera location, providing separate power can range from inconvenient to practically impossible and this need cannot be avoided in coaxial implementations. Emerging PVD (power-video-data) technology utilizes a pair of powered video transceivers to fully support CCTV applications and eliminate the need for external power cords by transmitting video (one pair), power (two pairs), and data (one pair) over one 4-pair telecommunications cable. PVD devices are not IP-enabled and data is still collected on a traditional external recording device such as a DVR. At this time, PVD transceiver solutions easily accommodate the operation of fixed position cameras, which typically consume less than 300 mA of power, over 100-meter structured cabling topologies. Be advised that the maximum distance supported by PTZ cameras, which typically consume at least 600 mA of power, is manufacturer dependent and may be less than 100 meters causing these implementations to fall outside the scope of structured cabling. The good news is that power delivery technology “borrowed” from the emerging related IEEE 802.3at PoE (Power over Ethernet) Plus⁷ application Standard may result in an improvement in the operating distances associated with PVD support of PTZ cameras in the future.

Figure 3:
Typical Analog CCTV Surveillance System Topologies



Typical structured cabling implementation topologies for analog balun-based and PVD video transceiver CCTV surveillance systems are shown in *figure 3 (see page 5)*. In these scenarios, the video distribution hub or PVD video integrator is located in the TR and a coaxial cabling backbone is provided. For maximum infrastructure flexibility and to facilitate adds, moves, and changes, it is recommended that an interconnect patch panel be used in the TR.

CCTV over structured cabling offers a distinct advantage over traditional coaxial cabling implementations in that scalability and flexibility are introduced into the surveillance infrastructure. With structured solutions, cameras can easily be added or moved as the system grows and needs change. However, this technology is not intelligent, meaning that, while substantial data is recorded, it is unlikely that the video is being actively monitored. Events can be missed and suspicious behavior can go unnoticed when monitoring personnel are distracted or otherwise occupied. It is also important to remember that images collected over analog surveillance camera systems are recorded on bulky cassettes or tapes that must be periodically changed and will wear out over time. Image quality can also be impacted by the limitations of the recording device. IP-addressable surveillance solutions overcome these hurdles.

IP-Based Surveillance Systems: IP-cameras and IP-based systems represent the future of video surveillance. These solutions deliver superior image quality, intelligent monitoring capability, remote accessibility, and infrastructure scalability. Today's fixed IP-cameras are all remotely powered and the use of an IEEE 802.3af⁸ enabled PoE switch is required. IP-cameras may be fixed or PTZ-enabled. Further enhancements, such as more powerful PTZ capability, when the IEEE 802.3at enabled PoE Plus switches become commercially⁵ available

The advantage of an IP-based surveillance system is that the camera acts like any other device on the IT local area network (LAN). Images are transmitted via Ethernet or wireless networks and can even be accessed through the Internet. This means that video feeds from multiple areas at multiple locations can be monitored from one supervisory site. Furthermore, because transmission is digital, the picture quality of an IP-camera is superior to that of an analog camera. Audio transmission is also supported. These capabilities result in IP-based surveillance solutions being increasingly integrated into the structured cabling network by companies with geographically dispersed locations, building access control systems, and point-of-sale applications.

Network intelligence can also be built into the IP-based surveillance system. Events can be monitored and alerts can be delivered to report suspicious behavior that would otherwise go unnoticed. For example, the activation of a motion detector, audio sensor, or anti-tampering mechanism could automatically result in an SMS text or e-mail being sent to the security operator.

Instead of relying on external recording devices, IP-camera images are recorded in digital format directly onto servers or hard drives, thus eliminating the need for bulky and unreliable tapes and cassettes. Video data can be stored indefinitely locally or transported to a remote location via the LAN or the Internet. Real-time video transmission is highly compressed and several compression options are available to maximize the trade-off between image quality, bandwidth, and storage capacity. Commonly used compression techniques include MJPEG, MPEG-4, and the emerging H.264 format. See *Table 2 (see page 7)* for a comparison of the features and benefits of these different compression schemes.

