Turning the lens on network video technology

Network cameras are here to stay. Here's what you need to know to capitalize on the trend.

Network cameras have been around since 1996, but cabling installers have only recently started paying attention to the technology because surveillance cameras initially ran on separate coaxial cables. About 10 years ago, the first network camera—the first surveillance camera to connect directly to a data network—started to change the surveillance landscape, and cameras began migrating from the analog world to the digital world.

Digital bridges emerge

In the early years, the technology was not on par with that of professional level analog cameras, and most network cameras were thought of as more advanced Web cameras, which were used to view objects and events over the Internet or a LAN. For that reason, many users opted to keep their investments in analog equipment and digitize the video in other ways.

Digital video recorders (DVRs) are one of these bridging technologies. DVRs are typically proprietary systems that add digital recording to an analog camera system by replacing VCRs with hard drives for the video recording. This requires the video to be digitized and compressed to store as much as possible; compression is done at the DVR level, so it is difficult for the DVR to handle inputs from too many cameras.

Although some DVR systems are still used today, many users with analog equipment have opted for the more futureproof video server technology. Video servers connect directly to analog cameras to digitize and compress the video. The video server then connects to a data network and transports the video to a PC server, where it is stored on hard disks.

The phenomenon known as interlacing affects analog cameras at high resolution, causing moving objects to blur even when the analog camera is connected to a DVR. Interlacing problems are depicted in the image on the (top). Network cameras that employ progressive scan technology more clearly depict moving objects, as shown in the image on the (bottom).

Today, network cameras have caught up with analog camera technology. They now meet the same requirements and specifications as their analog counterparts, and in some important areas, network cameras now surpass analog camera performance. Respected industry analyst firm J.P. Freeman and Co. Inc. forecasts that the

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network camera market is the fastest growing segment in surveillance, and by 2008 will surpass the sales of analog cameras.

A network camera can encrypt video to ensure it cannot be viewed or tampered with.

The analog camera is a static technology that lacks the flexibility and performance needed in today's digital world. As network cameras move digitization, video compression, and intelligence capabilities out and away from the DVR, systems can scale to handle thousands of cameras, and customers will be able to use cost-effective, industry-standard servers for recording and storage. This move to open systems, combined with the benefits of networking, digital imaging, and camera intelligence, is seen as a strong impetus for the adoption of network cameras.

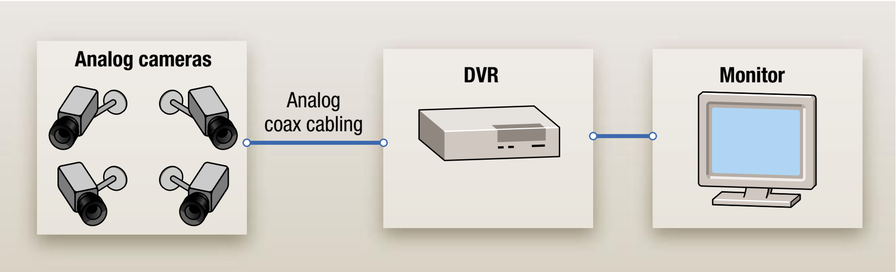
How to shift smoothly

Viewed in this wider context, shifting security and surveillance from analog to IP-based networks includes a number of factors other than a direct comparison of the two types of cameras. Performance, open systems interoperability, flexibility, futureproofing and network connectivity have all become important factors to consider. In fact, you need to know 10 important functional differences between today's network cameras and their analog counterparts before making your next camera purchase:

- **Interlacing.** An *analog camera* at high resolution (4CIF) has a significant problem with interlacing, causing moving objects to blur. All analog video images are made up of lines, and each image is formed from two interlaced fields. When an image contains a lot of movement, it will become blurry because the object moves between the two interlaced fields. Even when connected to a DVR, analog cameras will still have this problem. A *network camera*, on the other hand, can employ progressive scan technology that more clearly depicts moving objects. There are no separate lines, so this method of image capture provides crystal-clear images, even with a high degree of motion.
- **Power.** Powering an *analog camera* can be a major and costly obstacle. In addition to the coaxial cabling needed to transport the video, power lines also have to be fed to each camera location. *Network cameras*, however, incorporate technology specified in the IEEE 802.3af standard, otherwise known as Power over Ethernet (PoE), which means the cameras can be powered more cost-effectively over the same network cable that transmits data and video. PoE also allows cameras to receive centralized backup power from the server room, so they will continue to operate in the event of a power failure.
- **Resolution.** *Analog cameras* cannot provide resolutions above National Television Standards Committee (NTSC) specifications, with a resolution corresponding to 0.4 megapixel at 4CIF. Some security and surveillance applications today require a much higher resolution than 0.4 megapixels, and *network cameras* now deploy megapixel sensors that make it possible to capture increased detail over larger areas.
- **Intelligence.** In most *analog camera* security and surveillance applications, far too much video is recorded for anyone to manually search through for specific events. For this reason, intelligent video is the next big trend. *Network cameras* have built-in motion detection and alarm management, so the cameras can actually decide when to transmit and record video, which frame rate and resolution to use, and when to send alerts. For example, network cameras can be set to identify motion in a hallway at 3 p.m. as "normal." But if motion is detected at 3 a.m., the network camera will identify this as "abnormal" and will trigger an alarm. Network cameras also solve another emerging dilemma, which is the shortage of computing power to analyze more than a few video channels in real time. Network cameras have integrated hardware specially designed for image analysis tasks. As this intelligent video technology advances, it will be possible for cameras to perform such tasks as recognizing the numbers on a license plate or counting the number of people in an area.
- **Control.** With an *analog pan/tilt/zoom (PTZ) camera*, the serial communication that controls PTZ movement requires costly and separate cabling. *Network camera* technology enables PTZ commands to be sent over the same network cabling as the video, resulting in major cost savings and greater flexibility. Network cameras can also integrate input and output signals, such as alarms and controlling locks. It all adds up to less cabling, less money, increased functionality, and greater integration potential.
- **Audio.** For some security and surveillance applications, audio has become increasingly important. With an *analog camera* system, audio is not possible unless separate lines to the DVR are installed. A *network camera* can capture audio through built-in microphones, synchronize and integrate it with the video stream, and send it back for monitoring and/or recording over the network cabling. The audio can also be bidirectional, allowing two-way communication over speakers so that users can both hear and speak to visitors or intruders.
- **Security.** Unlike an *analog camera*, a *network camera* can encrypt video to ensure it cannot be viewed or tampered with. The system can also be set up to authenticate the connection, using encrypted certificates that only accept a specific network camera to eliminate the possibility of anyone hacking into the line. Network cameras can also add encrypted "watermarks" to the video data stream—with information on image, time,

location, users, alarms and more—to secure an evidence trail.

- **Flexibility.** The coaxial cabling or proprietary fiber needed for an *analog camera* system degrades image quality as the signal travels farther from the source. *Network cameras* overcome this obstacle at a much lower cost by using twisted-pair Ethernet cabling. Just like viewing Web site images from anywhere in the world, the network



The installed base of analog cameras can capitalize on some of the technology developed for network cameras by using devices such as Axis Communications' video server.

Top 10 myths about network video

Myth #1.
DVRs are the latest, greatest CCTV security technology.
Reality: Despite some of their digital advantages, DVRs are still analog systems. IP surveillance allows users even more performance benefits, including scalability, camera-level intelligence, cost-efficient infrastructure, superior image quality, two-way audio and simplified equipment upgrades and replacements.

Myth #2.
IP technology is unproven.
Reality: The market has recognized the superiority of IP surveillance. With schools, airports, courthouses and departments of transportation switching to IP surveillance, it is estimated that approximately 25% of security users in the U.S. currently use network cameras, while 45% have plans to buy the technology.

Myth #3.
IP surveillance cannot meet the demands of enterprise-level applications.
Reality: The IT standards on which IP surveillance is based make it ideal for enterprise-level applications, because they let users easily scale their networks to any size and reduce the amount of time maintaining and monitoring the system. Today, there are numerous examples of IP surveillance systems, with thousands of cameras deployed in education, government and retail environments.

Myth #4.
Networked video image quality is not as good as analog.
Reality: Using progressive scan and megapixel resolution, network camera technology has surpassed the image quality of analog cameras. Network cameras let users more closely follow details and changes in images, and do not have the interlacing problems that cause analog cameras to blur moving objects.

Myth #5.
Network video systems are more expensive.
Reality: Though a network camera is more expensive than a standard analog camera, the total cost of an IP-based system, including the cost of cameras, cables, and recording, is considerably less expensive than analog.

