

# Choosing The Right CCTV System For Your School

(a practical guide)

Before looking at what is currently available or possible in the field of CCTV it is worth taking just a couple of minutes to review the story to date, as although advances in technology have made things possible which previously were simply not feasible, many of the underlying principles remain the same.

## CCTV – a brief review

Initially all CCTV systems were analogue based, with images (when recorded) being stored on to magnetic tape (typically VHS or S-VHS), in a way similar to the operation of the domestic video recorder. As with any analogue tape based system, repeated re-use of tapes led to a gradual but inevitable degradation of the recorded images at each successive recording and of course copying images from tape to tape for archive or backup purposes resulted in further image quality loss.

Recording time or the number of images that could be stored was governed by tape capacity. The adopted industry standard media was the 3-hour tape, which offered a very restrictive 3 hours of continuous recording, however specialist 'Time Lapse' video recorders evolved which allowed users to stretch a 3-hour tape capacity to cover a 24 hour or even up to a 960 hour recording period. Time Lapse recorders work on the basis of recording individual images at intervals rather than continuous recording.

By way of a brief explanation, what we think of as movies (continuous recordings) are in fact simply a series of individually recorded images which when played back at the appropriate speed appear seamless and give us a sense of continuous movement. Early movies from the era of the 'Keystone Cops' or 'Laurel & Hardy', were recorded at 16 individual frames per second which is why they appear jerky and unnatural to us when we view them. It was Walt Disney who introduced the modern recording rate standard of 25 frames per second (FPS) to the movies, which we find so natural. When considering 'Time lapse' recording therefore we have to consider recording rates against the de facto standard of 25 FPS. To take a simple example, assuming a single camera is being recorded, at 25 FPS a 3 hour tape will allow 3 hours of recording. If however the recording rate is changed to 3 FPS the same tape offers an increase in recording time by a factor of 8 (25 FPS divided by 3 FPS), thus extending the practical recording capacity of the tape from 3 hours to 24 hours.

Apart from the issues of recording quality, tape based image recorders would typically only record a single input and therefore where images from more than one camera had to be recorded, specialist equipment was required to organise and sequence images before sending them on to the recorder. The Multiplexor / Switcher unit offered the solution at a cost with units available typically to handle 4, 8 or 16 camera inputs and provide a single streamed output. While such devices overcame the problem of connecting multiple cameras to a recorder, recording capacity remained a major issue. If we consider again the Time Lapse scenario above, a camera recording at a rate of 3 FPS offers a perfectly respectable security record of events as for each

second of real time, three still images have been captured. If however the system had 8 connected cameras, the 3 FPS recording would have to be shared between all 8 units meaning that each camera would only record one image approximately every 3 seconds, a situation that could even mean missing recording crucial images altogether.

### **Benefits of Current Digital CCTV Systems**

In simple terms the main benefits of digital based CCTV systems can be summed up as; improved image quality and system flexibility coupled with lower overall cost.

The current generation of digital systems typically record images to PC (Personal Computer) type hard disk drives, which can offer massive recording capacity as well as tremendous flexibility. Because images are stored digitally, in theory they can be copied or archived as often as required without any of the loss of quality experienced when copying older style analogue images. Images can also potentially be transported or viewed over a local computer network or even viewed on a remotely connected PC via the internet / dial up connection. Network connection or remote view systems can significantly increase the cost and complexity of the CCTV system and there are also many factors that can impact on performance.

Owing much to the development and evolution of the PC, digital CCTV systems are microprocessor based and incorporate sophisticated microprocessor chips and chip processing software in virtually every system component from the camera to the DVR (Digital Video Recorder) device.

In principle therefore, from point of capture (the camera) onward, capturing and maintaining quality images has never been easier. Not all systems however deliver the goods and many CCTV resellers seem hard set on selling their clients the most complex and expensive system available. We hope that the information offered in this document will help you to identify the key issues in selecting the right CCTV system for you and help you to focus on what you actually need for your application, rather than what some clever CCTV salesperson would like to sell you.