In another advance for the IP-based surveillance market, the Open Network Video Interface Forum (ONVIF), whose charter members include IP-video manufacturers Axis Communications, Bosch Security Systems, and Sony, has undertaken the task of developing Standards that will specify inter-operability requirements for video devices such as cameras, encoders, and video management systems. This initiative will go far in removing barriers, such as the perceived custom nature of IP-based surveillance and concern regarding specialized knowledge required to install these systems, that can be a hindrance to the adoption of the technology.

In most cases, an IP-based surveillance system is more cost-effective than an analog surveillance system. Furthermore, IP-enabled equipment is expected to decrease in price faster than analog equipment. The previously referenced total cost of ownership analysis prepared by Axis Communications concludes that IP-based solutions of 40 cameras or more have a lower cost to acquire, install, and operate than same-size analog-based solutions. In fact, while 32 camera systems are the break-even cost point between the two systems, the analysis finds that even 16 to 32 camera analog solutions are only "slightly lower" in cost than IP based systems.

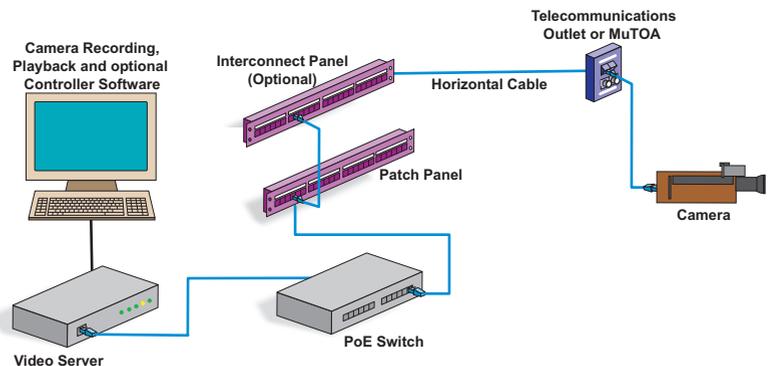
The typical structured cabling implementation topology for an IP-based surveillance system is shown in *figure 4*. For maximum infrastructure flexibility and to facilitate adds, moves, and changes, it is recommended that a full cross-connect be provided in the TR. A side benefit of IP-based surveillance technology operating over structured cabling: cameras can receive centralized backup power from the server room, so they will continue to operate in the event of a power failure.

Broadband Video Applications: Broadband video refers to a class of applications that transmit a wide range of RF (radio frequency) frequencies (typically up to 900 MHz) or channels over 75 Ω coaxial cabling. Examples of broadband video services include cable television (also known as antenna broadcasting or CATV), satellite video signals (whose transmission frequency is the microwave range) that are QAM (Quadrature Amplitude Modulation) modulated and converted into digital cable format, off-air or in-house video transmissions in analog or digital cable format, and playback devices such as DVDs and VCRs whose output signal has been modulated into analog or digital cable format.

	Pros	Cons
MJPEG	<ol style="list-style-type: none"> Each frame is a complete JPEG image Very high picture quality 	<ol style="list-style-type: none"> Bandwidth and disk space required for storage are high Maximum image capture rate: 30 frames per second
MPEG-4	<ol style="list-style-type: none"> Bandwidth and disk space required for storage are low 	<ol style="list-style-type: none"> Only a fraction of video frames are sent as complete images; when possible, only information differences between frames is transmitted Lower picture quality than MJPEG and H.264
H.264	<ol style="list-style-type: none"> Also known as MPEG-4 Part 10 Uses MPEG technology with more sophisticated between frame difference detection Likely to be the next widely adopted standard for video compression. Big Internet players (e.g. Google/YouTube, Adobe, and Apple iTunes) are backing the format 	<ol style="list-style-type: none"> Lower picture quality than MJPEG

The previously referenced total cost of ownership analysis prepared by Axis Communications concludes that IP-based solutions of 40 cameras or more have a lower cost to acquire, install, and operate than same-size analog-based solutions. In fact, while 32 camera systems are the break-even cost point between the two systems, the analysis finds that even 16 to 32 camera analog solutions are only "slightly lower" in cost than IP based systems.

