

Tech Note - 01

Surveillance Systems that Work!™



Video System Basics

The purpose of this GDV Tech Note is to introduce the reader to the basics of Digital Video Surveillance. In subsequent Tech Notes, we will, in greater depth, discuss many of the items we're only providing an introduction to in this article.

Brief History

In the early days of video surveillance, analog video was recorded on magnetic tape – similar to a typical home Video Cassette Recorder (VCR). A relatively simple piece of hardware called a multiplexer was used to translate multiple video streams (from multiple cameras) to a single, recordable, analog video signal.

While VCR technology was able to bring video surveillance system prices to commercially affordable levels, video was typically limited to black/white – today, nearly 100% of digital video systems provide color imagery. For a host of other reasons – detailed in the table below – digital technology provided better video quality without any of the hassles VCR tape users "lived with."

VCR Tape (Analog) Recording	Digital Video Recording
Time consuming manual search to find specific footage	Instant date, time, or event search
Ongoing purchase of videotapes and related tape "clutter"	Weeks or months of "built in" storage
Must remember to change tapes	High storage capacity requires no effort
Video image deteriorates with age, duplication or re-recording	There is no video loss with age, duplication or re-recording
Risk of lost data with failure to change tapes or record	Automatically overwrites oldest video footage
Poor video quality	Digital images are much "cleaner"
Inflexible configurations and settings	Flexible configurations and settings
Limited remote monitoring ability	Remotely view multiple locations from anywhere
Lack of redundant off-premises recording capability	Record video off-premises to a remote server
Low storage capacity	High storage capacity
Limited security	Multiple levels of user security
No intelligence	Intelligent features - motion detection, remote notification, image masking

With the advent of low cost, high-powered microcomputer technology, far superior digital video surveillance systems captured the market of commercial surveillance system users. Microprocessors now translate analog signals into digital files and hard disc storage has replaced magnetic tape as a means of storing and retrieving video imagery. For the remainder of our discussion on Digital Video Surveillance, we'll use Figure-1 below – a pictorial representation of a "typical" digital surveillance system – as the basis of our conversation.

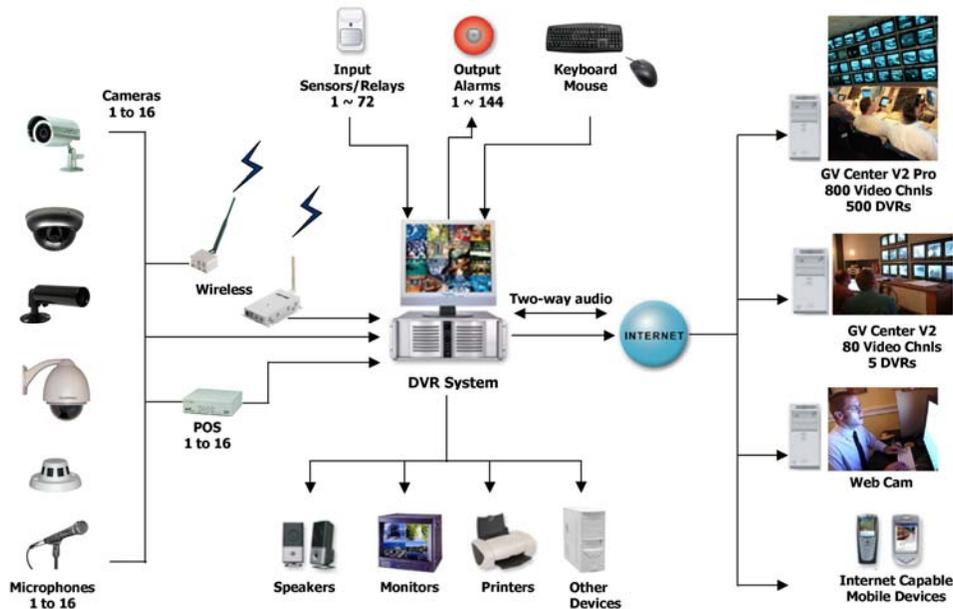


FIGURE-1

DIGITAL VIDEO RECORDERS (DVRs)

The heart of a surveillance system is the digital video recorder. While there are a plethora of DVRs on the market they can all be categorized into two basic types – *Stand Alone* and *PC Based*. In either case the internal technology is really quite similar. They both trace their conceptual inception to microprocessors and software.

Stand Alone DVRs

Stand Alone DVRs have hard coded (burned to read only memory) operating systems and video processing software.

PC Based DVRs

PC Based DVR's (typically) utilize a Microsoft Windows operating system and video processing software both of which are loaded onto a hard disk drive.

CAMERAS

CCTV cameras have similar specifications however; performance (even with identical specs) can vary a great deal. **GuardDog Video** goes to great lengths to evaluate every camera we offer to assure each matches our high performance standards.