### **Choosing the Components of a Digital CCTV system**

#### **Choosing your cameras**

With such a vast range to choose from, this can be a complex area and the wrong choice could cost you unnecessary expenditure and / or result in inadequate or inappropriate performance. From a technological point of view, amazing things are now possible with CCTV, for instance cameras and supporting technology now exists that will allow a car number plate to be read by satellite mounted cameras circling the earth in space, however for most normal applications much lower specification and more modestly priced equipment would be more than adequate.

**Powering Your Camera(s)** - all cameras require an electrical power supply to operate, however some cameras (described as line fed cameras) are powered via the connecting cable that feeds the camera's images back to the recorder or monitor. With line fed cameras therefore it is not necessary to install a 13a power supply at the camera installation point.

**Mono or Colour?** - in general terms, a mono (black & white) camera will be cheaper than its colour counterpart and will produce clearer images in poor or lower light conditions making it an ideal choice for a wide range of applications and a favourite for many security or safety applications. There are however situations where colour would be the naturally preferred choice, i.e. an up-market fashion boutique may feel that a mono system would not set the right image, whilst in a retail centre with good lighting, a centrally monitored colour CCTV system would allow the monitoring personnel to more easily describe a suspect character to floor security staff ... 'the male shopper wearing the green sweater and blue jeans, standing by the lift'

**Indoor or Outdoor use?** – all cameras can be used indoors, however where a camera is to be mounted in an outdoor location it must be weatherproof. Some cameras such as the bullet camera range are built into a sealed housing and so can be used externally whilst other cameras may need to be mounted into a special weatherproof housing to allow their use outdoors. An industry standard (IP) rating system indicates the degree of weatherproofing a camera or housing offers; 'IP54' rating for instance indicates suitability for use in a sheltered outdoor location such as under the eaves of a roof, while an 'IP65' rating indicates a fully weatherproofed unit.

**Static or Moveable Camera?** – high specification cameras of the type used to monitor town centres or supermarket car parks, can be controlled remotely from the monitoring station. Such cameras can be rotated and tilted as required to track moving incidents and the zoom lens can be dynamically adjusted to zoom in to capture maximum detail of a given incident. As well as the high cost of such cameras, there are also significant costs involved with the remote control equipment and software, etc. Static cameras are installed in a fixed position and are set to continuously monitor a predefined area.

**Fixed Focal Length or Vari-focal (zoom) lens?** – the focal length of the lens in conjunction with the format of the camera determines the horizontal and vertical field of view (viewable area covered by the lens). Vari-focal Lenses are obviously a more expensive option than a standard fixed lens and are not suitable for use with all cameras. They allow the image view from the camera to be adjusted during installation for optimum coverage of the area to be monitored, however in practical terms, are an unnecessary expense for many applications. **Warning;** some suppliers keen to make maximum profit from their customers, are happy to fit cheap plastic lens to their cameras (or camera bundles). At Insight Security however, we believe that the considerably better optical performance of a glass lens more than justifies the small extra cost and therefore all cameras supplied by Insight feature real optical glass lens.

**Compact or Bodied Cameras?** – a 'Bodied Camera' is a unit designed to take interchangeable lens and such cameras normally feature sophisticated controls such as backlight compensation, electronic iris control on the lens, etc. The lens must be purchased separately and typically, most users opt for a varifocal lens to allow optimum adjustment of area of camera view during the camera installation process. 'Compact Cameras' such as Insights Plug-n-View range are complete units, typically featuring an integral fixed focal length lens. Most such cameras are fitted as standard with a general purpose 3.6mm lens, which offers a horizontal field of view from the camera of approximately 70 degrees, however Compact Cameras can be supplied with alternative fixed lens options (or even mini varifocal lens in some cases) to allow the

viewing area to be changed. Fitting an 8mm fixed lens for instance would have a telephoto effect, thus in essence narrowing the field of view and apparently bringing the subject area closer to the camera. Compact Cameras normally incorporate an electronic iris control / light compensation feature within the microprocessor chip and processing software, which whilst not as sophisticated as the features on a Bodied Camera, should be more than adequate for all but the most demanding locations. A Compact Camera typically offers a significant cost saving over a Bodied Camera and Lens combination and for many applications will prove equally suitable in use.

