# Crime Stoppers Tips on Security CCTV – FAQ

Crime Stoppers has the ultimate task of keeping citizens and businesses safe. The job becomes immensely simplified when the monitored environment of citizens and businesses is assured that, should a crime occur, video or audio evidence collected may assist law enforcement if the presence of the equipment did not deter the crime and those responsible from the commission of the crime.

Local law enforcement receives calls daily from business owners and residents about crimes that occur where they believe those responsible have been recorded of a security system and the video should clearly identity the criminals only to find that for some reason the recording is of limited value. This material is partially designed to educate consumers, but it also is intended to make future buyers and users of CCTV systems aware that the system must be carefully chosen properly installed as well as monitored and maintained.

No system is perfect. No system will guarantee safety. But, most importantly, all systems require that the owner be aware of how the system works and how to communicate access and recovery of recorded data to law enforcement should the need arise.

We've all seen video from **surveillance cameras**, whether on news programs, TV and/or movies, and via the Internet. Surveillance can and should be an important part of a physical protection system, and helps provide peace of mind to homeowners, parents, and employers, by allowing you to keep an eye on things when you cannot be physically present. However, there is an enormous range of products available, with great variations in price, complexity, and capability. In this FAQ, we'll try to answer some common questions about surveillance systems and hopefully guide you understanding systems and options.

**What is a surveillance system?**

Obviously, you cannot be everywhere at once. What if you wanted a security officer to watch your front door and your loading dock at the same time? A surveillance system allows a single security officer to observe both locations at once. At its most basic, a surveillance system is a camera, a monitor, and a wire running between them. This kind of system is also called a "closed circuit television" system, abbreviated CCTV. This allows you to observe an area remotely, without actually having to be there in person.

**What if you want to observe multiple areas?**

You will need multiple cameras, each connected to its own monitor. This gets expensive, though, and multiple monitors take up space. So a piece of equipment known as a multiplexer was introduced into surveillance systems. This allowed a user to display four, nine, or sixteen cameras on a single monitor by dividing the screen into equal rows of two, three, or four cameras each.

**How do you record surveillance video?**

Originally, video was recorded using a videocassette recorder, or VCR. VCRs were a step forward for the surveillance industry, but using them properly presented quite a few challenges. The biggest issue was the limited storage space possible. A standard T-120 VHS tape could only hold about 24 hours of video or so. To stretch this out, a workaround had to be found.

What we think of as video is simply multiple still images shown in quick succession, one after another. In North American television systems, video is defined as a system that displays thirty pictures, or frames, every second. In order to stretch the video tape's usefulness, special VCRs known as time lapse VCRs were invented for the surveillance industry. They could be set to record 15 FPS (frames per second), 7 FPS, 3 FPS, or 1 FPS. Some VCRs could be set to record a single frame every other second! Using time lapse VCRs allowed us to save 960 hours on a single standard T-120 VHS tape. However, time lapse recording made it difficult to solve crimes. A better way had to be found.

**What is digital-based recording?**

After VCRs, digital video recorders, or DVRs, were introduced. In the surveillance industry, a DVR is a device that digitizes analog video. Converting the video from an analog signal to a digital one gives us many more options not possible with analog, VCR based recording. First of all, hard drives, even small ones, allow for significantly longer recording times than VHS tapes. Second, digital files can be searched

by characteristic, such as date and time, allowing users to quickly and accurately pinpoint video clips for downloading, instead of the continuous fast forwarding and rewinding VHS tapes require. Third, once a signal is digital, it can be transmitted over the Internet. That means that any PC with an Internet connection, anywhere on the planet, becomes a viewing station, and that you're never out of touch no matter how far away you go.

Eventually, a type of DVR known as the pentaplex DVR was developed. A pentaplex DVR has a built in multiplexer, which allows each camera to be recorded on a separate channel no matter what the DVR is doing, unlike a VCR which can record video or play back video, but not both at the same time.

