The Real-World
Networking Guide to

IP Surveillance

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Introduction

> Welcome to the latest in a series of real world networking guides from D-Link, written expressly for small business owners, managers and IT staff looking to get to grips with networking issues.

These guides will tell you everything you need to know in order to understand and deploy key networking technologies. Moreover, because technical expertise is at a premium in smaller organisations, they will do so with a minimum of fuss, resorting to jargon only where absolutely necessary and explaining what everything means in understandable, layman's terms.

This latest guide in the series is focused on deploying IP surveillance solutions. A number of developments including wireless technology, Power over Ethernet (PoE) and widespread take-up of IP (Internet Protocol) based technology

beyond the traditional IT environments, have led to IP Surveillance being not only a real alternative to CCTV systems, but as being able to create new applications in its own right.

Here we examine how IP Surveillance solutions can be deployed efficiently and cost-effectively, and what the key benefits of this technology are.

This guide examines how IP Surveillance solutions can be deployed efficiently and cost-effectively, the key benefits of this technology and further insight into the D-Link solutions.

> D-Link IP Cameras

DCS-3110   DCS-3415   DCS-6110

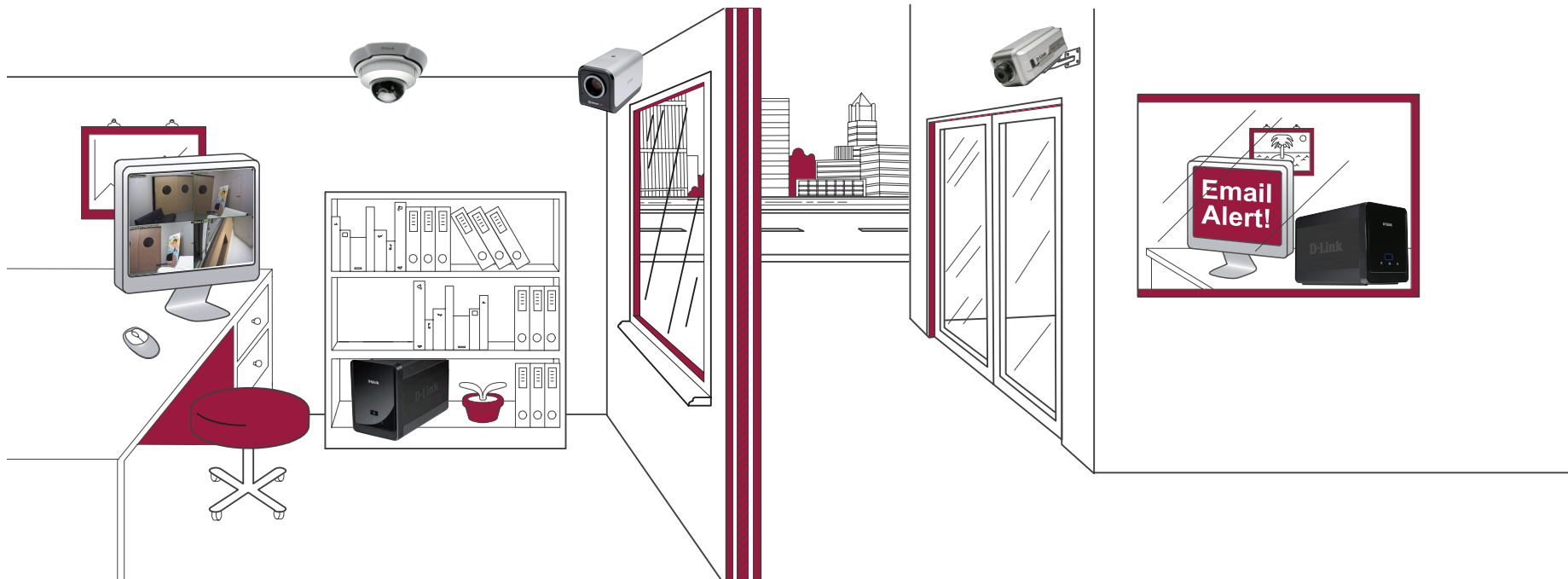Free D-ViewCam management software included with all D-Link cameras.

> D-Link NVRs

DNS-722-4   DNS-726-4

Free D-ViewCam NVR management software included with all D-Link NVRs.

