Introduction to Video Surveillance

The most obvious benefit of video surveillance is improved security. Whether you’re using security cameras to protect your home, business, or a large-scale campus environment, high-quality surveillance footage is an invaluable asset. There’s nothing more powerful in a criminal investigation than visual evidence, and that’s what surveillance cameras provide.

Security cameras can also work to deter criminal activity. We’ve seen countless examples where the rate of reported incidents has dropped significantly, in schools for instance, simply by the presence of security cameras. In many cases, strategically placed video surveillance cameras will make potential offenders think twice about acting out, which of course leads to a safer environment overall.

In terms of risk management, surveillance systems help to eliminate the threat of false claims and frivolous lawsuits. For most businesses, such scenarios often prove extremely costly. Video surveillance provides the necessary visual proof to confirm facts and address legitimate cases while refuting false ones.

It’s important to note that security cameras can deliver much more than video images for post-event analysis. Today’s video surveillance systems can provide users with the tools for efficient real-time monitoring, advanced motion detection, integration with external security systems, and other intelligent features that increase the chances of catching potential threats as they happen.

In the end, the role of video surveillance is different for each user. How can a video surveillance system help you? Answering that question is the first step in determining what type of surveillance setup best meets your needs.

IP vs. Analog Surveillance

The video surveillance industry has been shifting toward IP-based surveillance over traditional analog CCTV networks. The main difference between the two technologies is the way the video signal is processed and delivered. An analog system transmits video in a format suitable for local viewing and recording via television monitors and VCR. IP-based surveillance systems send digitalized video streams over a network, allowing users to access, record, and manage the footage remotely.

Hybrid DVRs and IP video encoders let users leverage existing analog cameras for an easy transition to IP video, but with full IP-based surveillance you can skip these extra steps, a decision which brings with it many advantages. Let’s take a closer look at both solutions.
IP vs. Analog Surveillance

Pros of IP Surveillance

- **Megapixel Resolution** – Many IP cameras offer high megapixel resolution, which can reduce the overall number of cameras needed.

- **Easy Remote Access** – Each IP camera features its own built-in web server so you can access footage and control camera functions remotely from almost anywhere.

- **Power Over Ethernet** – With Power over Ethernet (PoE), an IP camera can get both its power and network connection using a single Cat5 Ethernet cord, making installation easier.

Cons of IP Surveillance

- **Bandwidth Requirements** – Calculating network bandwidth requirements is an important factor when configuring IP surveillance solutions. To get the best performance, it is recommended you put the system on its own network.

Pros of Analog Surveillance

- **Lower Initial Cost** – Generally, analog CCTV cameras cost less than IP network cameras, making them an option for surveillance on a budget.

- **Easy Setup** – Analog CCTV cameras are designed to be plug-and-play, making them quicker and easier to set up if your business does not have an IT or technician available.

Cons of Analog Surveillance

- **Limited Resolution** – Many professional IP cameras feature HD resolution up to 5 megapixels, a range not available in analog cameras but important when using the system for recognition.

- **Expensive Cabling** – Analog systems aren’t recommended for some large-scale surveillance applications or locations because of the complicated and expensive cabling requirements.
Analog CCTV Surveillance Overview

What is CCTV?

CCTV, or closed-circuit television, refers to the use of analog video cameras to deliver signals via coaxial cable to a specific location for monitoring. While the surveillance industry has moved toward IP video technology, analog CCTV systems are still widely used and offer tried-and-true, cost-efficient solutions for a wide variety of surveillance applications.

Benefits of CCTV Surveillance

Long History of Implementation
The first CCTV system was installed in the 1940’s, and the technology has played a key role in the security industry since around 1970. With an analog CCTV system, you know exactly what you are getting because the technology has already been pushed and mastered. We know its advantages and its limitations, which makes it easy to determine whether a particular application is suitable for a CCTV solution, and what equipment is required.

Lowest Cost Solution
CCTV cameras and DVRs are normally priced lower than network cameras and IP video equipment. Of course, there are other factors to weigh besides initial cost when choosing between analog and IP. Still, depending on the specific needs of your application, a low-cost analog solution might just do the trick and could save you some upfront costs.

Large Selection of Products Available
Analog CCTV cameras come in a broad range of models to meet virtually any surveillance situation. Available offerings run the gamut from covert spy cameras to industrial PTZ domes. No matter how demanding or obscure your video surveillance requirements, odds are someone else has already used CCTV to meet similar needs, so a solution likely exists.

