CCTV & Video Surveillance over 10G *ip*™

Background

With the increase in data, research and development and corporate competition, many companies are realizing the need to not only protect their data, but their human resources as well. Closed Circuit Television Systems (CCTV) and video surveillance systems are becoming more commonplace in office buildings, external structures, our schools and even on city streets. Surveillance is becoming an integral component of access control methods augmented with biometrics, security tracking systems and access tracking systems.

Traditional CCTV systems require a separate infrastructure that employs coaxial cable. This cable was designed for point-to-point transmission of video from a camera to a recorder at the same site. The development of digital video allowed the progression to twisted pair and fiber optic cables. These image streams are stored in a digital format on servers or other computers as opposed to video tape, alleviating the inherent issues with magnetic media. The rising influence of the information technology industry is driving efforts of camera makers, storage providers and chip designers to provide full motion video on a variety of platforms.

This new breed of video allows IP (Internet Protocol) transmission of the video signals to devices that are IP addressable and can be transmitted in a combined voice/video stream. These transmissions can be stored or simply viewed in real time. This article covers the principles and evolutions of these technologies focusing on the latest digital IP video technologies coupled with important information regarding infrastructure needs and demands for implementation. The Siemon Company 10G *ip*™ advanced structured cabling system can support not only network traffic, but can also support video needs as it is the most robust infrastructure on the market today.

CCTV Technology Evolution

Coax and Optical Fiber Analog CCTV System

The origin of CCTV dates back to the 1950's. Advancements in the 1970's, specifically analog recording systems and solid state cameras, moved surveillance from concept to reality. As shown in Figure 1, the traditional system used 75 Ohm coaxial cable. Multiple cameras were connected through this cabling and home-run to a multiplexer which fed several video recorders in a central control room. The images could be viewed real time via several monitors, one monitor with a switch to change to the camera desired, or to monitors that could accept multiple video feeds in separate windows.

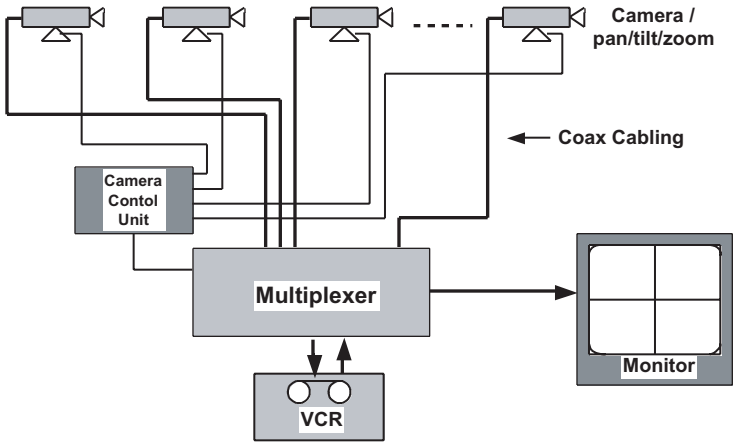

Figure 1
Typical Coax Transmitted Analog CCTV System Diagram

The inherent disadvantages of this method were predominantly in the cost of the security monitoring station. Further, the centralized security center constituted a single point of failure within the security infrastructure. All video feed and control cables had to be home-run to this location. If a camera was moved, often times a new cable run was needed. Tape libraries require many tapes and, as magnetic media is susceptible to magnetic discharge or discharge through static electricity, these systems did not always provide the full functionality for which they were designed. Human factors are also part of this system as a human must physically change the tapes, monitor recording sessions, etc. Optical fiber is sometimes used in this environment where distances would require the use of repeaters for signal strength or where EMI (Electro-Magnetic Interference) is an issue.