Figure 4:
Typical IP-addressable CCTV Surveillance Topology



The typical implementation topology for a structured cabling solution supporting multiple broadband video applications is shown in *figure 5*. Broadband video feeds from multiple sources may be merged with a combiner. A splitter is used to distribute the incoming broadband video source to the work areas (note that 75 Ω port terminators should be applied to all unused splitter ports to prevent electromagnetic emissions). A structured cabling approach for broadband video distribution improves reliability because there are no taps or splitters between the video distribution hub and the television or monitor. In addition, since each viewing device is serviced by a dedicated cable, the signal strength on existing drops is not affected when new televisions and/or monitors are added to the system.

If there are multiple video distribution hubs, it is recommended that one hub be used to support the shortest runs, another hub be used to support mid-length runs, and a third hub be used to support the long runs. This will maximize the use of signal amplifiers since short runs require little or no amplification, mid-length runs require moderate amplification, and long runs require significant amplification. Grouping runs of similar lengths ensures that optimal strength and quality is delivered to each television or monitor. As with all broadband video solutions, emissions testing is recommended after the installation is complete. This is usually done by walking through the installation with a leakage detection instrument.

Broadband video applications are optimally suited for transmission over twisted-pair cabling and require a pair of video baluns for conversion of the coaxial input signal. The video baluns convert balanced twisted-pair signals to 75 Ω broadband video signals utilizing common video interfaces such as Type F and PAL connectors. Amazingly, both analog and digital video and audio (including 480i/p SDTV and 720p and 1080 i/p HDTV) can be transmitted over one pair (the pair terminated on pins 7-8) of a twisted-pair cable! Naturally, broadband video applications also represent an excellent opportunity to take advantage of the cable sharing capability of the Siemon category 7/7_A TERA solution.

As shown in *Table 1* (see page 4), a wide range of structured cabling supports broadband video applications. While broadband video is acceptable for operation over category 5e cabling, experimental results⁹ published by Nordx/CDT, demonstrate that cabling with lower insertion loss and higher signal-to-noise margins, such as category 6 and higher, deliver improved picture quality when signal levels are weak.

With broadband video applications, no external powering is required for the passive balun devices. Baluns permit bi-directional operation for features such as video-on-demand and are extremely reliable. However, as with coaxial video distribution systems, signal amplification may be required depending upon the incoming signal strength, length of each run, and the highest and lowest channel being distributed, *sidebar 2* (see page 11). Amplification is usually provided before the video distribution hub and one amplifier can serve up to 24 drops in each TR. It is recommended to refer to signal charts provided by the balun manufacturer for detailed design guidance. Some manufacturers of video distribution hubs (e.g. Z-Band Video Inc.) offer integrated signal amplification in their devices for hassle-free deployment.