Myth #6.
If I already have analog cameras, DVRs are my only digital option.
Reality: Video servers also make it possible to create a digital system using existing analog equipment, and offer more flexibility than DVRs. Video servers convert the analog signal into a digital video stream so that it can be transmitted over the computer network rather than a separate coaxial network.

Myth #7.
Transferring video data over my network will overload it.
Reality: Users need only to make well-informed decisions during the installation process and properly configure the network to prevent network overload. Adjustable image size, compression, frame rate and resolution, in addition to built-in intelligence, mean that network video products can be configured to efficiently use bandwidth.

Myth #8.
Transmitting video for security purposes over an IP network is not secure.
Reality: With banks and financial institutions regularly using the Internet as a medium for global money transactions, IP networks are a proven medium for security and surveillance. Easily implemented security measures, such as firewalls, VPNs, and password protection, ensure that video transmitted over the Internet is protected.

Myth #9.
IP surveillance is less reliable than alternative technologies.
Reality: IP-based systems have proven reliable in some of the most sensitive and demanding locations, including airports, banks, train stations and prisons. When properly installed and configured, network cameras will function for years without being touched.

Myth #10.
IP surveillance is still five years away.
Reality: IP surveillance is here. The J.P. Freeman research also estimates that network camera sales will exceed those of analog cameras by 2008, and that by 2009, network camera sales will more than double those of analog camera sales in the network video market.

camera produces digital images, so there is no quality reduction due to distance. Unlike analog systems, IP-based video streams can be routed around the world, using a variety of interoperable infrastructures. In addition, many different video streams can be transmitted over a single Category 5 cable at full frame rate (30 frames a second).

- **Full digital solutions.** The CCD sensor in an *analog camera* generates an analog signal that is digitized by an analog-to-digital (A/D) converter, which allows the image to be improved in a digital signal processor (DSP). The signal is then converted back to analog for transport over the coaxial cable. Finally, the DVR converts the signal back to digital for recording purposes. That is a total of three conversions, and with every conversion, some image quality is lost. In the *network camera* system, images are digitized once, and they stay digital. There is no unnecessary conversion or image degradation.
- **Lower costs.** It stands to reason that all the advanced features described above come at a cost. Compared to an *analog camera,* the initial price for a *network camera* can indeed be higher, if a strict camera-to-camera comparison is made. But when comparing the cost per video channel, the network camera quickly becomes comparable with an analog system anchored by a DVR. In many system configurations, the upfront cost for a surveillance system based on network cameras is even lower when compared to analog options. This lower total cost for the network camera system is mainly a result of back-end applications and storage that can be run on standard servers, and not on proprietary hardware, like a DVR. This radically reduces management and equipment costs, particularly for larger systems where storage and servers are a significant portion of the total solution cost. Additional cost savings come from the infrastructure used. IP-based networks, such as the Internet, LANs, and wireless connections, can be leveraged for other applications across the organization, and are much less expensive than traditional coaxial and fiber.

Future directions

So, where is network video technology going next?

Look for developments in megapixel imaging, including support of new 16:9 (widescreen) formats, digital pan/tilt/zoom controls, and multi-window video. Intelligent video applications will also greatly improve. As mentioned, network video installations can already be used to read license plate numbers or count people. They can also handle alarms through motion or audio detection. Watch soon for the applications to commonly involve even more complex actions, such as noticing a person falling, detecting abandoned luggage, and identifying abnormal behavior, such as rapid pacing.

Some of the newest network camera models support IPv6 (Internet Protocol Version 6), the latest level of the Internet Protocol that will lengthen IP addresses from 32 bits to 128 bits. This makes room for future Internet growth and will ensure that there is no shortage of Internet addresses. Advantages of IPv6 include better communication with mobile devices, *ad hoc* networking to make installations faster and easier, speeding up overall network performance, ensuring higher quality-of-service, and improved methods for ensuring data integrity and privacy.

When looking for opportunities to install network video systems, cabling installers should look to key vertical markets that have shown the most interest for these systems—banking, transportation, retail, government, education, and industrial. The trend of convergence in the network video market is here, and it is one that should not be ignored.

With all of the advantages over analog systems, it is no wonder that network camera sales are continuing to rise. For cabling installers, this trend is opening up new markets and revenue streams.

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