Wide-Spread Compatibility
Most CCTV products can live in harmony, even when a variety of manufacturers are used in one system. This makes it easy to pick and choose analog cameras and surveillance equipment from different brands, and also incorporate new equipment into existing CCTV systems.

Hybrid Systems
To harness the power of IP video surveillance, many analog users are now turning to hybrid systems. With a hybrid analog/IP system, you can ease your way into the IP video world while still using much of your existing analog equipment. In fact, it’s quite easy to incorporate those old analog cameras into your new digital system. By using video encoders (also know as video servers) and hybrid DVRs, it’s possible to integrate analog CCTV cameras into an IP video solution.

Here's how it works. The video encoder connects to the camera via coaxial cable. It then converts the analog video signals to digital and streams them over an IP network so they can be accessed in the same way as your IP cameras. By using video encoders, you can reap the benefits of IP video without giving up on your existing surveillance equipment.
IP Surveillance Overview

What is an IP Camera

At its core, an IP camera (or network camera) is essentially a camera and computer combined in one unit. What makes these cameras so special is their ability to send digital video footage directly over an IP network. This allows for real-time viewing and recording from remote locations, plus a host of advanced features and functionality.

Benefits of IP Surveillance

Remote Monitoring & Storage

IP-based surveillance systems allow remote access from anywhere, at any time. How do they do this? By capturing and distributing high-quality video over an IP network, or the internet. Video footage is stored remotely using cloud storage, or on a local server. Users can then access the footage, and even control the cameras, by logging into the camera’s network using a computer, smart phone, or tablet.

Image Quality

Network cameras have the potential to deliver extremely sharp and detailed video images. A number of factors including the image sensor, encoding chip, lens type, and pixel-count help to determine the quality of video images captured.

An IP camera generally comes equipped with either a CCD, CMOS, or a megapixel sensor. CCD sensors offer excellent image quality and light sensitivity but consume more power than CMOS sensors. CMOS sensors enable more integration possibilities and have a faster readout which makes them ideal for applications requiring high-resolution images. Megapixel sensors provide the highest image resolution with the greatest detail, but offer less in the way of lowlight performance.

A camera’s encoding chip can also play a factor in the level of image quality. IP camera models offer varying levels of encoding performance, and the encoding chip helps determine the level of image quality based on format, compression, and resolution for video streams. Image quality is affected by the type of lens you use as well. The camera lens controls the amount of light passing through to the image sensor, working to ensure properly exposed images. Many IP cameras support interchangeable lenses to provide the highest quality images for different types of surveillance applications.

When we mention pixel-count, we’re basically talking about the maximum image detail that a network camera can provide. While analog cameras must meet NTSC/ PAL specifications that can limit their abilities in terms of extreme image detail, the possibilities with IP cameras are limitless, depending on the model of course. This is evidenced by the performance of megapixel network cameras which feature a high pixel-count, and capture exceptionally detailed video images.

Scalability

One of the great things about IP surveillance systems is the fact that they’re easily expandable. Any time your surveillance requirements grow, you can scale your system by simply adding new IP cameras to your existing network. ONVIF, or the Open Network Video Interface Forum, promotes a global standard of compatibility for IP cameras, NVRs, and VMS software so you can easily mix brands.
How to Design a Video Surveillance Solution

Types of Cameras

Fixed
A fixed security camera points in a single direction, which is ideal for monitoring specific areas, and very effective for deterrence against vandalism and criminal activity. Typically, a fixed camera is the preferred choice when it works in your favor to have cameras installed in clearly visible locations. Once the camera is mounted, the viewing direction is set. For added flexibility, some fixed cameras accept interchangeable lenses and housings for both indoor and outdoor use. These cameras sometimes feature integrated LEDs for peak performance in extreme low-light or no-light conditions.

Bullet
Bullet cameras are a type of fixed camera, encased within a protective housing. These cameras are quick and easy to install, and come in both indoor and outdoor options for increased flexibility. Depending on which lens the camera comes with a bullet camera can be used for wide-angle surveillance for monitoring a large open park or conference room, or zoomed in recording for facial recognition as people enter and exit a store.

PTZ
PTZ cameras work great for flexible wide-area surveillance and detailed monitoring. With a PTZ camera, you can control the pan/tilt/zoom functions to follow activity and zero in on specific individuals and objects within a scene. These functions are controlled either manually or automatically. In many cases a single PTZ camera can provide the same amount of coverage as several fixed cameras, although it cannot point in all directions at once.