Email Alert!

Traditional CCTV versus IP Surveillance

Historically, monitoring and surveillance applications have been served by analogue technology. However, the digital age has shown up some of the flaws in the analogue predecessor. For example, analogue CCTV systems are generally maintenance intensive, offer no remote accessibility, and are renowned

for being difficult to integrate with other systems. Plus tape technology has been plagued with reliability issues. Digital Video Recorder (DVR) technology has resolved the issues over tape, but the new wave of IP Surveillance systems has brought several benefits which we'll explore now.

So what exactly is IP Surveillance?

IP Surveillance is based around IP camera technology. This is effectively a CCTV (Closed-Circuit Television) camera that uses the Internet Protocol (IP) to transmit image data and control signals over an Ethernet or Wireless Network.

A number of cameras are typically networked and deployed alongside a Network Video Recorder (NVR) and possibly a Video Server, in order to create a complete record and playback system. Being IP-based, it is relatively easy to access the video remotely.

To date, IP cameras have been primarily used for surveillance in the traditional manner, but increasingly new applications are being discovered for the technology, some of which we'll explore later.

› Throw away and start again?

The million-dollar question…

No one likes to discard their existing systems for a wholesale replacement strategy. So, is it possible for those with existing analogue CCTV systems to add IP surveillance technology and achieve a harmonious marriage? The answer is "yes". With IP-Surveillance, you can still use all the cameras, lenses, and cables already in place, should you wish to do so. However, one should bear in mind the ongoing maintenance costs associated with a classic CCTV system such as tape wear and tear which is still an ever-present problem.

Furthermore, the actual quality of the images recorded is often unsatisfactory, particularly if used for official purposes. With IP-Surveillance technology, the video server and network server represent the next level of technological innovation, connecting existing cameras to the network with a video server and then storing the images on the network server and using Network Video Recorder (NVR) technology to achieve high quality recordings.

Soyes, using IP Surveillance to supplement and improve an existing CCTV system is entirely possible, but whether it is truly cost effective or not is another matter.

›What are the basic benefits of digital surveillance over analogue CCTV technology

What are the basic benefits...

- Advanced search capabilities
- Ease of use
- Improved compression and storage
- Integration potential
- No image degradation
- Simultaneous record and playback

IP-Surveillance provides all the advantages of digital over analogue operation and adds several unique features. Here are some of the key features obtained when adopting an IP Surveillance solution to replace or compliment an existing CCTV deployment:

Remote access
A key benefit of IP-based technology is that the user can now see surveillance images from any computer or handheld device on the network - without the need and expense of additional hardware or software. Any connection to the Internet enables you to securely connect from anywhere in the world to view a chosen facility or even a single camera from your surveillance system. By using a Virtual Private Network (VPN) this access can be completely secure.

Secure, unlimited storage.
As storage costs continue to fall dramatically, an IP Surveillance system gives you the ability to store near unlimited images. Moreover, these images can be both easily stored and viewed off-site and easily backed up.

Image distribution
Since images are stored as regular image file types, they can be distributed in the same way as any other digital video or picture. So, for example, you might want to take snapshots of an intruder or incident and email them immediately to the police. Again, access can be made completely secure, so you can set up a secure list of viewers – for example, local police and emergency services – who can access the images remotely and securely.

Alerting
In the event of a potential incident arising, individuals can be alerted via email or text message immediately.

Better OpEx
The beginning of this section listed the many advantages of digital technology, but it bears repeating that with no further need for time-lapse video equipment, tapes, tape changing and cataloguing - operating and maintenance costs fall significantly. While system performance and results markedly increase, total cost of ownership over time will continue to decrease – the best of both worlds. IP-Surveillance provides all the superior functionality of digital technology, plus the benefits of increased accessibility, storage and distribution of images, and superior cost-benefits.

IP cameras versus CCTV cameras

Let us start by saying that any ideas of CCTV cameras showing grainy, black and white images are very much off the pace. Despite the technology being rooted in the analogue world, CCTV cameras have improved in terms of features and quality and, in conjunction with DVR replacing VCR technology, you have a far more reliable replay system with greatly improved storage capabilities. For example, to resolve problems when an indoor security camera is pointed towards a window, to avoid the background appearing "washed out" the CCTV vendors introduced WDR (Wide Dynamic Range) technology so two process scans are taken and combined to reveal more details.

