ESI WHITE PAPER

Understanding surveillance video

Contents

Introduction

Purpose

The purpose of this document is to help you gain a clearer understanding of video surveillance. Armed with this information, you'll be better prepared to assist customers in making appropriate decisions regarding their surveillance needs.

Besides understanding basic video terms and setup, the most important factor in a successful video installation is to understand the site's needs and expectations. Not knowing this will lead to a problematic installation and user experience. Moreover, it's helpful to consider that the video capabilities in **ESI Media Management** were not designed to address every surveillance need. Rather, they were designed to handle basic video functions for small to medium-sized businesses — a few examples would include: monitoring lobbies and other publicly accessible areas; visual tracking of employees' entries and exits; and monitoring secure areas (such as drug closets or equipment storage rooms).

Document layout

The document is broken into different sections discussing the main topics of video surveillance. Each section refers to how the topic at hand relates to ESI Media Management. ESI video and user PC requirements are stated near the end of the document. At the conclusion, the document provides a few site examples to help you bring together the information herein.

Types of cameras

Analog

Analog cameras are also known as *standard-resolution* cameras or *CCTV* (closed-circuit television).

Analog cameras are so named because they record analog signals. Originally, these signals were recorded to tape-based media, such as VHS tapes. With the emergence of IP networks and digital video recorders (DVRs), output from analog cameras today is typically recorded to a digital medium, such as a CompactFlash device or hard disk drive. To accomplish this, a **digital video server** is needed to convert the video signal from analog to digital. For ESI video, this device is the **ESI Video Adapter**. A video server allows the site to migrate to digital surveillance without having to replace existing analog cameras.

Analog cameras typically use a standard **resolution** of 640 x 480 (**pixels**). Although this is inferior to the resolution provided by the latest network cameras (see "Network," *below*), an analog camera's resolution works well in several applications. In fact, in some situations, analog cameras are preferred.

Network

Network cameras are also known as *IP* or *digital* cameras.

Network cameras record digital signals which can be recorded directly to digital media without the need for a video server to convert the signal. In general, network cameras offer higher resolutions and, therefore, better video quality.

Megapixel IP and **HDTV** combine to produce the newest technology in regards to IP cameras, a technology that offers ever-increasing video quality. Megapixel cameras can be used in virtually any environment, but are geared toward specific applications that require detailed video — *e.g.*, license plate captures and face recognition. Site examples include casinos, airports, and highway toll authorities. HDTV extends this capability even further with the enhancement of offering a wide-screen format (16:9 ratio, as opposed to the 4:3 ratio in older video formats). Although megapixel cameras have clearer, sharper images than analog cameras, megapixel cameras do have two main drawbacks — network bandwidth and CPU loading. Megapixel and HDTV cameras use much larger video images, the decoding and resizing of which can quickly consume network bandwidth; and video storage devices, while encoding such images, increase CPU loading. The higher the megapixel rating — two-megapixel, three-megapixel, *etc.* — the larger the files.

Camera type	Advantages	Disadvantages
Analog	• Lower network bandwidth • Variety of models — bullet, dome, box • Uses less storage space (for recordings) • Less expensive	• Lower resolution • More wires and cabling
Network	• Higher, clearer resolution • Variety of models — bullet, dome, box • Less wires and cabling; easier installation • PoE (Power over Ethernet)	• Higher network bandwidth, specifically megapixel and HDTV cameras • More expensive

Video image quality

Image quality depends on a number of factors including **resolution** (pixel ratio) and video **frames per second**. Resolution refers to the number of pixels in a horizontal row and vertical column of an image. (Vivotek)[1]

A resolution of 640 x 480 means there are 640 pixels in a horizontal row and 480 pixels of vertical lines. The resolution of the entire image is 1.3 (horizontal divided by vertical) megapixels. The higher the number, the better the resolution; the better the resolution, the larger the video image — and, therefore, the more network bandwidth consumption and (possibly) CPU loading.

Resolution standards

There are two main **resolution standards** used worldwide — **NTSC** and **PAL**.

NTSC

NTSC was the world's first color TV broadcast standard, developed in 1953 by the National Television System Committee. NTSC is used primarily in the United States, Canada, and Japan.