UTP and Structure Cabling System Based Analog CCTV Transmission

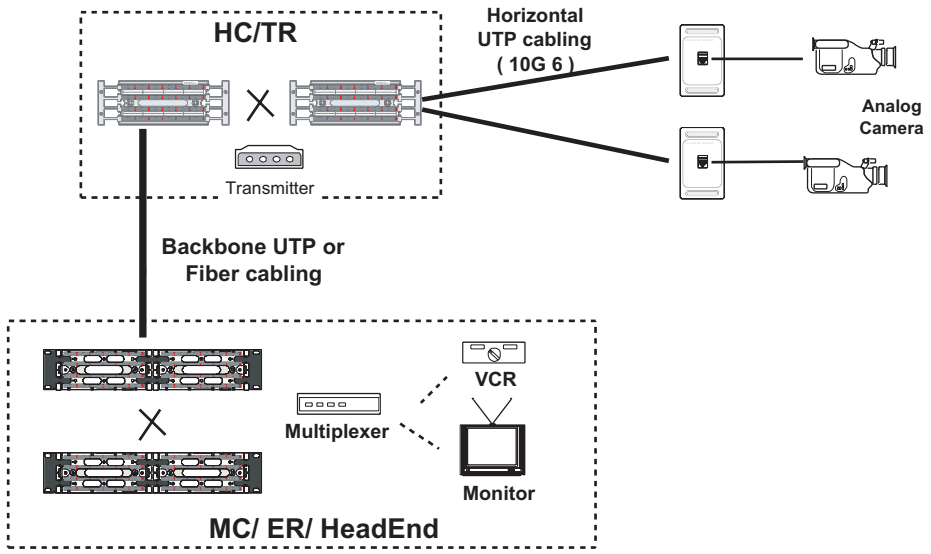

Figure 2
Typical UTP Structure Cabling Analog CCTV Solution Diagram

With the advent of UTP enabled cameras (see Figure 2 above), a second generation system was born. IP addressable cameras are now able to run on the existing infrastructure within a premise. These systems exploit the benefits of this infrastructure over coaxial cable.

This system may require expensive tape libraries and monitors, however, the costs for the central monitoring station are decreased. The single point of failure within the video room still exists. Moves, adds, and changes are easier, as cameras may be located wherever a network drop exists. The cabling is run to a multiplexer that supports the popular RJ45 connector. Legacy cameras with coax connectors can be retrofit with balun (balanced/unbalanced) adapters allowing the signal to be converted from the coaxial cable (unbalanced) to twisted pair (balanced) cable.

The Dawning of the Digital Age

Digital Video Recorders (DVRs) were introduced to answer many of the shortcomings of the magenetic tape media libraries. Digital videos are recorded on hard disk drives just as a file is stored on a PC. This allows for redundancy, decentralized viewing, better quality of images and a longer lifespan of recordings. Digital transmissions can be stored without the need for human intervention or changing of tapes. The recording times are greater and, due to compression algorithms within the devices and video streams, these recordings can be instantly accessed and viewed virtually anywhere that security policies allow.

A typical DVR can multiplex 16 analog channels for recording and playback. This represents a significant decrease in costs over other methods with an equally significant increase in functionality. With open standards, IP (Internet Protocol) addressable cameras are as easy to integrate into the security network as a PC. Data storage has seen a significant decrease in price with the emergence of Network Attached Storage (NAS), and SAN (Storage Area Networks) bringing CCTV to yet another evolution.

Digitized Video over IP

The plug and play approach allows IP addressable cameras to be placed anywhere on the infrastructure. Electronics that are already handling IP traffic are now an integral part of the surveillance system. As the videos are stored in a digital format, they can be viewed anywhere on the network with new security capabilities for the files being administered as part of the network security policies. Further, they can be viewed simultaneously from multiple points on the network. Not only is this easy to deploy, but it is also extremely versatile. Networks are not burdened with another protocol. Transmissions are native to the existing infrastructure, eliminating the need for separate cabling systems.

TCP/IP has become the defacto standard for networking. The open architecture allows for multiple systems to share network space, and take advantage of new technology aimed to improve the capacity, reliability, scaleability and accessibility of network resources. With the ability to utilize an existing infrastructure, a building can become totally automated on one cabling system. This automation can include not only CCTV, but also access control, fire/life and safety systems, building automation systems, voice and, of course, network traffic. Network administrators and network users are no longer bound to a desk as control and/or management of these systems can be performed on any workstation with access to the network. This is also true of the security staff. They can be located anywhere. The single point of failure becomes the digital camera, not the control center, as it is extremely easy to make the digital servers redundant at either one location or distributed to multiple locations.