With a CCTV camera system you can use either a VCR or DVR. You record the video at the site being monitored and can review it afterwards, store those records and additionally now, in some cases network these cameras to gain some of the benefits of IP Surveillance systems. However, IP cameras were designed with the Internet in mind from day one, to give a user the ability to see what is going on at their home or business, wherever they are in the world. These were a truly revolutionary breakthrough.

The ability to instantly see the transmission of images globally, while managing the monitor of cameras anywhere in the world from one remote location is incredibly cost-effective, compared with managing multiple sites from multiple sites. Being digital, quality does not diminish, regardless of the number of views and where that video is transmitted between.

More importantly, given the sensitive nature of most video captured on IP Surveillance systems, images can be encrypted and made completely secure, also rendering them tamper-free.

› Making the move from analogue to digital – In a nutshell

Even with the growth of CCTV and the recent acceleration in migration to digital video technology, significant technological limitations and adoption hurdles remain for many users, compared with the wholesale adoption of IP Surveillance.

There are clear, step-by-step methodologies available for the transition from analogue to digital, so it is purely an education issue. Anyone familiar with the Internet and networking will see IP Surveillance as just another

application. Those well-versed in CCTV technology but not IT per se, need basic guidance in terms of the components required, from the cameras through to the network components – switches, WLAN, ADSL routers etc that may be needed, depending on the installation. However, to use the old phrase, none of this is "rocket science", just simple connectivity. It is also important to know that in the transition from analogue to digital surveillance systems, no system is too small or too tightly tied to analogue technology, to benefit from digital technology.

The move from CCTV to IP Cameras: Other factors to consider

Nothing is ever as simple as it seems.

While identifying obvious benefits of IP Surveillance camera technology over its CCTV equivalent, there are other technology elements to bear in mind. First is to ensure that sufficient network bandwidth is available. On a LAN this is not a problem, with Layer 3 Ethernet switches even offering QoS (Quality of Service) and bandwidth reservation options to ensure bandwidth availability for these video streams. A WLAN has less bandwidth but still more than enough, especially with the introduction of the 802.11n standard, providing up to 300Mbps of throughput.

On a WAN however, bandwidth is very much related to what quality of video stream you wish to support. That said, any ADSL or equivalent broadband connection can support multiple high-resolution video streams. Problems are more likely to arise when trying to monitor IP Surveillance systems in truly remote areas, but if 3G is available, even a mobile data connection will now support good quality video.

It's a similar story with image storage. A simple rule-of-thumb based on frames per second (fps) recording quality means that – for example – storing video shot at 30fps will take up 30 times more storage than video shot at 1fps. However, in the same way that broadband Internet has become very competitively priced, likewise storage costs have fallen dramatically over the past couple of years, so even terabytes of storage can be added via USB or network connections for low cost.

Finally, it is important to understand what software is being provided with your IP Surveillance system. While 3rd party software is available, ideally your IP cameras and NVR should be provided with all the image, storage and management applications you need.

› Motion Detection and Video Analytics

IP cameras can have built-in motion detection and alerts. This allows you to configure "windows" within the IP camera video screen that will monitor that area for motion. If motion is detected, an alert can be sent via email, SMS, FTP or some other form of Input/Output.

By having this feature built-in, no software is required for the IP camera to offer a stand-alone solution for monitoring. Video Analytics are also being incorporated into IP cameras to offer advanced motion detection and tracking. Video Analytics is smart enough to distinguish between a person walking, a car driving or just a bush swaying in the wind.

IP Surveillance: The benefits

⟩ Advantages of IP Surveillance over CCTV

Camera advantages:

- Reduced system cost and added functionality due to general-purpose IP networking equipment infrastructure.

- Lower cost of cabling in large installations.

- Reduced space requirements in large (multi-camera) CCTV setups because video switching and routing is done via computer and does not need physically large and expensive video matrix switchers.

- Flexible image format.

- Support for a variety of image resolutions including both standard analogue CCTV resolutions (CIF, NTSC, PAL and SECAM) and megapixel resolutions.

- Capability for digital zoom of high-resolution megapixel images.