PAL

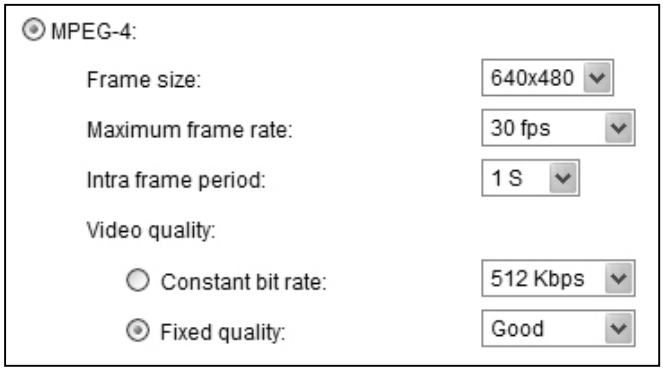
PAL is a newer color coding standard that was developed in 1967. PAL is primarily used in Europe.

ESI video supports only NTSC resolution; therefore, when deciding on a camera model, be sure to rely on its NTSC (not PAL) information.

Frames per second

Video is made up of individual **frames**. A **frame rate** of 16 or more **frames per second (fps)** means full motion to the viewer. NTSC perceives full motion at 30 fps. Either the ESI Video Adapter or a Vivotek IP camera will allow for a lower frame rate, which typically is chosen to reduce network bandwidth or CPU load.

The **intra frame period** setting as shown in the picture is the delay between each frame.



Fixed bandwidth vs. fixed quality

When programming an ESI Video Adapter or a Vivotek IP camera, there are two other fields associated with quality — **constant bit rate** and **fixed quality**.

Constant bit rate

Constant bit rate provides control over the amount of video streaming per second. If the site has a fixed amount of bandwidth for video the constant bit rate selection is more appropriate. Frame loss may be experienced with this setting.

Fixed quality

Fixed quality is selected when the amount of video streaming is variable and fixed bandwidth isn't a concern. This setting uses higher bandwidth during certain events (like motion) but lower bandwidth where there is no motion. Although the site may appear to have ample network bandwidth, it's still possible to quickly overload networks that are small or experience high traffic. Therefore, it may be necessary to change a camera's fixed quality to a setting lower than *Good*, *Detailed*, or *Excellent*.

[1] "Glossary," *http://www.vivotek.com/support/glossary/glossary_r.html*, 22 April 2010.

Following is a visual example of different resolutions and how each affects the video quality.

Each image was taken from its camera's panel in *ESI Video Viewer*. The images represent various panel sizes based on how the *ESI Video Viewer* user stretches the size of the application. To save space on this page, the images shown have been reduced compared to how they appear in the Video Viewer. For example, Image **C** is a representation of a panel in full-screen mode.

The analog camera being used to capture the video states 380 horizontal **lines of resolution (LOR)** on its packaging. This means the best maximum resolution is 380 horizontal LOR. Out of the images above, sizes **A** and **B** are better viewing sizes for this camera, since *380* is close to both *242* and *489*. However, image **C** has a height of *876*, which is more than double the camera's maximum resolution. This explains why image **C** is somewhat blurry: once the image is expanded beyond *380* it becomes fuzzier, because the pixels in the image are being stretched over a larger area, as in image **C**.

Infrared illumination

Infrared illumination is meant for dark areas where the user needs to see video. A common scenario is after hours, when a non-authorized person is accessing areas where the lights are off; for reference, note the images[1] *below*. If the site needs this type of viewing, ensure the camera supports infrared capability **(I/R)**.

Camera with infrared illumination

Camera without infrared illumination

Video compression

There are three main **video compression** standards used today — **MJPEG**, **MPEG-4**, and **H.264**. The compression comes into play when recording video. For ESI, video is recorded directly from the IP camera or ESI Video Adapter to the storage module on the ESI Applications Card. ESI uses MPEG-4 SP.

MJPEG

MJPEG compresses each frame as an individual JPEG image without reference to the previous or sequential frames. This creates redundancy in the images thereby generating larger images.