**What are the limitations of DVRs?**

While DVRs represent a great leap forward, they are in some ways still limited. There is no easy way to add a camera to the system. DVRs come in 4, 8, or 16 channel configurations, capable of recording one camera per channel. Adding a 15th camera to a 16 channel DVR was easy enough, but if you wanted to add a 17th, you would have to buy a whole new DVR. Another difficulty is wiring. Analog cameras transmit video over coaxial cable, requiring users to run a wire from the camera to the DVR. Power cannot be transmitted over coax, so a power cable has to be run along with it—the DVR is going to be in a spot that has an outlet anyway, and only putting cameras in spots that have a nearby outlet is inconvenient or impossible, so the camera power supply is plugged into the same outlet the DVR is. This Siamese cable, or two cables stuck together, is thick and difficult to run, but it has to be run all the way back to the DVR, as there is no way to daisy-chain camera cables together.

**What is an IP Camera?**

An IP camera (for Internet protocol) connects directly to a network in the same way a computer does. It does not need a DVR to digitize the video for recording or Internet streaming purposes because the video data is already digital. You don't need to run a wire from the camera directly to a recording device, because every device on the network can talk to each other equally. IP cameras use Ethernet cable, which is much thinner, more flexible, and far easier to work with than coaxial cable. Many IP cameras can be powered over the Ethernet cable as well, and one cable is far easier to run than two cables.

**How does a computer network help in surveillance?**

An IP camera is also known as a network camera. A network is a group of digital devices such as computers, printers, VOIP phones, or IP cameras that all have the ability to exchange information between them. Information is directed by a device known as a switch, which directs traffic and ensures that each device on the network can communicate with all the other devices.

Many routers have small built-in switches, usually with four ports, or connections. If you have more devices, you'll need more ports. Running a single wire from the WAN, or network input connection, to the Ethernet, or network output connection, will allow you to add as many connections as you need.

Remember, you'll need one port for every camera and one port for your recording device. It's usually a good idea to leave at least one port free for future expansion.

**Do IP cameras record to DVRs?**

IP cameras do not use a DVR to record video. Rather, they use either an appliance called an NVR, or Network Video Recorder, or otherwise a computer server running video management software, or VMS. Either of these can be connected anywhere along the network in order capture the video streams produced by the cameras. Some NAS (networked attached storage) drives have software that will allow them to be used as NVRs. Some camera models have SD card slots for internal storage, a good solution for a system with a small number of cameras.

**What is bandwidth and why does it matter?**

In order to select the correct switches, you will need to know how much bandwidth your devices will consume. Bandwidth is the amount of information a network is theoretically able to transmit. Think of information as water; if you have a certain amount of water to transport from point to point, you need to make sure your pipes are wide enough. If your pipes aren't wide enough, trying to force too much water at too high a pressure will just cause a big mess. With a plumbing system, the solution is to add more and

wider pipes. With a data network, the solution is to use higher quality cables and switches capable of moving more information. The resolution, frame rate, type and complexity of image, and compression method used will change the amount of bandwidth used, and most of these can be changed in the camera's settings if necessary. Most camera manufacturers include bandwidth calculators on their website, so you'll be able to figure out the kind of router and switches you need in advance.

**How do I start my surveillance system?**

You can either purchase your camera, cables, and recording devices separately, or you can buy any number of preassembled kits. A kit is a combination bundle, usually consisting of a recorder, a few cameras, plus cable and power supply. Monitors are almost always sold separately. The problem with a kit, especially the economy kits, is that they try to take a one-size-fits-all approach to a problem that really doesn't lend itself to generic solution. Often a professional service can assist with all these needs.

**What is the difference between analog cameras versus IP cameras?**

First, we will need to decide what category of camera to buy. Broadly speaking, cameras are divided between two technological categories: analog and digital (usually referred to as IP). Analog is cheaper, perfectly adequate for many applications, and easier to get up and running for users with no prior experience; IP is more flexible, more capable generally, more difficult to get up and running for users with no prior experience, and significantly more expensive (although the price differences have been dropping for a long time, and certain considerations may make IP cheaper for many customers—for example, the larger the installation, the easier it is to take advantage of the efficiencies built into IP). High resolution IP cameras are also more common and reliable than high resolution analog cameras. It is highly tempting to always say "oh, let's go with analog—it's cheaper and easier" or "oh, let's go with IP—the higher resolution means the camera will be effective at a further range, and HD is always a good thing". A smart security user, however, will take every factor into consideration and decide if the particular situation warrants use of one or the other.

