

Video Surveillance Basics

This guide is designed to educate you on basic system design and application. It is intended to help you make the right choices when designing a video surveillance system that will meet your expectations.

The first step is to understand the different technologies, their operation, and benefits. The technologies range from 20 year old "Analog" to cutting edge "Digital". Your goals and what you want to accomplish will dictate which technology is right for you.

There are 3 types of surveillance technologies to consider: They are:

- **Analog/Time Lapse Systems**
- **PC Based Digital Systems**
- **Hardware Based Digital Systems**

There are a few acronyms which you may or may not know. Just for the record here are the ones that matter.

- BNC: Fitting used to connect coax cable to cameras and equipment.
- CCTV: Closed Circuit Television
- DVR: Digital Video Recorder
- Mux: A four, nine or sixteen camera analog video multiplexer.

Analog & Time Lapse Systems

Monitors & Multiplexers:

Monitors are analog TV monitors which can display one video signal. In other words they have one video input. They are nothing more than high resolution TV's. They range in size from 9" to 25" screens. They are the only way to view cameras with a time lapse recording system. With the addition of a multiplexer you can display 4, 9 or 16 video signals on one monitor. The multiplexer only provides the ability to view multiple cameras on one screen, it does not provide the ability to record.



Color Analog Monitor



4, 9 & 16 Input Video Multiplexers

Time Lapse Recorders:

With the addition of a Time Lapse Recorder you can record the video signal from a single camera, or a multi-camera view from a multiplexer using a standard VCR tape. Time Lapse Recorders are available in several different versions. Some even record up to 960 hours on 1 VCR tape. But be aware, when you are recording 960 hours on one VCR tape you are only recording 1 frame or picture every 9 seconds. When programming a time lapse recorder we recommend you do not set the recording duration for more than 3 days or 72 hours. This will allow the minimum amount of tape changing and still record enough frames to make the recording useful. This also allows you to record over a weekend without changing the tape. Three days of recording on one tape records 1.5 frames or pictures per second....not great, but not bad considering this is a 20 year old technology.



Time Lapse Recorder



Standard VCR Tape

Playback

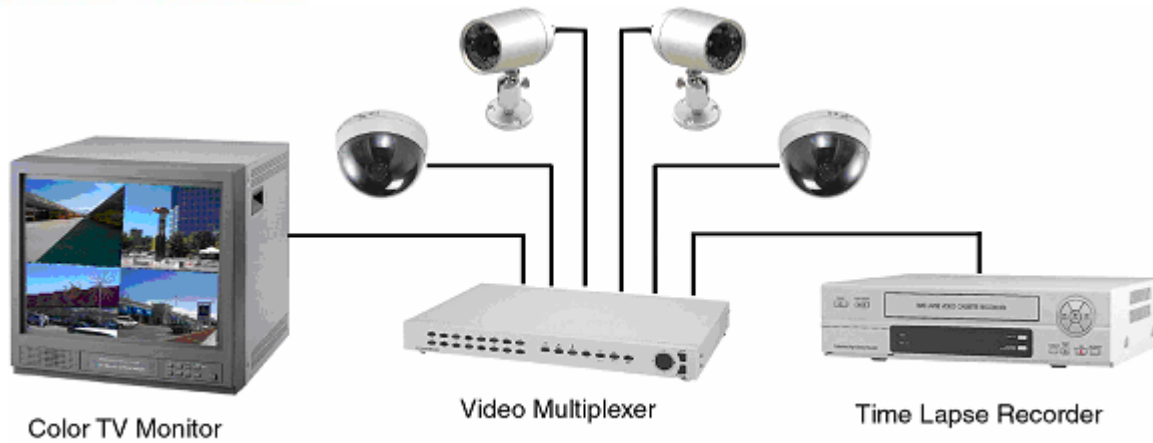
If a video is recorded in time lapse mode you must use a time lapse recorder for playback. The standard VCR's we all have in our homes can not process the time lapse format and will not provide a useful playback.