- Progressive scan versus interlaced scan. Note that not all IP cameras operate in progressive scan mode. Progressive scan allows still images to be removed in better quality from a video feed. This is particularly true for a fast moving target, in which case interlaced scanning will introduce shutter-blind artefacts.

- Ability to select specific frame rates and resolution for each camera in a system.

- No additional video encoder hardware is required to convert analogue video signals into digital data for recording onto hard drives.

- Choice of video compression codec, such as Motion JPEG, MPEG-4, H.264 etc.

- Extensible network infrastructure.

- Convergence onto new or existing IP cabling infrastructure, including sites with multiple buildings.

- Ability to use Power over Ethernet allowing for one cable to handle power and data.

- Capability for deploying with a wireless bridge.

- Ability to use legacy coaxial cables with appropriate converters.

- Ability to use fibre optic links with appropriate twisted-pair to fibre convertors.

- Transmission of commands for PTZ (Pan, Tilt, Zoom) cameras via a single network cable. Simple to add one camera at a time to the system.

- Greater functionality.

IP Surveillance specific benefits:

- Wireless allows the camera to be placed just about anywhere.

- No limit on resolution inherent in standard analogue video formats. Megapixel cameras can far exceed image detail from conventional CCTV cameras.

- On-camera automated alerting via email or file transfer in response to video motion detection or dry-contact alarms.

- Password lockout of unauthorised personnel to prevent viewing images or altering the camera configuration.

- Support for different streaming media and compression formats to relieve transmission bandwidth and data storage requirements.

- Encryption of camera control data and audio/video data.

- Support for new embedded intelligent video motion detection (video analytics) with shape recognition and counting applied to objects, people, and vehicles.

- Integration of video surveillance with other systems and functions such as access control, alarm systems, building management, traffic management etc.

- Remote configuration, diagnostics, and maintenance.

- Future-proof installations with field-upgradeable products due to the ability to upgrade camera firmware over the network.

⟩ IP Surveillance Camera Features

Zoom
Zoom functionality is obviously key to capturing the right information. At the higher-end of the camera range, look for features such as 18x optical zoom progressive scan, to capture high resolution images of moving objects that traditional interlaced scanning techniques cannot achieve. This level of capability effectively reduces motion blur and distorted, jagged edges of recorded images.

Audio
Audio is another important element. Look for a camera that comes with built-in microphone and audio ports allowing 2-way audio communications. Another useful feature is an audio switch to ensure privacy when needed.

Management Software
Management software should be provided with the cameras, enabling you to manage multiple cameras from a single PC, enable e-mail alert notifications, set recording schedules and trigger motion detection to record directly to your hard disk. Other features to look for include the ability to upload a floor plan of your business and create a realistic layout of where the cameras are located, further simplifying the management process.

Network Camera Support
In addition, look for network camera support for the universal plug-n-play feature, which allows PCs to automatically recognise a camera and add it to the network once connected. Users are then able to remotely access the camera without even having to remember the IP address if the camera name is registered on a DNS server.

IP Surveillance:
The IP camera explored

NIP cameras have been around since the mid '90's. As with digital still cameras, the resolution of IP cameras has increased with time, now typically ranging from 1-5Megapixels but extending beyond that in some cases to 10 and above. The breadth of features available now reflects the range of application areas such as consumer, broadcast, and security video.

Standardisation

Over time, analogue CCTV became standardised, in terms of video and broadcast television formats, whereas initial IP cameras had no initial standardisation, other than the IP commonality. In other words, each make of IP camera could differ in terms of its specific features and functions, video encoding (compression) schemes, supported network protocols, and the API to be used by video management software.

In 2008 however, two industry groups were formed to address standardisation issues in IP video surveillance - The Open Network Video Interface Forum (ONVIF) and the Physical Security Interoperability Alliance (PSIA). At the beginning of this year, each group released its 1.0 specification.

› A camera tailored to your business needs

Exactly what you want to get in an IP Surveillance camera depends precisely on what the requirements are in the first place, such is the range of options now. Even with cabling, while PoE connections over standard copper cabling may be the most popular wired form of connectivity, in some cases – for security, weather protection and distance – fibre connections may be a better option. Alternatively, wireless extends the IP Surveillance network easily and provides huge flexibility. Support for 3G provides the ability to extend monitoring capability to mobile handset connections. Flexible connectivity options are also important. For example, these might include digital input and output ports to external devices such as IR sensors, switches, and alarm relays. An RS-485 interface, providing connectivity to an optional Pan/Tilt enclosure, can also be extremely useful.