**What If You Decide To Switch Technologies?**

A note of caution: once equipment is in place, it's not easy or cheap to convert from one to the other. It can be done, but it's pricey and awkward. Once you've made your choice, you should be prepared to stick with it for the lifetime of the surveillance system (five to seven years for professional grade equipment and three to five years for consumer grade equipment, although regular systems maintenance can keep any system going for much, much longer than that—fifteen year old systems in perfect working condition are not unusual, and of course a badly installed and maintained system might be completely irreparable after two years.

**Which should I choose?**

The first consideration when deciding between analog and IP is resolution. The higher resolution, the further away we can effectively see, because the higher the resolution, the deeper our zones of effectiveness becomes. Figuring out how what distance we need our identification zone to be and what distance our classification zone has to be, relative to where the camera can be installed tells us what our resolution needs to be.

**What are the three zones of resolution effectiveness?**

No matter how high the resolution of the camera is, the camera is going to be more effective when our subject is closer to the camera and less effective when our subject is further away. The field of focus can be divided into three zones of effectiveness, called detection, classification, and identification.

When the subject first comes into view, the user can tell that there's something there that shouldn't be—a person or a vehicle. There isn't enough detail to tell much about it, but we know it's there, at least. We call this level of detail ***detection***. When the subject comes closer to the camera, we can see more details, enough to help distinguish the subject from other subjects. We can tell the difference between a van and a truck, or between a person wearing a jacket or a hoodie. We call this level of detail ***classification***. When the subject comes very close to the camera, there is enough detail in the image to definitively identify the subject. We call this level of detail ***identification***. There is enough detail to positively identify a subject in a

court of law.

**How is analog camera resolution measured?**

With an analog camera, the image being transmitted from the camera to the monitor is drawn in lines that fill the screen from top to bottom. First, all the even number lines are drawn on the screen. Then, the odd number lines are drawn on the screen. The odd number lines and the even number lines combine to create a complete image, or frame.

This happens 60 times every second, so that there are 30 sets of lines being drawn on the screen every second. Every frame is slightly different from the frame before, and displaying 30 frames, one after another, every single second, creates the illusion of movement, like looking at an extremely fast and extremely long flip book.

**What are vertical television lines?**

The thickness of the lines directly affects how sharp and clear of a picture the camera can see. The VTL (Vertical Television Lines) is a measurement of how many interlaced lines total (even and odd) make up the image. The more lines, the thinner each line must be. Therefore, all else being equal, the higher the VTL, the sharper an image the camera is theoretically capable of displaying. The higher the VTL, the more resolving power the camera has, which means the higher the VTL, the more fine details you will be able to make out. The advantage of more lines of resolution mainly becomes apparent when viewing motion. Every transition between lines causes a jagged edge, which is mainly apparent when the image makes a lot of transitions, as it does when the image changes due to movement in the field of view. The thicker the lines are, the more pronounced the jagged edges will be. IP cameras are progressive instead of being interlaced. Instead of drawing alternating series of lines 60 times every second, the camera draws 30 complete images every second, a great advantage when watching fast motion such as traffic or employees counting cash.

**How is IP camera resolution measured?**

With IP cameras, resolution is not given in VTL. Rather, IP cameras measure how many actual photo sensor elements, or pixels, are present on the image sensor. Each image sensor is covered in thousands or (more commonly) millions of elements capable of registering light in a specific color, all arranged in a grid. The more pixels, the better the image is capable of being. For example, given the same area to cover, a camera with a sensor capable of seeing three megapixels, or three million pixels, is going to have better resolving power (that is, the ability to see fine details) than a camera with a one megapixel (or one million pixel) image sensor.

**How much resolution is really enough?**

How many pixels, or VTL, do you really need? It's a tricky question, and the most common instinct is to simply try and get the highest resolution cameras available. However, this may not be the best use of resources. Often, two 1.3 megapixel cameras in just the right spot are more useful and more effective than a single 3 megapixel camera, for the same price. In other words, it's not just about how many megapixels the camera has onboard, but what we are asking those pixels to do. The more pixels the camera has on the subject, the sharper the image will be. The fewer pixels the camera has on the subject, the blurrier the image will be.