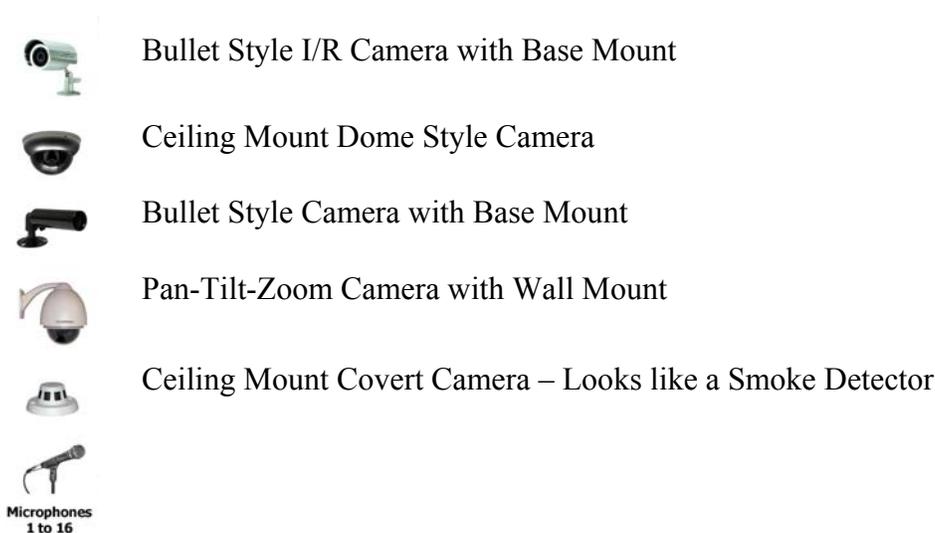


FIGURE-2

Camera Connections

CCTV cameras have at least two kinds of wiring connections – power and video. Power requirements are typically 12vDC or 24vAC. Power connections come out of the camera on two-conductor wire (terminated with a female connector), are internal to the camera (requiring a male input connector) or are of the screw terminal type. Similar to power connections, video connections either come out of the camera on two-conductor wire (terminated with a female BNC or RCA connector); have a female BNC or RCA connector integral to the camera body.

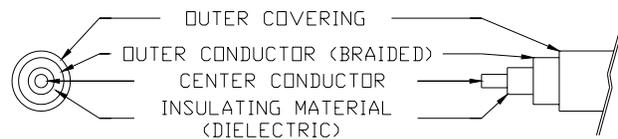
CABLES CONNECTORS and CONVERTERS

WIRE AND CABLE

When selecting cables for video, RCA, BNC coaxial cable or Category 5 (CAT5) twisted pair cable can be used. BNC cables generally have lower losses than RCA, are more rugged, and are most commonly constructed using coaxial cable, such as the one that runs in your home to connect with the cable company. This type of cable is referred to as RG-58 and RG-59. RG-58 cable is lighter and more flexible than RG-59, but has a little more loss at higher frequencies.

Coaxial Cable

A type of wire that consists of a center wire surrounded by insulation and then a grounded shield of braided wire. The shield minimizes electrical and radio frequency interference.



Coaxial cabling is the primary type of cabling used by the cable television industry and is also widely used for computer networks and CCTV. Although more expensive than standard telephone wire, it is much less susceptible to interference and can carry much more data.

Plenum Cable

Plenum (or plenum rated) cable is a type of cable that is run in the plenum spaces of buildings. In building construction, the plenum (pronounced PLEH-nuhm) is the space that is used for air circulation in heating and air conditioning systems, typically between the structural ceiling and the suspended ceiling or under a raised floor. The plenum space is typically used to house the communication cables for the buildings CCTV, computer and telephone network(s). However, use of plenum areas for cable storage poses a serious hazard in the event of a fire as once the fire reaches the plenum space there are few barriers to contain the smoke and flames. Plenum cable is coated with a fire-retardant coating (usually Teflon) so that in case of a fire it does not give off toxic gasses and smoke as it burns. Twisted-pair and coaxial versions of cable are made in plenum versions.

Siamese Cable

RG59 Siamese cable is a heavily shielded cable which contains both the video (COAX) cable and the power cable (18-22 gauge 2 conductor) in one jacket. Since both the video cable (RG59) and the camera power wire (2-conductor) are coupled together, with a single pull, everything necessary to make the camera functional on the system is in place. Additionally, Siamese cable is very durable, and you can run it long distances without interference. Also, you can cut each camera run (both video and power) for the exact length that you need. The only disadvantage is it does not contain an audio cable (so you have to run that separate if you need it).



Category 5 (CAT5) Cable

A network cabling that consists of four twisted pairs of copper wire terminated by RJ45 connectors. Cat-5 cabling supports frequencies up to 100 MHz and speeds up to 1000 Mbps. It can be used for 1000Base-T, 100Base-T, and 10Base-T networking.