MPEG-4 SP

MPEG-4 SP (also known as *MPEG-4 Part 2 Simple Profile*) is a more efficient compression by identifying differences between frames based off the original frame. This alleviates redundancy leading to a more compressed and smaller image size.

H.264

H.264 (also known as *MPEG-4 Part 10*) compresses video images even further than MPEG-4 SP. H.264 may have better compression, but encoding the images uses more than double the CPU capacity as compared to MPEG-4 SP. Because H.264 is not yet a widely accepted compression, there are few to any free PC video players in the market which handle H.264.

[1] From *http://ariescc.tv/ip.html*.

Video transmission

There are three main methods used to **transmit** video — **unicast**, **broadcast**, and **multicast**. ESI uses multicast over a LAN and unicast over a WAN (wide area network; Internet).

Unicast

Unicast (also known as *one-to-one*) transmits data to only one designated PC. If more PCs request the same data, the original PC will then retransmit the data repeatedly to these PCs. This is the most popular transmission method; however, unicast can consume more network bandwidth, especially when dealing with multiple transmission streams and multiple PCs. This is the only method supported over a WAN.

Broadcast

Broadcast (also known as *one-to-all*) transmits data to all PCs, regardless of whether the PC "needs" it. Although broadcast is a more efficient way to update several PCs at once, broadcast transmissions can flood the network with unnecessary data.

Multicast

Multicast (also known as *one-to-many* or *many-to-many*) transmits data to only those PCs that are requesting it. This means multicasting significantly reduces network bandwidth. If a PC has turned off the application requesting the data, transmissions will cease for this PC until the application is restarted. Therefore, multicast is efficient whether requests are coming from many PCs or a few.

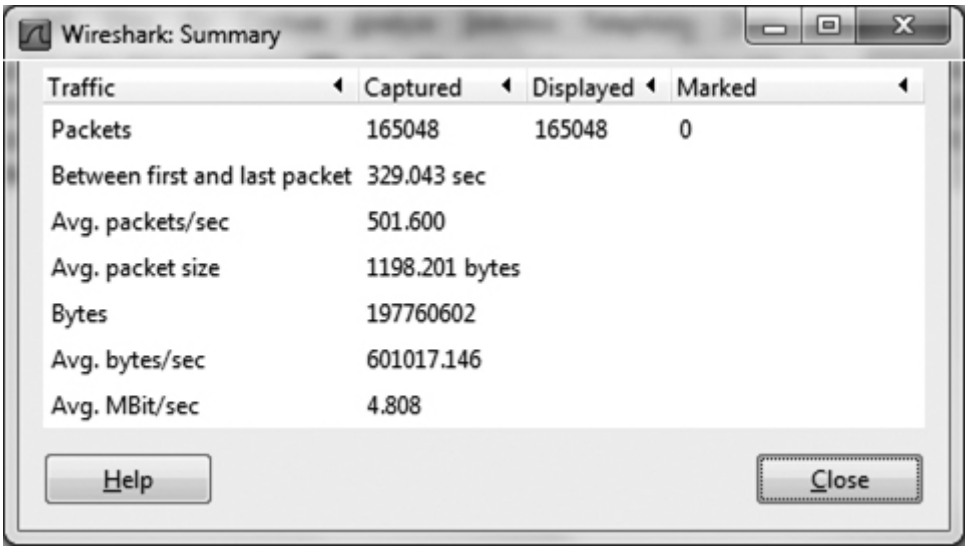
While unicast would be sending 30 streams of information to 30 users, multicast sends 30 streams to one device (a multicast router) that, in turn, delivers the information to the applicable PCs.