Fixed Dome
Usually designed for indoor surveillance applications, a fixed dome camera features a fixed camera contained within a small dome housing. Fixed dome cameras are also sometimes called mini domes. The main benefit of this type of camera is the discreet design which allows for unobtrusive surveillance. Unlike regular fixed cameras where the monitoring direction easily visible, fixed dome cameras typically make it difficult to see which direction the camera is pointing. Fixed domes with vandal-proof and outdoor housings are available for more demanding surveillance applications.
How to Design a Video Surveillance Solution

Camera Considerations

Low Light Performance
Before you choose which camera is right for a particular application, take a close look at the area you wish to monitor to get an idea of the lighting situation. Assessing low light performance depends entirely on whether the camera can handle your specific requirements. A camera’s light sensitivity is affected by a variety of factors including lens quality, aperture, the type of image sensor, exposure time, gain, and image processing. To simplify things, most IP camera manufacturers use a unit of measurement called “lux” to define the level of minimum illumination for a camera. The lower the lux number, the better the camera performs in low-light situations.

Of course there’s a difference between low light and no light. Even if a camera boasts superb low-light performance, at least some degree of ambient light has to be available, whether it’s from the moon, the stars, or a nearby street light. If the conditions truly are completely dark, you’ll need an IR illuminator or integrated IR LEDs in order to capture usable images.

Wide Dynamic Range
A security camera’s dynamic range is important to note, especially if you’re planning on monitoring areas where lighting conditions vary from one extreme to another. Examples include outdoor settings, and high-contrast or backlit scenes like you might find in a lobby. A surveillance camera with a wide dynamic range is able to address these difficult conditions by capturing quality image details in both bright and dark portions of the same surveillance area.

Auto Iris
For surveillance applications where light levels can change frequently and drastically throughout the day, a security camera with an auto-iris lens is usually required. In outdoor locations, for example, auto-iris is essential because of the varying light conditions. An auto-iris lens automatically adjusts the amount of light entering the camera so it stays at the optimum light level and video images remain properly exposed at all times. For some megapixel cameras, an auto-iris lens isn’t necessary.
How to Design a Video Surveillance Solution

Megapixel Resolution
A network camera with megapixel resolution is the preferred choice for applications where identification of people and objects is critical. Megapixel cameras not only capture exceptionally clear and detailed video images, but the high resolution also means they provide a much broader field-of-view than traditional security cameras. In fact, a single megapixel camera can monitor areas that would normally require multiple traditional cameras.

To get an idea for how megapixel resolution compares to that of analog cameras, consider that an analog camera, even after having its signal digitized by a video encoder, can only provide a maximum resolution of 720x480 pixels. Megapixel cameras start at around 1280x1024 pixels, and can get up much higher than that.

Image Detail
Remember the days when surveillance footage most closely resembled the grainy reception of a yard-sale television set? Back then video surveillance wasn’t very effective because the images simply weren’t usable. But thanks to IP video technology, there’s really no limit to the amount of image detail today’s cameras can provide. Of course, every camera model has its own capabilities, and the amount of image detail required depends on the application. For license plate or facial recognition, for instance, a high level of image detail is essential. To determine the amount of image detail a camera can provide, look at the pixel count in the stated resolution. The more pixels a sensor has, the finer the details it can capture.

With analog CCTV cameras, image detail is measured in TVL (or TV Lines). The video picture is composed of active horizontal lines transmitted to a monitor or recording device. The horizontal lines are delivered in two off-set fields, one containing even-numbered lines, the other containing odd-numbered lines. These lines are then interlaced so the viewer sees a complete picture. Because the picture has a 3x4 aspect ratio, the horizontal TVL resolution refers to how much detail you can measure in 3/4 of the picture’s width. This number varies depending on camera type, but in general, standard CCTV cameras offer 380 TVL while high-resolution cameras provide 540 TVL.
How to Design a Video Surveillance Solution

Digital PTZ
A key benefit of high-resolution, megapixel network cameras is they often provide digital PTZ functionality. Digital PTZ lets you move around your field-of-view, and zoom in on specific parts of the scene while maintaining a high level of image quality. You can even record at full frame while simultaneously zeroing in on finite details. Essentially, it's full pan/tilt/zoom functionality, but without moving parts, which provides the added benefit of extending camera life.

Camera Configuration
Unless you're already a video surveillance expert, you'll want to factor in how difficult it is to configure the camera for effective surveillance. Some cameras are ready to roll right out of the box, while others might require you to carefully adjust a multitude of settings. In the end it all comes down to your own comfort level, but typically, the less adjusting you have to do, the easier it is to avoid performance issues.