**I need help understanding resolution measurements?!?**

First, we need to establish how many pixels the camera actually has available. A camera rated at 720p has an image 1,280 pixels high. A camera rated at 1080p has an image 1,920 pixels high. A camera rated at 5 megapixels has an image 2,592 pixels high. It's all the same image, but each pixel is being asked to cover a smaller piece of the image, which means better resolving power. The wider the field of view, the more each pixel is being stretched, and the fewer pixels are available to see each point of the image. Therefore, the wider the lens, the closer to the camera the subject has to be before you can identify who or what the subject is. The narrower the field of view, the more pixels available to resolve the subject, and, therefore, the further away from the camera you will be able to recognize a subject. You cannot use the same camera to see a very wide and very far image at the same time if you need any kind of clarity at all.

**What are pixels per foot (PPF)?**

Cameras have three pixel zones. Because the field of view is a pie shaped wedge, the pixels get stretched more and more the further they get from the camera. If we need the camera to be able to recognize—that is, have enough pixels to identify facial features—subjects, we need to calculate the proper lens and resolution combination for identification. If we need to the camera to simply be able to classify—that is, tell the difference between a blue car and a red car, or the difference between a subject wearing a hoodie from a subject wearing a jacket—you need fewer pixels. If you simply want detection—that is, being able to tell that a vehicle or person is in an area where they shouldn't be, without necessarily needing much details—you need fewer pixels still.

The calculation we need to make is to pixels per foot, or PPF. Say you own a grocery store, and want to cover the register lines to see how fast the lines are moving. You've determined that your field of view is 25 feet across, based on the spot you want to mount your camera and the focal length of the lens you're planning on using. Simply divide the height of the image in pixels by the field of view in feet to determine your pixels per foot. In our example, using a 720p camera will give us 51 PPF, and using a 1080p camera will give us 77 PPF. Say we want to watch over the parking lot as well. The entrance to our parking lot is 100 feet away from where the camera will be mounted, and the parking lot is 75 feet across. A 720p camera will give us just under 13 PPF, and a 1080p camera will give us just over 19 PPF. A 5MP camera will give us about 26 PPF.

**How many pixels per foot is ideal?**

Recommendations differ, but most experts agree that you'll want about 60 PPF for recognition, 40 PPF for classification, and 20 PPF for detection in full daylight, and 80 to 90 PPF for nighttime recognition, 60 PPF for nighttime classification, and at least 40 FPS for nighttime detection. Therefore, using our parking lot example, we will need a 5MP camera to see vehicles entering the parking lot, and even then, we will just barely be able to make them out. We will most likely not be able to see any details, like make or model, and we will certainly not be able to read a license plate. Using a single camera to cover the entire parking lot will allow us to see how many cars are parked in our lot but won't be useful for much else. If we want to be able to see vehicles entering and exiting our parking lot, we will need to use a second camera with a telephoto lens aimed directly at the entrance, so that our PPF is no less than 90.

Analog cameras are easier to figure out, because there are fewer potential resolutions, which eliminates a lot of the guesswork. The resolution of the video in an analog system is dictated by the resolution of the digital video recorder, or DVR, used. The most common resolution found in modern DVRs is D1, which is an image 720 pixels high (a little more than half the height of a 720p image). CIF is another common legacy resolution, which gives you an image 352 pixels high.

Knowing all this, we can now calculate exactly what we can see with a given camera, which allows us to choose the exact resolution and lens combination necessary. An analog camera recording at D1 resolution will allow us to recognize subjects with a field of view of 12 feet across, classify subjects with a field of view of 18 feet across, and detect subjects at a field view of 36 feet across. An IP camera with 720p resolution can recognize subjects with a field of view 21 feet across, classify a subject with a field of view 32 feet across, and identify subjects with a field of view 64 feet across.

For example, say you've got a camera with a 4mm lens, a common focal length. An analog camera will recognize a subject at a distance of 10 feet, because your average camera with a 4mm lens will give you an image 12 feet across. Any wider, and you won't have enough pixels per foot to recognize a face. If you want to be able to recognize facial features at a longer distance and get the same 88º field of view, you'll have to choose an IP camera, because a 720p camera has more pixels per foot, and can recognize facial features at 18 feet with the same field of view. There are several good lens calculators available online. All you have to know is the imager format, usually 1/3rd of an inch, and the distance to subject. The lens calculator will tell you the field of view, allowing you to make your PPF calculations.