Bandwidth consumption

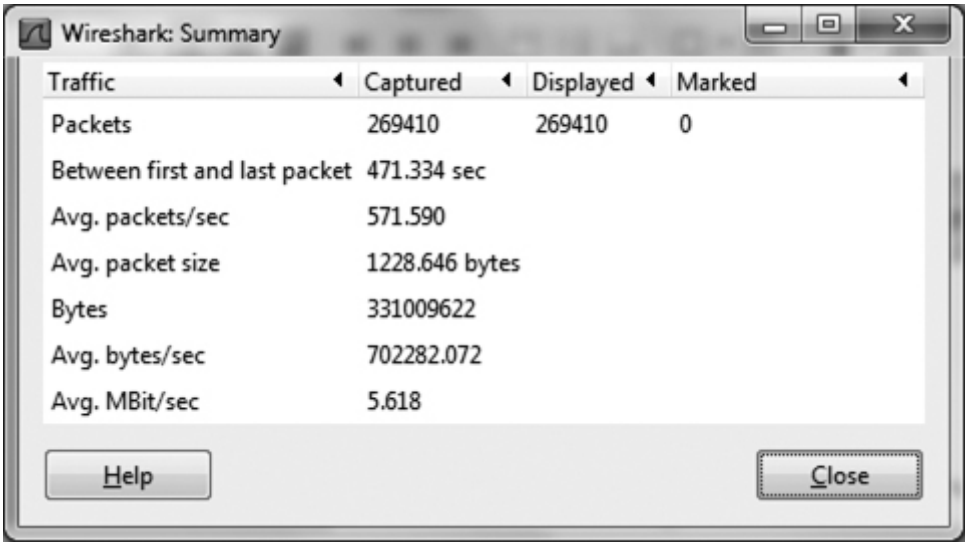
Local cameras

The following images depict LAN activity (10/100 MBit/sec) under certain conditions.[1]

- One *ESI Video Viewer* user viewing **one analog camera**:

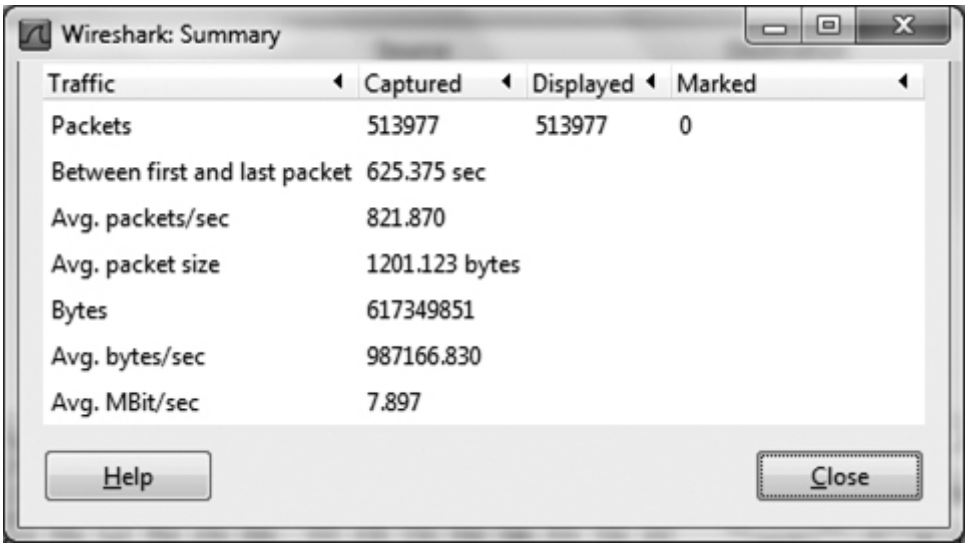


- One *ESI Video Viewer* user viewing **one IP camera** (Vivotek FD8161 with few motion events):