Tapes

Time Lapse Recorders use standard 2 hour VCR tapes. Always make sure you buy only the highest quality tapes. You should also have 10-12 tapes which are rotated in order. For example, if the recorder is set to 72 hour recording or 3 days, the tapes would store 30+ days of video. Changing the tapes also increase the life of the recorder and the tapes.

Analog/Time lapse System Wiring:

The video signal from each camera (usually transmitted with RG59 coax cable and BNC twist on fittings) are plugged into the multiplexer. One coax cable is connected from the multiplexer to the video input on the TV monitor. A cable from the VCR (out) on the multiplexer is connected to the video (in) on the time lapse recorder. The system is programmed through the VCR's control panel. The monitor displays the programming options. On playback the recorder feeds the multiplexer the video in a special format that allows the multiplexer to provide the monitor a multi camera playback of the video which was recorded.



Analog / Time Lapse System Overview

Benefits:

- The systems are very reliable and no computer skills are required to operate them.

Limitations:

- The video quality is considered fairly low compared to the digital systems.
- The tape must be changed every three days or more.
- The system requires regular cleaning and maintenance on the VCR.
- The video quality degrades over time.
- The systems do not have the ability for networking or remote viewing i.e.: Internet & dial up.

PC Based Digital Video Systems

A PC based DVR is comprised of a computer, video capture cards and custom written software. These systems are considered to be the best bang for the buck. They provide a 100% increase in video recording clarity over Time Lapse and are easier to use and more flexible than Hardware DVR's. These units are available as kits which you install on your PC or as complete factory built recorders. Some factory models can be expanded as your needs grow, this is not the case with Time Lapse or Hardware DVR's.

PC based DVR's are available in 4, 8, 12 and 16 camera configurations. PC based DVR's are programmed and operated with a keyboard and mouse. The video is recorded to the computers hard drive in a compressed format. This compression allows a huge amount of video to be stored. On average, a four camera system recording continuously should record at least 30 days of video for all 4 cameras on one single 80 gig hard drive. To double the recording days simply add another 80 gig hard drive.

These systems are designed so they do not require any scheduled action to maintain the video recordings. They record video to the hard drive until a certain amount of disc space is left. Then the system will delete the oldest clips and record the new video. This provides a continuous 30+ days of recordings at anytime.

The video is played back on the computer monitor or is saved to a floppy or burned to a CD. Some systems saves the video so it can be played back on any PC with Windows Media Player (a real nice feature). You can also print or save a jpeg image of any specific video frame.

These systems allow you to view and playback any combination of cameras without interrupting the systems recording process. Some features are as follows:

- | | |
|-------------------------------------|---------------------------------------|
| * Motion Detection Recording | * Still Frame Picture Printing |
| * Internet/network/Dial Up | * Digital Picture Adjustments |
| * Multi Camera Play Back | * Complete Search Options |
| * Remote Viewing | * Frame Rate Control |
| * Alarm Monitoring | * Password Protection |
| * Speed controls | * Audio Recording |
| * Digital Zoom | |

Cable & Maximum Distance

CCTV video coax cable is used to transmit the video from the camera to the front end. The maximum distance the cameras can be from the front end is a function of the cable rather than the camera itself. Using RG59 coax, you can extend the camera out to 600'. Using RG6 coax cable, you can extend it to 1000'.

Cameras

Any professional grade camera that uses RCA or BNC connectors will work with these systems. Please see the "**Cameras**" section for detail on the various cameras available.

PC Based Digital Video Recorder Overview

Benefits:

- 320 x 240 Digital Video Recordings. 100% clearer than Time Lapse.
- Easy to use and flexible.
- Saves time playing back video.
- Stores large amounts of video or recording days.
- Little or no maintenance.
- Easy network integration.

Limitations:

- The system runs on a PC with the Windows Operating System, the system is only as stable as Windows.
- Video clarity is much better than Time Lapse but not as good as a Hardware DVR.

Hardware Based Digital Video Systems

Hardware based DVR's are built specifically for video recording. Unlike a PC based DVR's which is first a PC and then built into a DVR these units are built from the ground up to perform one specific function...record video. While they do operate some software internally the video processing is hardware based. It is this hardware which provides the incredible clarity and high resolution performance of the systems.