In terms of active features, starting with basics – does a camera need to operate in daylight-only, or at night as well? It is possible to get hybrid cameras that provide automatic day/night functionality, adjusting the image from colour during the day (or in low-light conditions) to monochrome at night, or during very poor light conditions. In some cases it may be necessary to add an Infra Red illuminator to view and capture images at night. Another option in some cases is to interchange lenses to have specific day and night lens technology.

Cameras also come in many and varied forms – not just for indoor or outdoor use with suitably protective enclosures, such as tamper-proof casing – but in terms of their appearance. So, for example, for discreet indoor monitoring, a dome-based camera may be ideal for being as transparent in use as possible.

› D-Link IP Cameras: Specifications

DCS-3110

- 1.3 Megapixel Scan sensor High quality and high resolution imaging with reduced motion blur and distortion
- MPEG4 Multicast Support Ensures smooth video streaming to all monitoring stations
- Built-In 802.3af Power over Ethernet – Allows camera placement on high walls/ hidden locations
- Direct recording to NAS No need for a dedicated PC (Samba client)
- Simultaneous access from a computer or 3G mobile phone/PDA
- CompactFlash card slot for front-end storage
- Removable IR-cut filter - Gives high-quality images in both daytime and night time
- Supports 2-way audio*

* requires connection to an external speaker

DCS-3415

- 18x Optical Zoom Progressive Scan – Guarantees high-quality and long-distance capture of moving objects whilst effectively reducing motion blur and distortion
- MPEG4 Multicast Support - Ensures smooth video streaming to all monitoring stations
- Built-In 802.3af Power over Ethernet – Allows camera placement on high walls/ hidden locations
- Advanced Solution - Provides precise identification to the finest detail
- Dual streaming - Simultaneous live viewing and recording
- Removable IR-cut filter - Gives high-quality images in both daytime and night time
- Supports 2-way audio*

* requires connection to an external speaker

DCS-6110

- 4x Digital Zoom - Exceptional picture quality through VGA Progressive CMOS technology
- Adjustable viewing angle (350° x 45° x 350°)
- Digital I/O - For sensor input and alarm output
- 3G Video Support – Allows remote monitoring over the internet through your Ethernet connection
- MPEG4 Multicast Stream Providing compressed high quality real-time videos in MPEG-4 and JPEG format
- Built-In 802.3af Power over Ethernet – Allows simple and cost-effective installation
- Dual Stream Support Simultaneous dual-streaming for live monitoring & recording
- Built-In Samba client for NAS No need to directly connect to a PC to capture and transfer images

The Role of Wireless in IP Surveillance Solutions

One of the key benefits of IP Surveillance is the flexibility available with its deployment.

For either indoor only or indoor-outdoor installations, using wireless rather than wired connections provides real versatility. Moreover, the wireless network can be made completely secure, so along with the increased bandwidth available with the new WLAN standards, there is nothing lost in extending a wired Ethernet network into the realms of wireless. Only one cable is required, such as a Cat5/6 Ethernet cable to provide PoE connectivity (see below), so very little work is required to install the camera in its recording location.

Power over Ethernet (PoE)

PoE provides the ability to power an IP camera (and other PoE enabled devices such as WLAN Access Points - APs) via a single Ethernet cable. This ease of installation, in eliminating the need for a power cable makes the installation of IP Surveillance both easier and less expensive than when compared with a traditional CCTV installation, or even non-PoE enabled digital technology.

At the heart of the installation is an Ethernet switch with PoE ports, the cost of which is now extremely competitive, from which connections to IP cameras and possibly WLAN APs are made. So all connectivity is centrally administered and controlled at the local site, as well as managed remotely.

› Network Video Recorder

A Network Video Recorder or NVR is an IP-based device that sits on a network. Since they are IP based, NVRs can be managed remotely across a LAN, WLAN or the Internet, providing great flexibility. Just like DVR for CCTV systems, NVR provide stand-alone recording management for IP cameras.