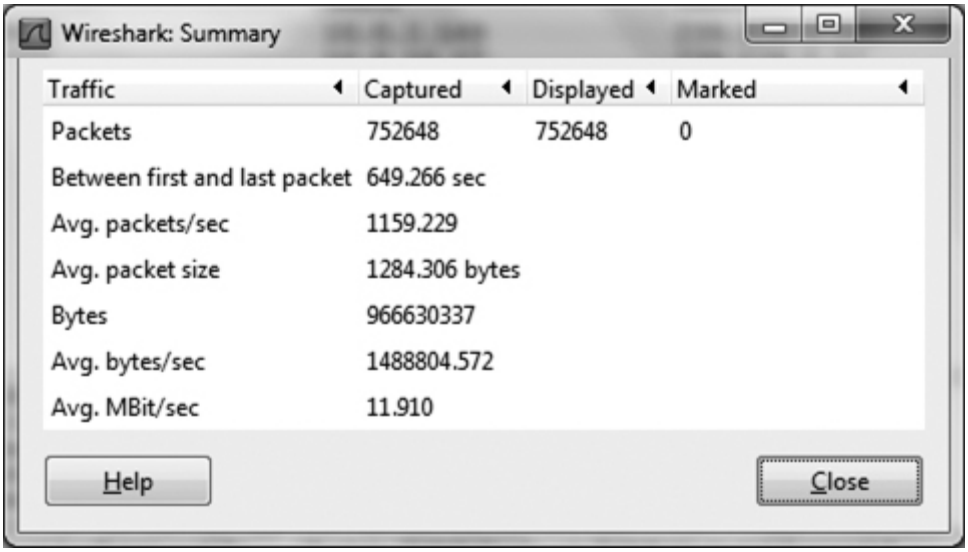


[1] Results may vary depending on network conditions.

- One *ESI Video Viewer* user viewing **four analog cameras** and **four IP cameras**:

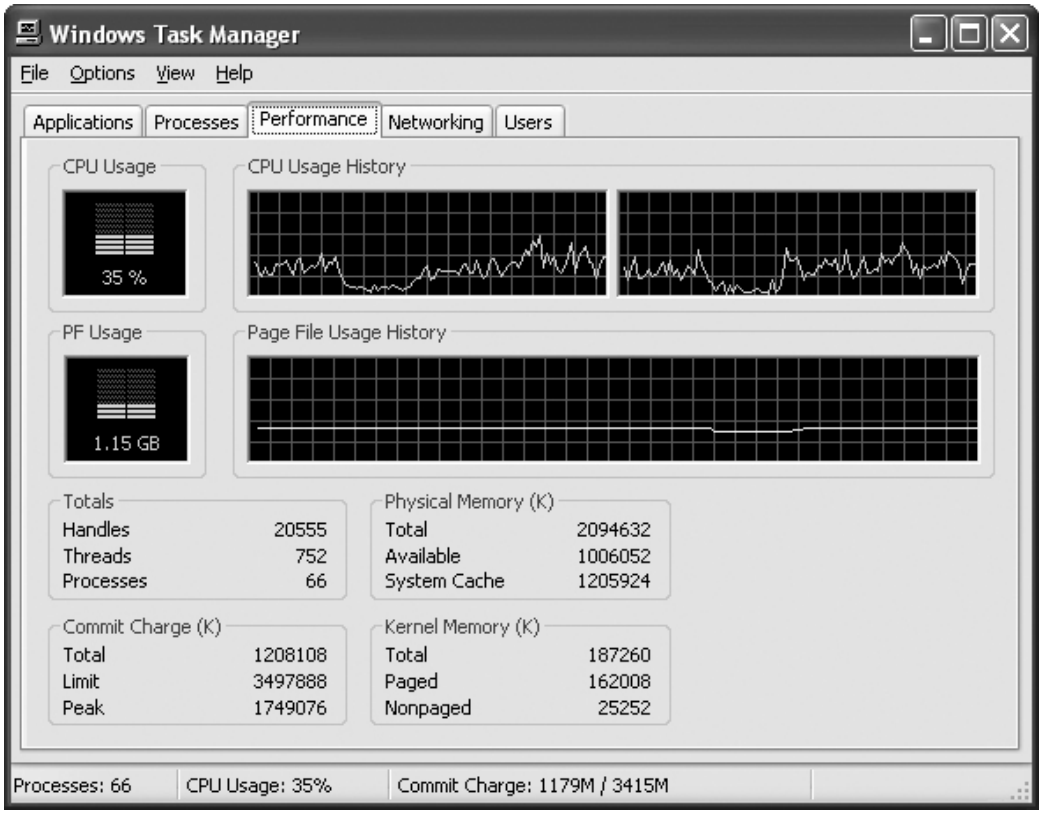


- Two *ESI Video Viewer* users viewing **four IP cameras** and **four analog cameras**:



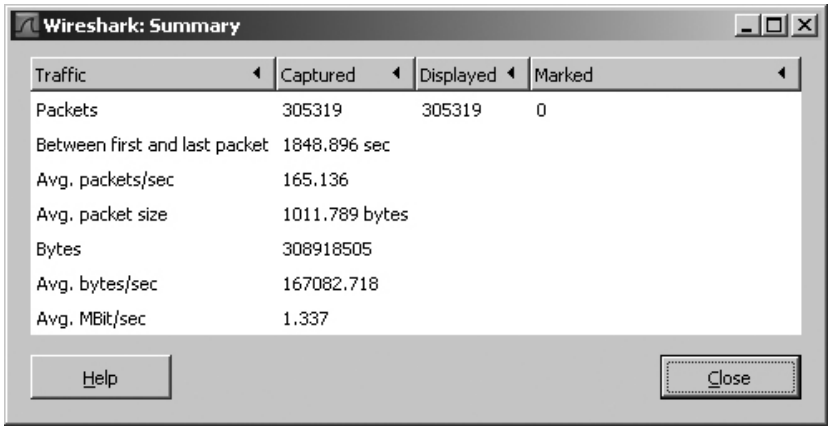
Notice that the average MBit/sec didn't double in size when the second viewer was added. This is due to multicasting packets on the LAN.

The example below shows CPU activity on a PC running *ESI Video Viewer* while viewing **14 cameras**, which are a mixture of analog and IP. In this example, CPU usage can go as low as 20%, but reaches 35–37% when motion events are occurring on various cameras.



> **Note:** The processor in the PC from which this image came is an x86-Family 6 Model 15 Stepping 2 Genuine Intel at 2,128 MHz.

Remote cameras



The term **remote cameras** refers to a setup where cameras are at an off-site location and being viewed live at the main office in *ESI Video Viewer*. One thing to remember with remote cameras is that the video images are sent and received via unicast (see "Video transmission," page 7), which is the only method supported over the Internet.

As you can see in this example, the **Avg. MBit/sec** is *1.337*, which is nearly the entire size of a T1 (1.54 MBit/sec). Adding one more camera or one more viewer basically doubles the figures shown here. When viewing remote cameras, the *ESI Video Viewer* user may see a five-second (or longer) delay from real-time.

Camera

There are various attributes that can affect the selection of a camera. The most important thing is to discuss the site's needs and expectations. Only then will you have a successful installation.

Following is a list of common questions and how possible answers may affect the camera selection.

- **Can the site's network support surveillance cameras?**
  If unsure, you should perform a network analysis just as you would when installing local IP or remote IP phones. Video viewing and recording will not perform well if the network is not set up to support video traffic. The load will affect not only video but also, possibly, the site's Internet connectivity — including download speeds of items such as e-mails.
- **Do the user's PCs meet minimum requirements?**
  If unsure, take the time to ensure these requirements are met. Just because the network can support video viewing doesn't mean the user's PCs have adequate processing power.
- **Does the user need to view an area** (lobby, storage, parking lot) **or is there a need for detailed viewing** (facial recognition, money transactions)**?**
  If detailed viewing is needed, the site will want a megapixel camera. It is possible that the sites' network is not adequate to support this camera type. Also, *ESI Video Viewer* and the ESI Applications Services Card (ASC) were not designed for megapixel cameras. Technically cameras such as the Vivotek IP8161 work with ESI equipment, but you should keep in mind that these type of cameras require much more bandwidth and CPU processing. In other words: if a site needs several high-end megapixel cameras for defined viewing, ESI Media Management may not be the best solution.
- **Does the camera need to be hidden?**
  If yes, ensure any LEDs on the camera can be turned off via Installer programming of the camera itself.
- **Will the camera be installed in a confined space?**
  If yes, ensure the chosen camera fits in this space so that the desired area is viewable.
- **Will the camera be installed in an area where the user will need to adjust the angle of the camera?**
  If yes, ensure the camera is adjustable in the appropriate direction. For example: if it's mounted on a wall, and the camera must be moved to the right for viewing, be sure the camera **can** actually be moved (tilted, angled) to the right when installed.
- **Is there a power source close to where the camera is to be installed?**
  If no, you may want to choose a network camera with PoE. Otherwise, be sure to account for this power need and any additional costs associated with it.
- **How much lighting is in the viewing area?**
  If the answer is little to none (*e.g.*, at nighttime), be sure to choose a camera with either infrared (I/R) capabilities or low-lux ratings. These settings are commonly noted on the camera's packaging or online specifications. You may also want to consider adding more light to the area.
- **Does the camera need to be used outside?**
  If yes, choose a camera that is marked "for outdoor use." Ensure the environment meets the camera's documented specifications. For an analog camera, you'll need to consider the specifications of the ESI Video Adapter and the analog camera.