Hardware DVR's are a mixture of time lapse technology and PC based DVR's. They use the same analog TV monitors that the time lapse systems use and they program with a hand held remote much like a regular VCR. But they provide high resolution digital recording which surpasses the quality of a PC based DVR.

While Hardware DVR's offer many features of the PC based DVR's. They are harder to program and operate than the friendly software of the PC based systems. Hardware based systems offer:

- **720 x 480 High Res. Recording**
- **Live Video Viewing**
- **Remote Access via Internet**
- **Motion Recording**
- **Automatic Schedules**
- **PTZ Control**
- **Alarm Monitoring**
- **Email Paging**
- **Password Protected**



Hardware DVR Applications:

You should consider a hardware based DVR if high resolution recording and live camera viewing is needed for your application. You should consider a PC based DVR if ease of use and expandability are needed for your application.

Hardware Based Digital Video Recorder Overview

Benefits:

- 720 x 480 Digital Video Recordings. Twice as clear as PC based DVR's.
- Live Camera Viewing. No delay.
- Stores large amounts of video or recording days.
- Little or no maintenance.

Limitations:

- Harder to program than PC based DVR's.
- Cost up to 50% more than PC based DVR systems.

Feature/Performance Comparison

Features	Time Lapse	PC Based DVR	Hardware Based DVR
Recording Days	3 Days	30-60+ Days	30 Days
Monitor Type	Analog TV	PC Monitor	Analog TV
Programming	VCR Control Panel	Keyboard & Mouse	Hand Held Remote
Recording Quality	Low	320 x 240 Med/High	740 x 480 High
Recording Media	VCR Tape	Hard Drive/Digital	Hard Drive/Digital
Multi Camera Viewing	Yes	Yes	Yes
Multi Camera Playback	Yes	Yes	Yes
Alarm Monitoring	No	Yes	Yes-Limited
Motion Recording	No	Yes	Yes
Automatic Schedules	No	Yes	Yes
Video Picture Adjustments	No	Yes	No
Password Protected	No	Yes	Yes
Audio Recording	No	Yes	Yes
Remote Alarm Monitoring	No	Yes	Yes-Limited
Digital Picture Zoom	No	Yes	No
Live Camera Viewing	Yes	Delayed	Yes
Remote Dial Up Viewing	No	Yes	No
Remote Internet Viewing	No	Yes	Yes
Custom Camera Viewing	No	Yes	No
Expected Operational Life	3-4 Years	5+ Years	5+ Years

Indoor Cameras:

Indoor cameras come in all types, sizes and styles. The most popular is the smoked mini dome camera. The dome camera can be mounted on the ceiling or wall and adjusted to view any angle. Although the dome is designed to protect the camera inside, they are not weather tight and should not be installed where they are exposed to moisture or extreme temperatures.

Outdoor Cameras:

The only difference between indoor and outdoor cameras is that the outdoor cameras are in a environmentally protected housing. Some housing's have heaters and blowers to keep the temperature inside within the operating parameters of the camera. Others such as the mini outdoor bullet cameras generate their own heat for operation. All outdoor cameras discussed in this guide are designed to operate in -10 degrees to 120 degree temperature.

Night Vision

Affordable night vision cameras are the latest innovation to the video surveillance industry. There are many types and styles to choose from but they all have one thing in common, infrared LED's. Small LED's that transmit out infrared light surround the cameras lens. The LED's cast out light the camera can see but the human eye cannot. The distance a camera can see in the dark is based on how many LED's the camera has. As a rule a camera with 10-20 LED's can see 20 feet in complete darkness. Some cameras such as the one below can see up to 120' in complete darkness. Notice the LED's surrounding the camera lens.

Day/Night Cameras

Night vision cameras provide black and white video. A variation of night vision cameras is Day/Night cameras. Day/Night cameras provide color video during the day and when the light levels drop past a minimum they automatically switch to night vision video. When the light levels increase the camera automatically changes back to color video. These cameras are very reliable and flexible and should be considered when designing your system.

Hidden Cameras

Because cameras are so small now they can be hidden in almost anything. Its common to see cameras in pictures, clocks, radios, smoke detectors, motion detectors, books, ties and anything else we can dream up. The cameras are the same cameras used with standard indoor cameras. The only difference is the housings used.