Figure 5:
Typical Broadband Video Topology

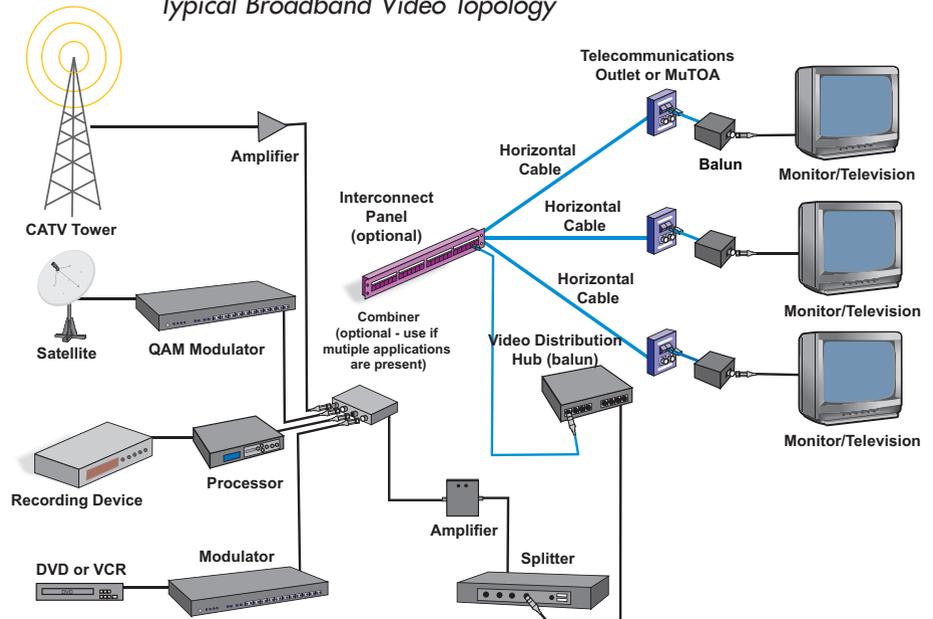
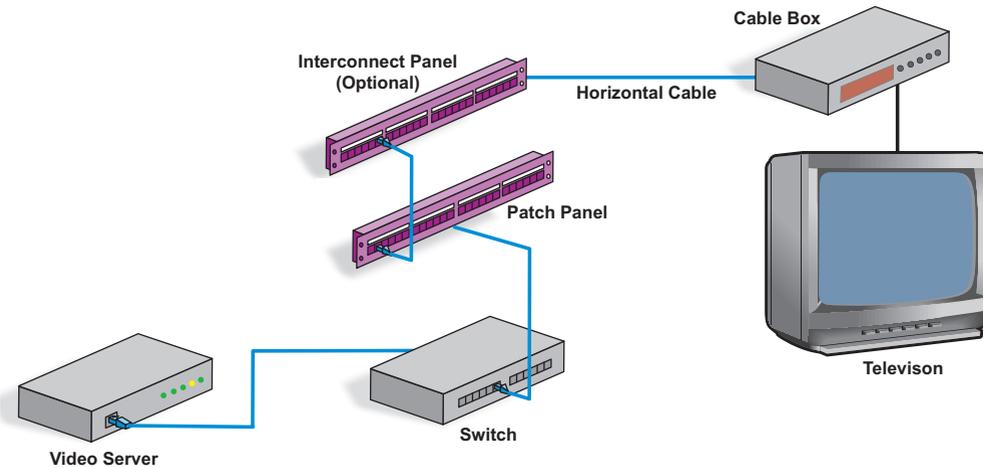


Figure 6:
Centrally Managed, In-house IPTV Distribution Topology



IPTV: The “intelligent” advantage of IP-based technology may soon be capturing a share of the CATV market in the form of IPTV. In this high-definition video application, IPTV signals are transmitted via IP packets and a set-top box at the customer location decodes the packets and sends the image to the television. This emerging technology offers viewers an “on-demand” experience and limited (for now) Internet access capability to sites providing information such as local weather forecasts, personalized stock quotes, and streaming videos.

IPTV is a secure, closed system with content that is managed by a service provider, such as AT&T or Verizon, or by an end-user that centrally manages in-house IPTV equipment and delivers content to specific on-site and off-site locations. Because of the flexibility to manage content, IPTV is a growing trend in the hospitality and hospital industry, as well in as the residential community. According to Kurt Scherf, vice president and principal analyst for Parks Associates, “In terms of the percentage growth in IPTV, the U.S. is actually near the top of the market. There were only 300,000 subscribers at the end of 2006, and now there are 1.2 million, which is significant growth”.

IPTV operates over a range of data cabling as shown in *table 1* (see page 10). Today, the main challenges associated with IPTV include maximizing the video compression format to ensure that bandwidth requirements are not exceeded (bandwidth needs to increase as the number of televisions in a single facility increases), picture quality is not disrupted (e.g. no small “digitized” squares appear on the screen) due to congestion and errors on the service line, and delays associated with changing channels (i.e. “channel-zapping”) are minimized. IPTV performance will improve significantly once infrastructures become capable of supporting faster Ethernet speeds (1000BASE-T and 10GBASE-T capability is expected to eliminate all bottlenecks, while supporting superior content transmission) and migration to these faster transmission rates takes place.