ESI camera minimum requirements

ESI does not offer cameras for use with ESI Media Management. To be compatible with ESI Media Management, a video camera must meet these requirements:

- 380 to 480 lines of resolution (LOR). You may use a higher-resolution analog camera, but the ESI Video Adapter will process only up to 480 LOR (and you'll remember that a higher LOR means more bandwidth consumption).
- Either color or black-and-white is supported.
- NTSC only (PAL and ATSC are not supported).
- Wireless and webcam-type cameras are not supported.
- The following Vivotek IP camera models are supported: IP7330; IP7153; IP5130; IP8161; FD7131; and FD8161.
- An ESI Video Adapter is not needed for Vivotek IP cameras.

Cabling and power

The only item included with each ESI Video Adapter or Vivotek IP camera is a power supply for the device.

Keep in mind the following when purchasing and installing video equipment:

- Each camera and ESI Video Adapter will require power from a 120VAC outlet.
- A video cable is needed to connect the camera to the ESI Video Adapter. This cable isn't always included with the analog camera.
- An Ethernet cable is required to connect the ESI Video Adapter or a Vivotek IP camera to the LAN.
- For all cables, be sure the lengths are sufficient for the appropriate connections.
- For power cables, shielded wiring is recommended. **Double**-shielded wires, while more expensive, protect equipment more effectively from surges caused by electrical storms.

Other considerations

UPS — ESI highly recommends the use of an uninterruptible power source (UPS) for both the ESI Video Adapter and the camera. This provides maximum protection against not only unexpected losses of electrical power but also the damage that can be caused by surges, electrical noise, and other similar difficulties which neither device's own power supply is designed to handle.

Computer system requirements

ESI Media Management and its associated applications require a PC using *Windows XP*[1], *Windows Vista*, or *Windows 7* and meeting the following **minimum** requirements:

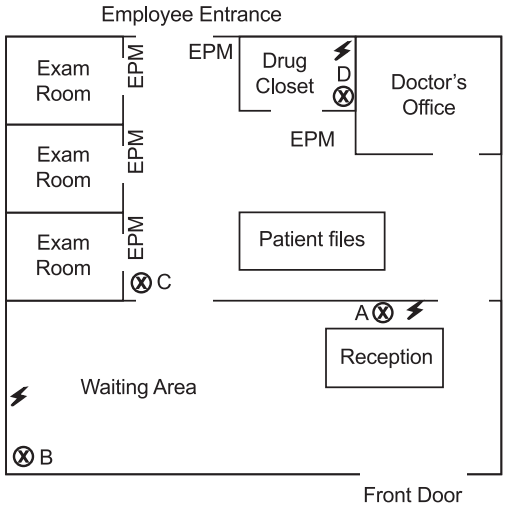
- 2 GB of RAM.
- A Pentium® 4 processor or better with a minimum speed of 2.0 GHz.
- 256-color (eight-bit) video output. ESI recommends using a **separate video card**, as opposed to built-in CPU video support, especially for viewing multiple motion-detection cameras. This is because a separate video card exerts less of a drain on the CPU, allowing the PC — and *ESI Video Viewer* — to run more smoothly than when depending upon built-in video support on the CPU.