Wireless Cameras:

Lets cut right to the chase...we all want wireless cameras! When someone finally makes an affordable wireless camera that actually works....we'll let you know. We have tested hundreds of wireless cameras and have not found one under \$600 reliable enough to be used in a professional surveillance system.

If you have ever received a bid from a professional video surveillance company you may have noticed they did not bid wireless cameras. When you start to see the professionals using wireless cameras you'll know wireless has come of age and are reliable enough to consider.

If you do find a wireless camera you want to try, it can be wired into any of the systems discussed in this manual. Wireless cameras transmit the video signal to a receiver. The receiver has a video output which you plug into the video input on the recording system. We recommend you keep the boxes, packing and sales receipt of any wireless camera you buy until you have installed the camera and it has proven to operate reliably for at least 3-5 days.

Basically do not expect to get more than 25-30 feet maximum distance out of any wireless camera which sells for under \$600. There is good long range wireless video transmission available but be ready to pay \$600 to \$1,200 per link.

Camera Detail Guide

Below you will find operating details on the various aspects of security cameras. If it seems confusing simply refer to the camera flow charts listed above. All the cameras listed meet and exceed the minimum standards for professional surveillance applications. A lot of this information is good to review but you really do not need to memorize it.

Lines of Resolution:



Each cameras performance is based on the number of horizontal lines the chip in the camera provides. The cameras line of resolution dictates the quality of the video the camera can produce. In other words the higher the lines of resolution, the better the quality of the video.

Performance	Color	Black & White
Standard	330 Lines	380 Lines
Medium	420 Lines	470 Lines
High	480 Lines	580 Lines

Lens:

The lens dictates the field of view the camera provides. Lenses range from 2.8mm to 18mm on an average. The larger the lens size the farther it will view. The draw back to a 12mm or 18mm lens is that the horizontal view narrows to as little as 15'.

Lens	Distance	Width
2.8 mm	10'	15'
3.6mm	30'	30'
6 mm	60'	20'

**As a general rule we recommend standardizing your cameras 3.6mm lens. They are designed to be installed in a corner, provide a 90 degree field of view, and provide effective surveillance in a 30 x 30' area. The number one mistake when designing a camera system is that we all expect one camera to do the work of two or three. Bottom line is, unless you pay the big bucks for a Pan, Tilt, Zoom camera, don't expect a camera to effectively cover more than a 30-50 foot area.

Auto Iris:

Almost all cameras have either a digital or mechanical auto iris. Most cameras have them built in. Do not consider a camera without auto iris. You will constantly be adjusting the camera as the light levels change.

LUX or Minimum Light:

When choosing your cameras pay attention to the amount of light which will be available in the areas you want to see. Most color cameras have a .1 lux minimum which means not a lot, but some light is needed for operation. You can tell if a color camera does not have enough light to operate because the picture will go grainy. If you are not sure you have enough light consider using night vision or black and white cameras. Black and white cameras have a .01 lux minimum and do much better in low light. Night vision cameras can see in complete darkness or 0.0 lux. See the camera section for more detail.

Power:

Cameras are powered with either 12V DC or 24V AC power. It does not matter which you choose as long as you don't connect a 12V camera into a 24V power supply or 24V camera into a 12V power supply. We recommend using 12V DC cameras and power supplies. See our Power Supply section for more detail.

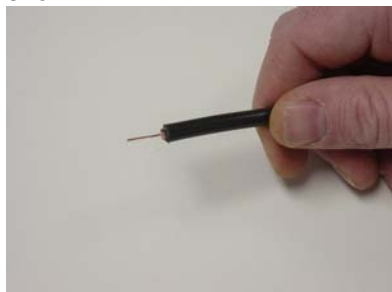
Video Cable & Maximum Distance

All professional grade systems use video coax cable to transmit the video from the camera to the recorder. The maximum distance the cameras can be from the recorder is a function of the cable rather than the camera itself. Using RG59 coax cable you can extend the camera out to 600 feet. Using RG6 coax cable you can run up to 1000 feet. Cable is available in 500' boxes or pre-made cables 200', 100', 50' lengths.