The typical structured cabling implementation topology for a centrally managed, in-house IPTV distribution system is shown in *figure 6*. IPTV services distributed by a central office provider are delivered to the building entrance facility via a DSL (digital subscriber line) access multiplexer.

HDMI, VGA, and other Video Applications:

While this paper focuses on the most common video applications traditionally supported by coaxial cabling, it is important to keep in mind that balanced twisted-pair cabling is capable of supporting many other video formats such as HDMI, VGA, SVHS, and composite/component video with the use of appropriate baluns. Simple channel deployment of these applications may require the use of up to all 4 twisted-pairs and, in the case of HDMI, may even require two 4-pair cables. More advanced video distribution methods (e.g. using a modulator to convert the input signal to a cable signal at the head-end) may support reduced pair counts, as well as cable sharing implementations. In all cases, using balanced twisted-pair cabling to support video applications offers multiple advantages over a coaxial cabling system including convergence of applications over one common infrastructure and full support of Standards-based cabling distances and topologies.

Picture This: Surveillance and broadband video technology is becoming more capable every day. The end-result is that advanced video systems now deliver the highest-levels of system performance, image quality, flexibility, and intelligence; capabilities that can only be realized with the implementation of IP-based technology and a structured cabling infrastructure.

Does it make sense to plan for the support of video applications using your IT infrastructure? Absolutely. Now, you're getting the picture!



APPLICATION NOTE 1.

Juxtaposing Surveillance Equipment and Wireless Access Point Coverage:

Identifying the exact location of surveillance cameras at any time during the cabling design phase, as well as developing a flexible surveillance infrastructure that can accommodate device moves and upgrades, can be challenging. One way to overcome this challenge is to piggyback surveillance equipment access points with wireless access points. This approach supports all surveillance topologies and may be especially convenient for the management of installations where cabling sharing is used to support up to four 1-pair video signals over one Siemon category 7/7_A TERA channel solution.

TIA TSB-162¹⁰ and ISO/IEC 24704¹¹ offer guidance on locating wireless access points in ceiling spaces that can be applied to video equipment access points. A pattern of circles or grids with coverage areas is defined, as shown in *figure 7*, with the intention that work area outlets should be centrally located in their coverage area and MuTOAs should be centrally located in their associated coverage area grid. Although coverage areas may range in size from 3 meters to 30 meters, 12 meters is generally recommended as an optimum size to accommodate most wireless and surveillance applications.

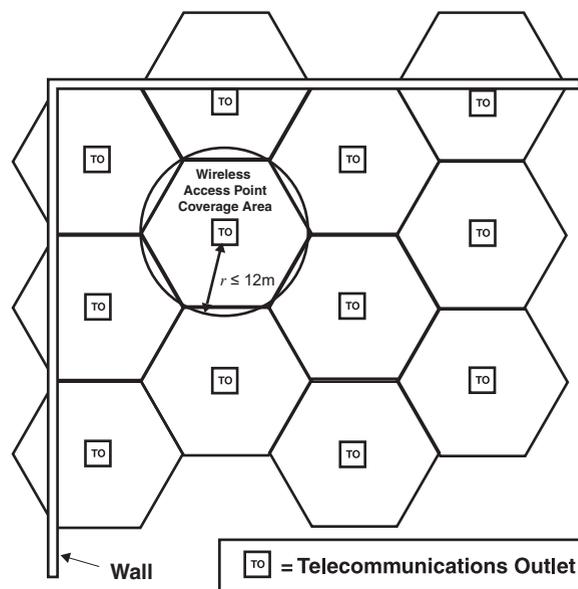


Figure 7:
Example of Ceiling Coverage Areas for Video Equipment and/or Wireless Access Points

APPLICATION NOTE 2.

Video Amplification Techniques:

In some broadband video applications, signal amplification is required depending upon the incoming signal strength, length of each run, and the highest and lowest channel being distributed. It is generally accepted that video signals must fall in the range of -10 dBmV to +15 dBmV in order to be properly displayed by televisions and monitors. An RF signal strength meter is used to collect these measurements. Note that bi-directional amplifiers are required to support digital broadband video applications to ensure that sufficient signal strength is delivered on the return path to the service provider.