IP-Based CCTV System

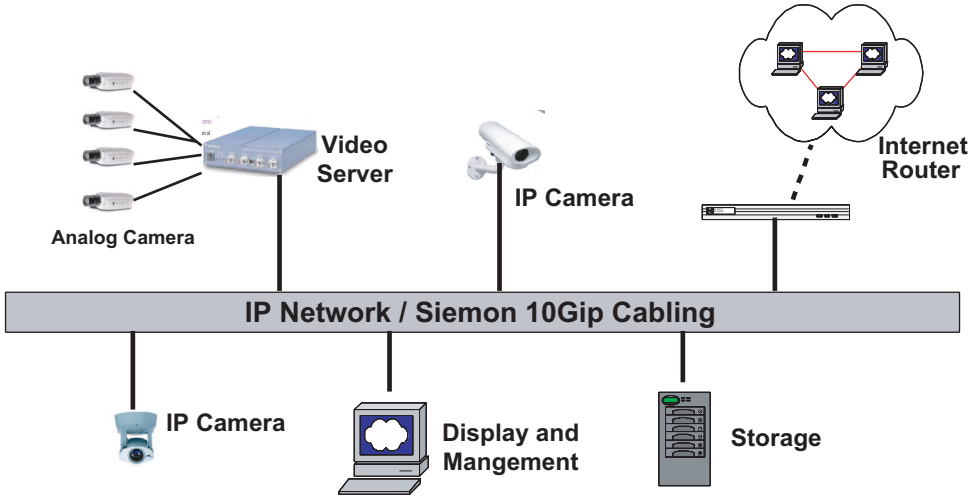

Figure 3
Typical IP Network Digital CCTV Solution Diagram

A typical IP based CCTV system is shown in Figure 3. As you can see, it is far different from either of the other two solutions. IP cameras, IP video servers and IP keyboards can be placed anywhere. The IP keyboards can actually control the PTZ (Pan, Tilt and Zoom) movement of a video camera based on its IP address. As with any IP protocol, management functions are built into the transmissions. These include Digital Signal Processing (DSP), alarm handling, recording, archiving/search capabilities, scheduling and automation. These management and control functions utilize SNMP (Simple Network Management Protocol) and other Control Frames, all part of the IP standard.

These cameras can be equipped with advanced features such a motion sensors, automated PTZ and, if desired, analog video outputs. Newer versions come equipped with internal DVRs which can be replicated to a centralized DVR server. Research according to J.P. Freeman and Frost & Sullivan project that sales for these cameras in the US market will approach $500 million in sales by the year 2005, with a projected revenue of $1.6 billion.

Another IP-based system, CCTP (Closed Circuit Twisted Pair), was introduced by a company called Anixter (www.anixter.com/cctp). This system allows video, control, and power signals over a single twisted pair cabling system. This chassis-based system can accommodate 40 fixed cameras and 16

PTZ (pan-tilt-zoom) cameras in one chassis. The addition of power to the infrastructure provides another benefit to the system through ease of adds, moves and changes and initial installation, as separate power does not need to be run in parallel to the cabling system.

Video Compression Standards

High resolution digital images need bandwidth for transmission and disk space for storage. Storing and transmitting these images is cumbersome on older technologies and infrastructures both on the intranet and over the internet. Compression algorithms were developed to help assure high quality transmissions over lower bandwidth mechanisms. There is a trade-off between frame rate and image quality. JPEG, JPEG2000, MPEG-1, 2, 4, Wavelet and H.261/H.263 are all methods of compression that deal with these transmissions.

JPEG (Joint Photographic Experts Group) and MPEG (Motion Pictures Expert Group) are ISO/IEC standards which allow high quality video transmission. JPEG is the standard for still images while MPEG deals with moving images. The latest international audio-video standard for motion video is MPEG4 (ISO/IEC 14496). Wavelet-Like Motion-JPEG is the process of combining still photos into moving video. The H.261 and H.263 standards were developed for video conferencing and do not deliver clear images for fast moving objects.

Why Siemon 10G ip?

When discussing CCTV and all of your networking needs, one message is dominant. Bandwidth utilization is on the increase. The drive for compression is no longer as great a concern as it once was, largely due to more bandwidth being available. Video conferencing, CCTV and all of the other converged applications do have an impact especially if one's infrastructure is outdated or out of spec. No one thought two years ago that you could actually focus a camera on a child in class or day care or watch Video on Demand over networks. But the reality is that these technologies are here. There will be new ones tomorrow that are just today's dreams.

The Siemon 10G *ip*™ solution consists of 10G 6™, XGLO™ fiber and TERA™. Combined or separate, these represent the best performing IT cabling solutions available for today's realities and tomorrow's possibilities. Your CCTV system can carry high quality, high resolution, real-time video in a converged environment. 10G *ip*™ was designed with the end-user in mind and the fact that companies expect their infrastructures to last 10+ years. This system, installed today, will seamlessly integrate with 10G MAN/WAN without the need to upgrade your infrastructure with future generations of active equipment. This assures that your network infrastructure investment is protected and secure. One single

trend today is spanning every industry, that is, companies want to protect not only their data, but all of their assets and the people that utilize them.

IP-based systems including servers, electronics, CCTV, and the myriad of other solutions are judged based on reliability, scalability and active life cycles. This cabling system was designed around these principles to provide a solid return on investment. The Siemon Company participates in all of the appropriate standards organizations to assure that our systems will provide longevity and state-of-the-art cabling to assure that your electronics investments will operate at their maximum achievable capacity today and tomorrow.

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Video over 10G *ip*™, The Siemon Company, www.siemon.com

The Siemon Company
World Regional Headquarters

The Americas
Watertown, CT USA
Phone (1) 860 945 4200

Europe/Middle East/Africa
Surrey, England
Phone (44) 0 1483 480040

Asia/Pacific
Shanghai, P.R. China
Phone (86) 21 6390 6778