Camera Configuration
In the world of IP surveillance, Power over Ethernet (PoE) brings a great deal of flexibility to the installation process. IP cameras that support PoE receive their power via standard Ethernet cable. This same cable is also used for transmitting video and other data over the network. By integrating power into a standard LAN infrastructure, PoE effectively eliminates the need for nearby power outlets in camera locations, which means you can install your IP cameras virtually anywhere.

Video Compression
IP cameras and video encoders use a variety of compression technologies to reduce file sizes when delivering video and other data over your network. This process helps to optimize bandwidth while also saving storage space. The most efficient compression technologies are able to do this without sacrificing much in the way of image quality. Different network cameras and encoders of course support different compression formats. Here are some of the most common compression technologies available:

- **H.264** – H.264 is the latest compression technology available with select network cameras, and it's likely to become the new standard. H.264 compression significantly reduces video file sizes when compared to Motion JPEG and MPEG-4, effectively using far less bandwidth and storage space while allowing for superior image quality. This is especially beneficial for surveillance applications requiring megapixel video.

- **MPEG-4** – MPEG-4 is primarily used for bandwidth-limited applications. It offers more compression efficiency than Motion JPEG by finding the differences between frames and leaving out redundant information. In this way, MPEG-4 reduces file size and bandwidth requirements by only compressing those frame-to-frame differences.

- **Motion JPEG** – Motion JPEG reduces file size by breaking the video stream up into a series of individual JPEG images. For full motion video, this stream must be transmitted at 30 frames per second, though even at 16 frames per second the viewer still perceives motion video. The biggest advantage of Motion JPEG is there's no drop-off in image quality between the individual frames. They’re all at the same level, which makes it ideal for snapshot viewing.
How to Design a Video Surveillance Solution

Wireless
Wireless technology provides another flexible, cost-effective solution for video surveillance applications. With wireless technology, the need for complicated cabling schemes is completely eliminated as video is transmitted over a wireless local area network (WLAN). This makes wireless IP cameras well-suited for monitoring large areas such as city centers and parking lots, and any location where running cables isn’t an option. Please note that wireless cameras still require a power supply.

Camera Configuration
Many of today’s IP camera models include built-in audio support so you can listen in on areas under surveillance and even communicate directly with those in range of the camera. Audio can be an invaluable tool for a variety of applications, for instance video conferencing, communicating with visitors and intruders, and integrating prerecorded messages for use with access control. Analog CCTV systems require separate cables and equipment for audio, while an IP camera sends both video and audio over the same network cable.
Video Management

Analog Video Management & DVR Recording

We talked earlier about hybrid systems, which allow you to incorporate analog CCTV cameras into a networked surveillance solution. Managing video in this type of system requires a digital video recorder (DVR). With a DVR, your software, hardware, and video storage are all combined in a single unit that accepts analog camera feeds and digitizes them.

Benefits of DVR Technology

- **Remote Access** – Almost all DVRs now support remote monitoring over the internet. While the analog CCTV systems of the past were limited to dedicated security monitors in a central location, today’s DVR systems let you access your camera feeds in real-time from any web-enabled computer, and some systems even enable viewing via handheld devices.

- **Secure Connectivity** – Password protection ensures that only authorized users can access footage remotely.

- **Video Compression** – Helping to further optimize storage space, digital video recorders support a variety of compression formats, from Motion JPEG and MPEG-4, to leading-edge H.264 technology. These compression technologies help to reduce video file sizes while maintaining optimum image quality.
Video Management

IP Video Management

NVR-Based Software
A network video recorder can serve as a standalone solution for video recording and management because it includes pre-installed video management software. All NVRs support basic software functions such as monitoring live video, recording video, and searching and viewing archived footage. Different categories of NVR solutions are available for IP surveillance systems of varying types, from small systems requiring only basic functionality, to multi-site systems and large-scale surveillance networks requiring fail over and central management.

In an IP-based video surveillance setup, software plays a key role in how you manage your cameras and surveillance footage. IP video software provides basic tools for monitoring, recording, and video management, along with sophisticated functions for intelligent surveillance and system integration. The software can be either PC or NVR-based. Let’s take a closer look at some of the basic functions of video management software.

Monitoring
Since network cameras include a built-in web server, users can remotely monitor the footage on a computer, or through apps for smart phones and tablets. Video management software offers the most flexibility in terms of monitoring. Typically, users are provided with different viewing modes, and can monitor live and recorded video images from multiple cameras simultaneously. Many software programs also let you remotely adjust camera settings and control functions such as pan, tilt, and zoom commands for detailed monitoring.