**What about the camera mounting height? Is that important?**

The height of the camera depends on what the camera is supposed to be able to see. Cameras intended to record faces should be not lower than roughly 9 feet and not higher than 12 feet from the ground. This

will give you the best chance of getting a good shot of a face—any higher and you will see mostly the tops of people's heads, and much lower and the angle of the camera will cause a deep blind spot directly underneath the camera. To see activity, though—say, parking lot traffic, or activity in a warehouse or factory—the camera should be higher up. A height of between 18 and 24 feet from the ground should be sufficient. For license plates, you will want the camera to be mounted low; 3 to 5 feet is usually recommended. Additionally, license plate cameras should be in a choke point where vehicles normally slow down to a speed of under 10 miles an hour, such as a parking lot entrance or driveway turn. And of course you will need to ensure that your PPF will be high enough to read the plate numbers; 90 PPF should be sufficient.

**Do I need to make provisions for the environment?**

Cameras can either be weatherized, referred to as outdoor cameras, or not weatherized, and referred to as indoor cameras. Nothing stops you from using an outdoor camera indoors, of course, but using an indoor camera outdoors will only last as long as the first rain, or the first time it gets very hot or very cold outside.

If you are worried that the camera may be subject to vandalism, you should select a vandal resistant camera, which has a hardened housing. The IK scale rates electronics on their resistance to external impacts. The highest the scale goes is IK10, which means that it can withstand an 11 pound weight being dropped on it from a height of 15.75 inches. Surprisingly, "explosion proof" does not mean a camera can withstand the effects of an explosion. Rather, explosion proof means the camera is rated for use in explosive environments such as an oil refinery, and is sealed against sparking and so forth. In other words, an explosion proof camera is a camera that will not cause an explosion, not a camera that will survive one.

**What about lighting?**

Most surveillance cameras are expected to operate 24 hours a day. Therefore, attention must be paid to the lighting conditions that the camera will be subject to, and accommodations made. If your field of view will be too dark for the camera to operate normally, you will have two choices. If you have some light, just not enough, you can choose a camera designed to enhance available light. If you have no light at all, you can add light, either by installing extra lighting, or by choosing a camera with built in illumination.

A camera with a low light capability rating will show much the same image from one edge of the picture to the other. An internal IR illuminator typically only illuminates the center of the image, leaving the edges of the image in deep shadow. However, the low light function on a camera is the result of digital processing, and can often give a noisy, grainy image. Therefore, careful thought must be given before deciding on either a low-light camera or a camera with IR illumination. Remember, a low-light capable camera only enhances available light, so the scene has to have some lighting, such as a streetlight. Low light capable cameras are usually listed as True D/N, or Day/Night. Cameras listed as Digital D/N require more light than cameras listed as True D/N. Cameras with built in infrared illuminators are usually listed as D/N IR.

**What is a varifocal lens?**

While many cameras still come with fixed, or non adjustable, lenses, cameras with manually focused lenses, known as varifocal lenses, are becoming increasingly popular. This is because the camera can be focused to give you the exact image, from a very wide image to a very zoomed-in one. Remember from our PPF discussion that the wider the lens is set, the shorter of a distance you will be able to recognize fine detail from.

**What are box cameras?**

The oldest type of camera is the box camera. This is a non weatherized camera that is sold without a lens. At first glance, it may seem like the least capable camera type. However, the industry standard lens mount means that you can buy any number of lenses for it, allowing you to get exactly the shot that you need, from super wide angle to extreme zoom. The larger size of this camera allows manufacturers to include more electronic components in this camera type, making this camera a good choice for challenging shots other camera types are not capable of viewing. Since this camera is not weatherized, you will need to mount this camera in a housing if you will be installing it outside. A variety of housing options exist for different prevailing weather conditions.