Computers hooked up to LANs are connected using Cat-5 cables, so if you're on a LAN, most likely the cable running out of the back of your PC is Category 5.

While distance beyond 500' becomes a video signal problem for coaxial cable, Cat5 can comfortably extend out to 1,000' and with "active" video baluns (see below) that distance can be increased to 10,000'. There is great debate as to whether coax or CAT5 delivers a better signal.

CONNECTORS

RJ45 Connector

Short for Registered Jack-45, an eight-wire connector used commonly to connect computers on local-area networks (LAN), especially Ethernets. RJ-45 connectors look similar to a telephone line connector (RJ-11 connector), but they are slightly wider.



RJ-11 Connector

Short for Registered Jack-11, a four- or six-wire connector used primarily to connect telephone equipment in the United States. RJ-11 connectors are also used to connect dial-up modems to the internet using your telephone line.



BNC connectors are usually molded onto the cable end. Standard pre-made cable lengths are 3', 6', 10', 25', 50', 100' and 150'. For most installations, bulk wire, from rolls of 500' or 1,000' is cut to the required length and crimp on BNC connectors are attached to each end of the cable in the field. Although RG-58/-59 cable is great stuff, it's relatively heavy and may be awkward to work with.



There are many grades of RCA cables available, some intended for audio, some for video, and some for both. RCA cables are usually thinner and not as rugged as BNC cables. For cable lengths under 20 to 25 feet, most RCA cables provide acceptable results for both audio and video but you will rarely if ever see professionals use RCA. At lengths of as little as 30 feet, RCA cable can start to show a measurable loss at the higher frequencies, depending on the quality of the cable. RCA cables usually have molded connectors at the cable ends and the connectors themselves may come with tin plating (standard) or with gold. The gold looks nice, but is really not necessary for a good, reliable connection.



CONVERTERS

Video Baluns

Video baluns come in a wide variety of shapes, sizes and with a host of connection types (BNC to BNC, BNC to RCA, CAT5 to BNC, etc.). For example, the picture on the right shows a small lipstick size device – a single channel balun – that can be used to convert coax cable (terminated with a BNC connector), to an RJ45 connector so the video signal can be transmitted over a Cat5 cable. Since Cat5 cable has four pairs of wires up to four video signals can be transmitted on a single cable and being much lighter is easier to work with.



1-Ch
Balun



4 BNC to 1 RJ45

Also, for simplicity in panel design, devices that couple multiple baluns into a single component are available. The picture to the left combines 4 coax video channels (via BNC connections) into one RJ45 connection. This device can also be used in reverse to convert the single CAT5 signal back to 4 BNC connected coax cables.



In addition to their shape, size and connection varieties, video baluns can be classified into two additional types – active or passive.

Passive baluns are used to simply translate one connection and cable type to another. For example, one may want to translate a video signal from coax (BNC connector) to CAT5 (RJ45 connector). A passive BNC to RJ45 video balun would be the proper choice. The 4 BNC to 1 RJ45 balun above is an example of a passive device. Passive baluns can also be designed to filter unwanted noise from a video signal. Most passive baluns can be used in either direction – as transmitters or as receivers.

Active baluns, in addition to translating from one connection mode to another, also amplify the video signal. These are sometimes referred to as video amplifiers. The 4 BNC in 4 BNC out amplifier (right) is an example of an active balun – note the signal adjustment potentiometers (POTs) on the top of the device? Also, note that on the left side of this balun there is an input for 12vDC power. The amplifier circuit uses this input power to modulate the video signals. Active baluns are single direction devices they can only be used to transmit – i.e. they cannot be used to receive.



4 BNC in 4 BNC out

VIDEO MONITORS

Regardless if a video surveillance system has a stand-alone or a PC-Based DVR if one is to view live or recorded video it is necessary to include a video monitor in the system. Stand-alone DVRs can have S-Video, composite video (BNC) or VGA output capabilities while PC Based DVRs generally have VGA outputs.

S-Video or Composite Video Monitors

The cross-corner dimension defines video monitor screen size. Typical sizes range from 12 to 24 inches. Input connections are either composite or S-Video. S-Video connections typically accept RCA type molded plug connectors while composite video requires a coaxial cable connection.



VGA Video Monitors



19" CRT Monitor

VGA monitors are also built using two distinct technology types – LCD (flat screen) or CRT (Cathode Ray Tube). In either case, a multi-pin connector is used to communicate video information (usually from a PC Type DVR but also available as an option on some Stand Alone units) from the DVR to the monitor.

While CRT monitors are still available, LCD technology is making significant marketplace strides. As prices continue to fall LCD type monitors are expected to take over as the primary monitor of choice.