**‘Standard’, ‘Day/Night’ or ‘Self Illuminating’ Camera?** – cameras need light to operate effectively, be it daylight or some form of artificial light. The minimum light level that a camera will operate at is normally specified as a ‘LUX’ rating where typically 1 LUX is measured as the amount of light produced by a single candle when measured at a distance of 1 metre from the flame. A good colour camera may operate effectively in light conditions as low as 3 LUX, whereas a good Mono camera may even drop as low as 0.1 LUX before a supplementary artificial light source is required. Day/Night cameras are typically colour cameras which drop into mono mode as light levels drop and are designed to produce images even in very low light conditions, although low light images are often quite grainy or speckled in appearance. Self illuminating cameras incorporate infra red LED illuminators mounted around the lens. These are automatically switched on as light levels drop, to ensure that good image quality is maintained. The effective range of the infra red illuminators is dependent on their power and the number of LEDs incorporated, however illumination up to 25-30 metres is currently feasible at reasonable cost.

**Audio or Image Only?** – whilst many cameras are available with a built in microphone, this is not a widely used feature and is subject to some constraints. For a start, most DVRs (Digital Video Recorders) can only record a single audio track and will only record audio when operating in full ‘Real Time’ mode (i.e. when the recorder is recording at 25 FPS). In a multi-camera recording system therefore only audio from one of the cameras could be captured. In general terms it is also unlikely that meaningful audio could be captured from the integral microphone of an externally mounted camera due to the use of weatherproof housings, etc. or even extraneous wind or environmental noise.

**Is Vandalism a Threat?** – special anti vandal cameras / housings are available and such units normally feature all metal housings, unbreakable polycarbonate lens covers and anti tamper security fixings.

### **The Digital Video Recorder (DVR)**

Probably the greatest technological advances and price drops in recent years have been in the area of image recording. The DVR (Digital Video Recorder) offers major benefits over the older analogue ‘Time Lapse’ video recorder technology and latest units incorporate many of the functions previously performed by specialist equipment such as the multiplexer, etc. DVRs feature full colour compatibility, so images are recorded as input, i.e. mono images (from a mono camera) will be stored in mono format, while colour images will be stored in colour format.

When choosing a DVR it is important to focus on the features that you really need for your application. Don't be seduced by sexy but unnecessary features and widgets that will simply cost you more money without offering you real benefit.

It is also important to buy from a reputable supplier in order to ensure that the DVR that you buy will offer the level of quality, reliability and performance you require as well as continuity of spares, etc. for future maintenance.

Virtually all quality CCTV equipment and components are manufactured in Korea and other far eastern countries. Insight Security's CCTV buying partners regularly visit the manufacturers in their factories and have built a strong relationship with them over many years to ensure quality products and performance along with continuity of supply. You can be confident therefore that any equipment supplied to you directly by Insight Security is the real thing and not a cheap copy or grey import.

**So what is a DVR and how does it work?** – a DVR is a microprocessor (PC like) unit designed to record and process images onto a PC type hard disc drive. The unit will typically feature it's own proprietary operating system (which may be based around Windows, Unix or the manufacturers own software) and specialist compression and image management software that will allow efficient storage of images in the minimum possible disk space. It will feature one or more direct camera inputs (the most popular models offering 4, 8 or 16 direct connections) and one or more video outputs to a monitor or external recording device for the viewing or archiving of images as required.