Video amplifiers are available for as little as \$10. More expensive amplifiers offer greater gain, more features, cleaner signal output, cooler operation, and longer life. Optional amplifier tilt and gain adjustments can be beneficial in ensuring that one end of the video signal spectrum (e.g. the low frequency range) is not over-amplified when signals at the opposite end of the spectrum (e.g. the high range) are boosted.

The level of amplification required can be predicted by referencing signal attenuation charts provided by the broadband video balun or structured cabling manufacturer. These charts are developed by comparing the approximate signal loss associated with the cabling, video baluns, video distribution hub, and splitters to the incoming signal level. Cabling with improved insertion loss and signal-to-noise margin will support broadband video applications over the longest distances with the least amount of signal amplification. Refer to *table 3* for typical distances supported at various frequencies by a Siemon category 7_A TERA cabling solution and 2 video baluns with signal amplification. The use of additional video distribution/amplification equipment or video receiving equipment with higher input sensitivity (e.g. -10 dBmV) may result in longer distance support. Due to the unique capabilities of different manufacturers' video distribution systems, Siemon recommends consulting the equipment manufacturer for specific implementation guidance and performance specifications (including distance supported).

Table 3: Typical distance supported at various frequencies by Siemon category 7_A TERA cabling (rated to 1,000 MHz) and 2 video baluns with signal amplification*

Center Frequency	North American CATV Channel Number	Length in Meters (typical)
85 MHz	6	100 m
195 MHz	10	95 m
249 MHz	28	83 m
309 MHz	38	65 m
441 MHz	60	53 m
549 MHz	78	47 m
651 MHz	100	42 m
855 MHz	134	36 m

* assuming an input signal level of 30 dBmV and a 0 dBmV video signal delivered to the television

Definitions:

- Analog:** Audio or video signals translated into electronic pulses; analog transmission has size limitations regarding how much information can be carried and errors are unrecoverable, although true audiophiles claim that analog transmission has richer sound quality.
- Combiner:** A device that converts video signals from two or more separate sources into one common, synchronized output format.
- dBmV:** A power measurement of 'x dBmV' indicates that a particular signal is x dB greater than 1 mV in a 75 Ω coaxial cabling system: A negative dBmV value indicates that the signal is x dB less than 1 mV. The following equation is used to convert x mV to dBmV: $\text{dBmV} = 20 \log (x \text{ mV})$. Using this formula, 0 dBmV is equal to 1 mV in a 75 Ω coaxial cabling system.
- Digital:** Audio or video signals translated into binary code (e.g. 0 or 1); digital transmission has significantly more capacity and error-correction capability for better audio and visual clarity.
- Modulator:** A device which changes the characteristics of a source or carrier signal (typically, high frequency microwave sinusoid carriers are modulated into lower frequency RF signals).
- Multiplexer:** A device that selects one of many analog and/or digital input signals and outputs that one signal.
- Splitter:** A device that separates one incoming video signal into two or more outgoing signals of the same source format.

Acronyms:

CATV: Community Antenna Television

CCTV: Closed Circuit Television

dB: Decibel

DSL: Digital Subscriber Line

DVR: Digital Video Recorder

FD: Floor Distributor

HDTV: High Definition Television

HDMI: High Definition Multimedia Interface

IP: Internet Protocol

IPTV: Internet Protocol Television

LAN: Local Area Network

MJPEG: Motion Joint Picture Expert Group

MPEG-4: Motion Picture Experts Group

MuTOA: Multi-user Telecommunications Outlet Assembly

mV: Millivolt

PoE: Power over Ethernet

PTZ: Pan-Tilt-Zoom

PVD: Power-Voice-Data

QAM: Quadrature Amplitude Modulation

RF: Radio Frequency

SDTV: Standard Definition Television

SVHS: Super Video Home System

TR: Telecommunications Room

VGA: Video Graphic Array

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