Presently, large monitor manufacturers are planning to phase out CRT manufacturing and concentrate on widening their LCD offerings. So, has LCD won the competitive battle? Perhaps not yet, as CRT monitors still hold a few key advantages. Below we summarize some of the differences of TFT LCD VIDEO monitors versus CRT monitors, and which holds the current manufacturing advantage:

Image Brightness: LCD Monitors easily win in this area, offering brightness approximately twice that as CRT monitors on average. This is particularly important for viewing in daytime, high light areas, like a room with many windows. LCD VGA, video monitors will easily appear brighter than CRT monitors. An LCD manufacturer has many more component modules to deal with than CRT manufacturers.

Contrast: LCD VGA, video monitors have made great strides to narrow the gap on contrast. Contrast is important for viewing in low light situations and ensuring that black tones appear black (rather than muddy grays), and is most important for gaming and movie playback.



19" LCD Monitor

Although CRT monitors pull out the victory, the margin of difference is now minor, with the best LCD VGA, video monitors matching CRT video VGA monitors for most practical purposes.

Color: CRT monitors still hold the advantage in regard to color purity and quality. LCD monitors have again made great improvements here, and now offer bold, brilliant colors in many cases. The best TFT LCD VGA video monitors are very good, and the average user would be hard pressed to note the difference for basic computing use. For gaming or movie watching, as well as professional-level image editing, this difference can range from slightly to significantly noticeable, especially in a side-by-side comparison.

Size/Weight: An obvious advantage for TFT LCD VGA video monitors, and one of their main selling points. LCD monitors can weigh as little as 1 pound for the smaller portable handheld screen sizes, and are often just 1-6 inches deep, including the depth of the base stand. CRT monitors by comparison can easily weigh 40-50 pounds, are often over 15-inches deep, and are very inconvenient for moving. It goes without saying that LCD monitors help free up a tremendous amount of desk space.

Screen Burn-in: TFT LCD VGA or video monitors do not suffer from screen burn-in. Although most CRT displays today also avoid this issue, because of the way TFT LCD monitors are manufactured, there is no risk of burn-in caused by nonmoving images that are displayed for a long period of time.

Viewing Angle: CRT video or VGA monitors do hold the advantage versus TFT LCD monitors here as well. However, it should be noted that TFT LCD monitors have dramatically improved, and current models offer a very wide viewing angle, easily over 160 degrees, which is all that is needed in practical situations.

Response Time: Response time refers to the time the screen takes to update pixel colors. This is very important for gaming and other fast moving images like movie playback. A slow response time will leave a 'trailing effect' where certain pixels seem to lag behind the action. The very best TFT LCD video, VGA monitors now offer sub 20 millisecond response times, which makes them generally acceptable for gaming. CRTs of course still hold the advantage, since their response time is not noticeable.

Screen Flickering: For those that spend a lot of time on a computer, one of the biggest issues leading to sore eyes and headaches is the screen flicker caused by CRT displays. Although screen flicker is generally not a problem for CRT displays that offer a 85 MHz screen refresh rate, many monitors do not, and default Windows settings are often lower as well. LCD video, VGA monitors clearly are the better choice here, as there is no flicker at all as a result of the differences in technology.

Magnetic Interference: TFT LCD video or VGA monitors have the advantage here, and are not affected by magnetic sources, namely speakers. As a result, some LCD monitors even offer integrated speakers, and do not require special shielding. CRT monitors are affected by the magnets in speakers, and depending on the model and closeness of the speaker, can result in a distorted picture.

Touchscreen for TFT LCD VGA, Video or PC monitors

Touch screen overlays will reduce up to 25% of the monitor's brightness. Touchscreens are becoming now more popular because of the interfacing between computers and small handheld TFT LCD color monitors. Handheld battery operated TFT LCD video monitors are more popular because of new led backlit technology that is extending the life of the LCD calf light bulbs by a factor of up to 5 times longer. Some portable handheld units can now work up to 100 hours with a single set of batteries.

Power Consumption: Again, TFT LCD vs. CRT, LCD comes out ahead. LCD monitors consume considerably less power than CRTs. Most LCD monitors consume between 20-50 watts of power, while CRT monitors generally consume 50 to over 160 watts. Touchscreen models even more current.

Dead LCD Pixels: One disadvantage of TFT LCD monitors is that they do include the potential of having so-called dead pixels, i.e., pixels that simply do not function. These pixels cannot be repaired, and can be quite annoying if they are in the main viewing area of the monitor, and are especially noticeable in word processing and other applications where the screen background is generally white. CRT displays do not suffer from this issue, but TFTLCD manufacturing has improved to greatly reduce the frequency of this problem.

CONCLUSION

We trust the above information provides you a solid introduction to the basic components of today's video surveillance system technology. If you'd like additional details or would like additional information on alternative subjects, please let us know.

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