Making a BNC Fitting

#1.

Strip away all of the cable and shielding so you have 1/2" of the center conductor exposed as shown.



#2.

Then strip away the black covering so you have 1/4" of the shielding exposed. Do not allow any of the copper shielding to touch the center conductor.



#3.

Insert the cable into the fitting and gently find the hole for the center conductor before you press the fitting on the wire. Now just twist the fitting on the wire while firmly pressing down until the fitting has been firmly twisted on to cable.



Connecting Coax Cables

BNC fittings are used to connect the cable to both the camera and the recorder, multiplexer or monitor. You simply push the fitting on the video port and turn it 1/2 revolution...couldn't be easier.



**Connection from
to BNC Fitting on Cable**



Multiplexer Connection



DVR Connection

Camera Power

Cameras can be powered two ways. You can power each camera with its own plug in power supply, or you can wire multiple cameras back to a multi-camera power source. Both options plug into a regular 110V electrical outlet and then step the power down to 12V DC or 24V AC to feed to the camera. Make sure you match the cameras voltage to the power supply. In other words power a 12V DC camera with a 12V DC power supply and power a 24V AC camera with a 24V AC power supply.

We recommend using 12V DC equipment. 12 volt replacement parts are readily available and they filter power spikes from getting to the camera.



Plug In Power Supply



Multi-Camera Power Supply

Plug in power supplies are usually located within 6-10 feet of the camera. The multi-camera power supplies are installed in a closet or somewhere out of the way and then a two conductor power wire is pulled to each camera. When designing a surveillance system you may want to use a combination of plug in and multi-camera power supplies. This will depend on where your power outlets are located and how easily you can



pull a wire from a multi-camera power supply to each camera. Multi-camera power supplies have one fused, dedicated power output for each camera. This design provides excellent protection from power spikes and surges.

Camera Power Cable

While almost any wire will work to power a camera the quality of the wire will dictate the maximum distance you can transmit power. We recommend using an 18 gauge, 2 conductor, non-shielded, twisted cable. This cable will allow you to extend the distance from the power supply to the camera **up to 500-600'**, and allow you to power two or three cameras with one wire run. This cable is very common and is used in burglar alarm and fire alarm systems as well. We recommend this wire because:



18 Gauge: Offers very low resistance to the flow of power and less likely to break.

2 Conductor: One lead for (+) power, the other for (-) ground.

Non-Shielded: Shielded wire costs more and does not offer any benefit for transmitting power.

Twisted: The twisting of the wire greatly reduces resistance to the flow of power and extends the maximum distance up to 500-600 feet.



Stay clear of systems which transmit the video and camera power over a single cable. These systems draw power for the cameras directly from the monitor or multiplexer. It can be extremely difficult to find compatible replacement parts and you may end up replacing the whole system (cameras included) if the power supply goes out. Remember all professional grade CCTV equipment uses BNC or RCA fittings and coax cable.

Choosing the Right System for Your Needs

The following is intended to help you choose which system will best fit your needs and goals.

If cost is your #1 concern:

Consider the PC Based DVR systems. They cost about the same as Time Lapse systems but they provide 100% clearer recording. Kits that install on a computer you provide are the most cost effective.

If performance and video clarity is your main concern:

Consider Hardware based DVR's. Because their components are designed specifically for recording digital video and they provide the clearest video recording.

If you are not comfortable with computers:

Consider either Time Lapse or Hardware DVR's. Both systems program similar to your VCR at home.

If you want the best performance for the money or (Value).

Consider PC based DVR's. While PC based DVR's do not match the recording clarity of Hardware DVR's they offer the most features and are very easy to program and operate. They require minimal computer skills.

If remote viewing of cameras is your main concern:

Consider either PC based or Hardware based DVR's. Hardware based DVR's offer remote viewing and playback through the internet (Cable or DSL). PC Based DVR's offer dial-up, internet or local area network remote viewing options.

If automatic recording schedules and motion activated recording is your main concern:

Consider PC based DVR's. They offer the best programming and motion detection options to customize the automatic operations to your specific needs.