Recording
With video management software, you usually have several different recording modes to choose from. Examples include continuous recording, scheduled recording, and event-triggered recording. The advantage of recording on a schedule, or having it triggered by specific events, is that storage requirements and bandwidth usage are reduced. You can also conserve storage space and bandwidth by configuring different frame rates for live monitoring and recording. For instance, you can program the system to only use full frame rate during event-triggered recording to guarantee high-quality video footage at the most important moments.

Playback
IP video software makes it easy to search and playback recorded surveillance footage on demand. This is one of the key benefits of a digital IP video solution, as archived footage is searchable by date, time, location, or event. With video management software, you can view recorded footage in separate windows, and in many cases, multiple authorized users can access the video images at the same time. The software also provides tools that allow you to zoom in for closer inspection and detailed analysis of your archived video.

Video Analytics
If you’ve ever heard the term “intelligent surveillance,” it’s referring to the use of sophisticated video analytics to detect specific, predetermined activities. This advanced level of video analysis takes place either at the front-end within the camera, or via IP video software. The goal is to achieve preemptive surveillance, meaning you’re not just reviewing footage after the fact, but actually detecting suspicious activity as it happens.

While the technology is still being developed, it’s already widely used for a number of functions including advanced motion detection, license plate recognition, audio detection, facial and behavioral recognition, and detecting acts of graffiti, vandalism, or situations where an object is suspiciously left behind.

Bandwidth & Storage
When designing an IP surveillance system, it’s very important to that you evaluate and calculate bandwidth requirements long before installation. These bandwidth requirements can vary based on a number of factors. Desired resolution, frame rate, and image quality play a role, as the higher you go, the more bandwidth is required. Compression type is another key factor.
Assessing storage demand is equally important. When calculating the amount of storage required, you’ll want to take into account the number of cameras being deployed, image quality, frame rate, type of video compression, and recording time. You’ll also want to determine if recording will be continuous, scheduled, or triggered by events.

Integration

One of the many benefits of a digital surveillance solution is it allows for easy integration with other systems operating along the same network. When video footage is integrated with other systems, a variety of functions can be triggered. Special equipment and software is often required for these types of installations, so please tell your integrator if you are considering such a solution. To give you a better idea of how this all works, let’s look at a few common examples of system integration.

Point of Sale
Integration with point-of-sale (PoS) systems allows cash register transactions and their accompanying video footage to be linked together. This helps to prevent customer and employee theft, and also provides fast and accurate visual verification of PoS exceptions such as returns, cancelled transactions, and refunds and exchanges, while making it easier to verify suspicious activity in the process.

Access Control
When video surveillance is integrated with a facility’s access control system, every situation involving individuals entering or exiting specified areas can be logged with video. This process provides detailed visual verification, and can come in quite handy for identification purposes and for preventing tailgating (the act of following someone else into a room or building after they swipe their access control card).

Audio
Adding audio to your video surveillance system can enhance your business’s security system. Some surveillance cameras come equipped with a microphone, while others will have audio input and output jacks. This will allow you to record and listen to conversations, a useful application for interview rooms, focus groups, and integration rooms. Always check your local laws for audio surveillance regulations.
A New Era of Video Surveillance

We’ve covered a lot of ground, and obviously there’s much to consider when planning a new surveillance installation. But designing a surveillance system should not be perceived as a daunting task. Instead, it should be seen as an opportunity to enhance safety and security. In the past, a standard analog system with local monitoring was your only option. That’s no longer the case with the wide range of cameras, systems, and technologies now available. Best of all, the overall performance and quality of these systems is vastly improved.

With increased use of IP video and digital technology, users have far greater flexibility when it comes to monitoring and recording surveillance video. Whether you’re still using analog cameras, or making the transition to IP network cameras, we now have the ability to provide you with feature-rich solutions that enable remote monitoring, digital storage, simplified integration, and a variety of other innovative functionalities.

As an industry-leading security integrator, VideoSurveillance.com brings peace of mind to businesses and organizations around the world through custom video surveillance solutions. Our complete video surveillance systems come with everything you need, so you can focus on the task of running and managing your business. With over 50 years of surveillance experience, certifications from leading manufactures, and a passion for helping you, our experienced staff will design a unique solution for your project.

With clients ranging from high schools to Fortune 100 companies in over 60 countries, we have worked with every surveillance concern. Maybe you’re looking for a large-scale system to monitor an entire school or business campus, and need it to integrate with existing alarm equipment? Or you’ve got a small retail store and want to track customers to optimize your store’s layout for higher purchase rates? Or you want clear video at night, with thermal cameras, to secure the border of your farm or industrial facility and deter theft? We can help, so call our surveillance experts today.