**What are bullet cameras?**

The most common camera type is called a bullet camera. A bullet camera is a tube-shaped camera with a weather resistant housing, and infrared illuminators for enhanced night vision performance and built in lens. The lens can either be fixed or varifocal. Tube shaped cameras without built in infrared illuminators are called lipstick cameras. This style of camera is the easiest to install, as its bracket means that during installation you can pan the camera to the right or the left, tilt it up and down, and rotate it left or right to get exactly the shot that you require. Of course, you will not be able to move the camera again unless you loosen the bracket and readjust, unless you purchase a camera with a motor built into the bracket. The majority of cameras allow the bracket to be mounted on the bottom or top of the camera, allowing you to install the camera on a wall or hang the camera from the ceiling or an overhang.

**What are dome cameras?**

Dome cameras are often preferred where esthetics are of particular concern, as they're less noticeable than bullet or box cameras. It's also more difficult to determine what the camera is directed at with a casual glance. Dome cameras may have either fixed or vaifocal lenses, and may or may not have built in infrared illuminators. Most dome cameras are designed to be mounted to a ceiling or overhang, but some cameras can have their imager assemblies twisted around so that the camera can be mounted to a wall. Dome cameras that have hardened housings, known as vandal resistant dome cameras, are a good choice in industrial applications where flying debris can damage the camera. They are also a good choice in applications where deliberate vandalism is a concern. Not only does the shape allow the camera to better absorb impacts from heavy objects such as a thrown rock or a swung hammer, but the camera cannot be covered with a towel or plastic bag hung over the camera, and the dome shape ensures that a rope thrown over the camera simply slides off instead of allowing an attacker to pull the camera away from the wall.

**What is PTZ?**

Dome cameras with a built in motor that allows an operator to pan back and forth, tilt up and down, and zoom in and out is known as a PTZ, or pan, tilt, zoom camera. Often, one can purchase several ordinary cameras for the price of a single PTZ camera. Several fixed view cameras will allow you to view an entire scene at once. A PTZ can pan over an entire scene and then zoom into a particular spot, but of course the camera can only see what it is pointing at. If you happen to have the PTZ pointing in a particular direction or at a particular spot, you will be unable to view or record activity in any spot not being covered by a fixed camera, and that action will be lost. Therefore, PTZ cameras are mainly to be used to give an overview of very large areas, and should be supported by fixed cameras permanently focused on areas of particular concern.

**How do we get information from the camera to the recording or viewing device wirelessly?**

Wireless seems like an attractive option at first, but there are a few factors to consider. First of all, it is quite difficult to transmit a high quality video signal wirelessly, due to bandwidth concerns. A wireless transmitter capable of sending an analog video signal to a receiver can be quite expensive. Some manufacturers compress the signal in order to be able to use a less powerful transmitter, which makes for lower quality video. A bigger problem is power. Video cables are often run along with power cables, allowing you to place the camera's power supply near the recording device or switch, which has to be placed near an electrical outlet anyway. Wireless cameras, however, need to be placed near electrical outlets, making the installation of wireless cameras outdoors a challenge.

Interference too can hinder wireless camera performance. The materials of walls in between the camera and the receiver, RF interference from the electrical wiring, and Wi-Fi routers all degrade the camera's image. It is possible to add an antenna to either the camera or to the wireless receiver, but this will only boost the efficiency of the wireless transmission to a limited extent. Therefore, careful thought should be given to the feasibility of running wires before deciding to purchase a wireless camera instead.

**What about distance limitations?**

Distance limitations, at least, are less of a concern when using wireless IP cameras, as opposed to wireless analog cameras. Special Wi-Fi routers known as Wireless Access Points, or WAPs, pick up and rebroadcast a network connection. Simply placing another WAP at the edge of the Wi-Fi router's effective

range, and another, and another, will allow you extend that range as long as you'd like. You can even install a weatherproof WAP outdoors to mount a camera on a pole, or on another building, assuming your camera is within range. IP cameras come with built in Wi-Fi antennas, or you can purchase a WAP with an Ethernet port and plug an ordinary camera in. This means that any IP camera can become a wireless camera with the addition of a WAP and a Wi-Fi router. Check to see what the bandwidth rating of the WAP is, and how much bandwidth the camera requires. You may need to lower the resolution or the frame rate, or raise the level of compression, in order to stay under the bandwidth rating limitation, but IP camera manufacturers have been making great advances in compression methods recently, ensuring that high resolution images take up less and less bandwidth. Remember, of course, that each IP camera requires power, and WAPs require power as well, so you will need to place your WAP close enough to an electrical outlet to power it.