A single PC can view only 15 cameras simultaneously. The more motion-detection cameras that are in the layout being used by *ESI Video Viewer*, the higher the CPU usage. If motion occurs constantly in these camera views, the CPU usage will increase even more. Even on a PC that fulfills the computer system requirements, it's possible for the PC to run slowly due not only to other running applications (such as anti-virus scanners) but also the number of cameras being viewed simultaneously that are receiving a continuous flow of events, especially motion.

[1] 64-bit versions of *Windows XP* are not supported.

Site example A

Dr. Quinn has a typical family doctor's office. After passing the front door, the patient is greeted by office staff, who verify the appointment and insurance as well as take payment. Once called, the patient is escorted to an exam room. After the doctor's visit, the patient leaves the building the same way he/she entered. Some medical staff have access to a drug samples closet.



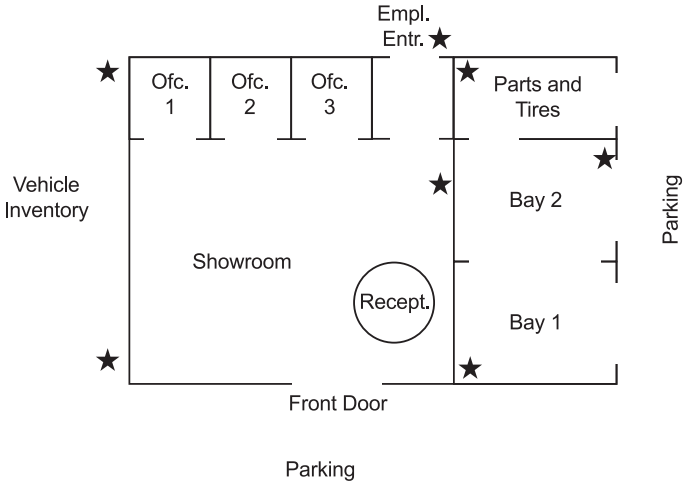
Shown here is a layout of the doctor's office. This gives the installer an idea of where to place cameras, based on what the doctor wants to survey and available electrical and network drops. Cameras are marked by the ⊗ symbol; ESI Presence Management RFID Readers are marked by "EPM." Camera A, which is high on the wall, can pick up the back of Reception as well as the front door. Camera A can be associated with the front door's RFID Reader, which will capture employee fobbing. Camera B is high on the wall, in the corner, to view the waiting area. Camera C is also high on the wall, in the corner outside the first exam room. Depending on the camera's visual range and its height over the door(s) when open or closed, the camera should be able to see most of the area in front of the exam rooms and well as viewing those accessing the drug closet. The interior of the drug closet is viewed by camera D, which is also associated with the door's RFID Reader. This allows for a real-time visual alert to the *ESI Video Viewer* user and a trigger event that can be recorded.

Note that Camera C may present an issue, as there is no easily accessible electrical outlet; it's possible a network camera is a good solution for this spot.

The doctor doesn't need detailed video. He's looking for simple surveillance of broad areas like the waiting room. The drug closet may need slightly more detail than the other areas. That means not necessarily an IP camera, but rather a higher-end analog camera, one that reaches 480 LOR.

Site example B

Freeman's Ford is a small automobile dealership which employs salespeople, receptionists, and mechanics. Customers can be seen in the vehicle inventory area, parking area, and showroom. In general, the owner wants the receptionist and himself to see visiting customers' activities. He's also had an issue with employee breaks and concerns over warehouse inventory.



After surveying the property and discussing the site's needs, the ESI Reseller suggests the camera locations indicated by stars in the layout shown here. Although the cameras' locations may view the desired areas, it's not indicated whether these locations have adequate network or power connections. An ESI Presence Management RFID Reader should be used at the back employee entrance; when the RFID Reader is associated with a camera, this will allow visual capture as each person fobs in or out. The site also could choose to have an RFID Reader on the door to the parts area. The receptionist will be viewing several cameras simultaneously; therefore, a second monitor would be helpful.

The site is considering a high-image-quality camera (megapixel) in the bay area. Either of two Vivotek camera models — FD8161 or IP8161 — would be a good choice for this area; but, remember that each is a two-megapixel camera which produces large images. This means either camera could be especially draining on the network because it would be in a high-activity area and thereby capturing motion events frequently.

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