Typically the DVR will offer the capability to 'Time & Date-stamp' and record images from all cameras concurrently at all times and will allow the unit to be set up so that when the storage disk becomes full, it will automatically start to over-record images on the basis of oldest first, hence no operator intervention is required unless an incident occurs. Top end DVR units will typically allow simultaneous viewing or archiving of stored images while all connected cameras continue to record new images. Interrogating stored images is normally done via the event log where image recordings can typically be accessed by event or by time and date.

Typically a monitor will be connected to the DVR to display the images from the cameras. The images as displayed on the monitor are normally controlled via the DVR (which subject to the number of cameras supported by the DVR) will allow the display of a single camera, or four, nine or sixteen cameras concurrently in separate picture windows on the monitor screen.

### **Optional DVR features may include;**

Audio recording (this is normally restricted to just a single audio track and typically only records when the DVR is recording at the maximum frame rate of 25 FPS)

Continuous, Alarm Triggered, Event Based or Timed recording options. All systems allow for 'Continuous' recording and typically also offer 'Alarm Triggered' recording options. Higher specification units may also feature pixel recognition technology, which allows them to be set up so that images from a camera are only recorded when a change in the normal pixel pattern shown by the camera is detected (i.e. a person

moving through the field of view, etc.). Pixel recognition can be a useful facility, however is not foolproof as changing light patterns, moving foliage, etc., can all cause the pixel processing software to trigger an event and initiate recording. To reduce the incidence of false events, pixel recognition based systems normally feature pixel masks which can be set up by the user for each camera to define which areas of each camera image should be monitored for change – i.e. a mask could be set up to block off monitoring of part of the camera view showing a tree or bush which could move in the event of a wind blowing up.

Auto restart after power failure. Obviously in the event of a power cut or loss of electrical supply, the DVR cannot operate, however many units feature an automatic restart facility which means they will automatically start recording again when the power is reconnected.

Removable disk drive(s) are available on some units. Multi drive ‘Hot Swappable’ ‘Caddy’ based disks can be removed or exchanged while the unit is operating, however some users prefer the added security of a ‘non removable’ hard drive.

Connecting to a LAN (local area network) is possible with some DVRs and would allow any PC (loaded with the appropriate software) connected to that LAN to view the images being recorded onto the DVR and thus act as a monitor. The heavy load put onto the LAN whilst carrying image traffic, could however cause considerable degradation to response times for other PC users and we would suggest therefore that no more than a couple of PCs should use this facility at any time. (Note; A dedicated ‘non PC’ monitor will typically still be required for system set-up).

Vehicle mounted CCTV security / safety recording systems, it is quite feasible to install multi camera recording systems into vehicles and in fact for certain types of vehicle such as the school bus, this is now specified as an essential requirement by many local authorities. Vehicle based systems are designed to operate at vehicle voltages (12-32v) and must also incorporate sophisticated and specialist anti vibration protection for the hard disk drive to ensure shake free image recording.

CCTV as a Vehicle Reversing Aid, reversing large or awkward vehicles can be a nightmare, leading to accidental damage to the vehicle or building structures or in worse case, death or injury to pedestrians. Modestly priced reversing camera systems are now in general use on a wide range of vehicles and many users employing such systems are already reaping the benefits of reduced vehicle off road time (fewer reversing accidents) and reduced injuries to pedestrians.

## **The Monitor**

Because the control of the displayed images is typically a feature of the DVR, a simple monitor is probably all that’s required. The main considerations are colour or mono, size, and screen resolution.

Colour or Mono? - If you are only using mono cameras, there is no point in wasting money on a colour monitor, however if you have even one colour camera connected you will probably want a colour monitor.

Size? – a 6” or 10” monitor may be adequate to monitor a single camera image, however if viewing multiple cameras on a split screen format a larger size is required. To view a four image ‘quad’ screen - as a minimum a 12” mono monitor or a 14” colour monitor would be recommended, for nine or sixteen image display formats, larger screens would be preferred.