**What if I don't want wireless transmission?**

If you decide to directly wire your cameras, you will find that the signal will be far more stable. Analog cameras use a coaxial cable connecting the camera directly to the DVR. Typically speaking, this coaxial cable uses a locking connector called a BNC. RG-59/U is most commonly used coaxial cable. This cable can reliably transport a video signal a distance of 300 feet. If your DVR is more than 300 feet from the camera, you will need to use RG-6, which is thicker, less flexible, and more expensive, but can transmit a video signal 800 feet to 1000 feet away, depending on the quality of the cable. This cable can transport a video signal 800 feet away. RG-59/U can be purchased in rolls of 500 feet and 1000 feet long, and can be purchased in a siamese configuration—that is, combined with a power cable. Siamese RG-6 is more difficult to find, but you could always run an RG-6 and a separate 18 AWG 2-conductor cable for power.

**What are baluns?**

For very long runs, you can always use Cat5e cables with specialty adapters called baluns. Some baluns have RJ45 ports, which means you can use them with ordinary Ethernet cables. Other baluns simply use screw terminals, transporting video on a single twisted pair. Some baluns allow you to power the camera on the same Cat5e. These are called pass through baluns. Standard, or passive, baluns can transmit video over 750 feet over Cat5e. Some powered, or active, baluns can transmit video up to 1.5 miles away, over Cat5e! If you want to transmit standard definition analog video further than that, you will have to use fiber optic converters, which can transport video as much as 26 miles away, although this option can be pricey.

**What is a Siamese cable?**

If you end up using a Siamese cable, be aware that you will end up peeling the cable apart when you get to the DVR. The coaxial half of the cable will get a BNC connector, and will connect to the DVR, while the power cable will plug into a transformer, or power supply. Power supplies come in two basic types: single channel power supplies with industry standard 2.1 millimeter plugs, and multichannel power supplies with screw terminals in a wall-mounted enclosure. The majority of cameras run on either 12 volts of DC power or 24 volts of AC power. In addition to matching the voltage to the camera, you have to ensure that the power supply you use has enough amperage as well. Cameras with infrared illuminators, cameras with heaters for use in low temperatures, and PTZ cameras all use more amperage and need higher rated transformers than cameras without these features.

**Do analog cameras always need cables? What kind of cables?**

No matter what cable you end up using, analog cameras always need a cable run wired directly between camera and DVR. IP cameras are simpler. All IP devices use either Cat5e or Cat6 cable. Cat6 cable offers more bandwidth and network speed, but is more costly and more difficult to run. Knowing what cameras you want to use and how much bandwidth they will consume will help you decide if Cat6 is necessary or if Cat5e will suffice. Every camera will need to either be wired to a switch or connected to a Wi-Fi signal. Cat5e and Cat6 are both limited to a distance of 300 feet. At 300 feet, you can connect a switch and use it to rebroadcast the signal, allowing you to run another 300 feet, and so on. Today, most IP cameras can be powered by the Ethernet cable itself, a feature known as PoE, or Power over Ethernet. Make sure you select a switch that supports PoE. Cameras with infrared illuminators, cameras with heaters for use in low temperatures, and PTZ cameras all use more power than cameras without these features, and may require high powered PoE, also known as PoE Plus.

**Any last thoughts or suggestions?**

As you can see, purchasing and using a surveillance system requires careful thought and planning beforehand. Understanding exactly what you want the camera to be able to do, and understanding the capabilities of the camera, will allow you to choose the exact device for your needs.

Surveillance video equipment is only one part of a physical protection system. As we said before, the proper equipment must be joined with the proper procedures and the personnel trained to use them. Once your surveillance system is installed and ready to use, you need to develop procedures for the use of your surveillance system, by deciding how and where to view the video, how to conduct an investigation with the surveillance video footage, and how to save video for future use as evidence. Once those procedures are established, you will need to have personnel trained in these procedures.

We hope that this guide has helped clarify the differences between the different surveillance products available. While specific technologies may come and go, we've tried to cover the most fundamental concepts common to all surveillance products. As surveillance technology continues to evolve, keep what you've learned in this guide in mind, and you'll be able to understand what value the changes help bring.