Resolution? – screen resolution is normally expressed as TVL (TV lines) for conventional type screens and either as pixel resolution or contrast ratio for the new generation of slimline TFT or LCD type screens. In general terms the higher the number for any of the above measures, the better the image quality is likely to be, however it is probably true to say that currently, images displayed on the new style slimline screens (TFT or LCD screens) are likely to appear less punchy than images displayed on a conventional screen of similar size.

### **Cabling & Connectivity (wire free?)**

With so many different types of connectors used within the CCTV industry, this can be a major problem area. Among the more popular connectors currently in use are; bayonet type ‘BNC’ connectors, telephone plug type ‘RJ’ connectors (4 pin and 6 pin varieties), ‘DIN’ and ‘Mini Din’ connectors (4 pin and 6 pin varieties for each) and so on, however even the same type of connector used by two different manufacturers may be wired differently which could cause major problems when trying to mix and match equipment within a CCTV system.

At Insight Security we have put together a broad range of very competitively priced, fully compatible quality equipment and connectors / adaptors which allows our users total flexibility. Top of the range pan, tilt and zoom, remote controlled cameras, can be used alongside the most inexpensive compact fixed lens cameras, offering maximum flexibility for our users when putting together a CCTV solution and ensuring that the system can be configured for the lowest possible cost.

Various types of cabling are available, however typically, Insights Plug-n-View CCTV systems feature pre-terminated cables (in 20 metre lengths which simply plug together to extend the cable length as required). They plug into the camera at one end and connect to the recorder or monitor at the other end, and incorporate a power supply feed for the ‘Line Fed Cameras’ thus eliminating the need to run a separate power point to each camera position. Other cable options include Cat 5 and COAX type cables which normally require professional installation.

License exempt wire free installations are possible using RF (radio frequency) technology and equipment, however should only really be considered as an option where a ‘hard wired’ solution is not possible or where a camera may need to be relocated on a frequent basis. Short range RF systems are relatively inexpensive and manufacturers typically claim an operational range of up to 100 metres. Such claims are based on line of site transmission (where the transmitter and receiver units can see each other with no obstructions such as walls, doors, floors, foliage, etc., between them) and are operating in ideal environmental conditions. In reality when such systems are used within a building, a practical operational range is more likely to be between 25-30 metres.

## **Supplementary / Artificial Lighting**

Although many modern cameras are capable of operating in very low levels of light, generally speaking the brighter the lighting, the better the quality of the image. Artificial lighting can produce some strange colour casts on colour images, however daylight balanced lighting such as that used in most retail centres are fine.

Infra-Red lighting is invisible to the human eye (in as much as we cannot see it light up the objects it falls on, as a torch beam or conventional lighting would... although looking directly into the light source, a dim red glow will be seen with most IR illuminators). IR lighting offers a practical solution to night time supplementary lighting where the use of conventional artificial lighting could prove intrusive to neighbours, or would be impractical for other reasons. When using infra-red it is important to remember that it only works with mono cameras (or colour cameras, capable of switching into mono mode), so images will only be displayed / recorded in mono mode. Traditional infra-red lights incorporate special infra-red bulbs which are not only expensive, but offer limited operational life and thus require frequent replacement. The revolutionary new generation of LED (light emitting diode) based infra-red lighting units offer long life operation and are proving practical and cost effective. LED based infra-red units are proving ideal where limited range (up to around 30 metres) illumination is required.

## **Installation**

The Insight Security range of Plug-n-View systems (including the special digital CCTV for Schools package) are simplicity itself to install and are primarily designed for customer installation thus eliminating expenditure on specialist external installers. Simply unpack the components from the box, plug them together and you will have an instant working system, while fixing the cameras in position (wall or ceiling) requires no more than basic handyman type skills.

One delighted customer with no previous experience of CCTV, rang to tell us that the order he placed on the Thursday afternoon, was delivered the following morning, the system was installed and fully operational by lunchtime ...and recorded the first incident during the afternoon ...which led to the matter being resolved before close of school that day!