The NVR should be able to take advantage of existing network architectures and features such as Point-to-Point Protocol over Ethernet (PPPoE) and ADSL for remote access and act as a DHCP client for easy installation. Maintaining an accurate record of time is essential if recorded data is to be used as evidence. To ensure that the recorded time is always accurate, an NVR should be able to update the system clock from an internet server using the Network Time Protocol (NTP).

The basic function of an NVR is the simultaneous recording and remote access of live video streams from an IP camera. Key elements are ease of use and installation, support for Intelligent Motion Detection and Pan, Tilt, Zoom (PTZ) camera control.

› How does NVR work within a network?

Video streaming
Audio streaming
Event trigger

Storage
Recording schedule
Live streaming server
Remote playback server
Configuration
Web UI

Remote live view
Remote playback

NVR vs DVR

In relation to recording and play-back, an NVR has some similarities to a DVR.

An NVR is a true digital system that receives digital images/video streams over the network and records them on a hard disk in a digital format. In contrast, a DVR is actually a hybrid system that can accommodate analogue cameras and store the video on a hard disk in digital format. Some DVRs have a rudimentary interface to the network that offers remote viewing capabilities, but NVRs were designed from day one to be viewed and managed remotely across any network connection from a PC or equivalent client type.

IP Surveillance:
The NVR explored

❯ D-Link NVRs: Specifications

DNS-722-4

- Simultaneous real-time viewing Record and playback up to 4 D-Link cameras, either locally or via the Internet

- Stand-alone device - No need for a dedicated PC

- Mass Storage - Up to 3 TB of space (HDD not included)

- Directly Connectable - Can connect to the Internet (PoE) without a remote router

- Automatic backups – Creates backups to mirrored hard drives using RAID 1 technology

- Free Software - D-View Cam NVR software included for the management of up to 4 NVRs

DNS-726-4

- Simultaneous real-time viewing - Record and playback up to 4 D-Link cameras, either locally or via the Internet

- Compatibility – Works with D-Link, Sony, Panasonic and Axis network cameras with smart PTZ camera control

- Mass Storage - Up to 3 TB of storage space (HDD not included)

- Directly Connectable - Can connect to the Internet (PoE) without a remote router

- "Smart Search" Technology - For simplified event investigation

- Free Software - D-View Cam NVR software included for the management of up to 4 NVRs

❯ Monitoring & managing video recordings

From a GUI you should be able to monitor and manage live and recorded video, such as per camera connection and recording status, along with frame rate and bit rate information for each camera. Total available recording time for the system should also be clearly displayed. In many cases, multiple NVRs can be combined to provide large numbers of active channels, local and/or remote.

Live Monitoring & Camera Adjustment are important benefits of this type of system, where users are provided with a variety of options for viewing and organising camera footage on-screen. For example, on a system with multiple channels, users can simply drag and drop selected cameras to the viewing area. A single camera may be viewed full-screen with optional two-way audio. Users can control PTZ functions from within the interface using the provided interface buttons or by directly clicking on the video.
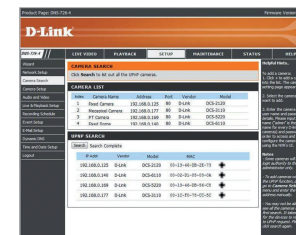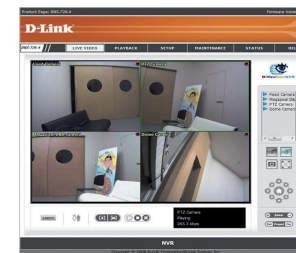
Intelligent Playback
Another key element of NVRs is intelligent playback, in order to avoid time-consuming searching for the correct recording. For example, by selecting a target area on the video and setting search sensitivity, a smart search can traverse the video database based on specified search criteria to locate key events. These search criteria might include options such as motion detection, missing or abandoned object, lost focus or camera occlusion. Typically video can be exported using formats such as AVI or ASF.

Scheduling Systems
Scheduling systems allows for continuous recording or recording during specifically allotted timeframes, on a per camera basis. The NVR centrally controls the digital output, e-mail notifications and recording for all the connected cameras. Input triggers from camera motion detection or digital input interfaces can additionally be monitored. These events will be logged, with optional notifications via e-mail or output devices. Users should be able to set up multiple contact lists for event notification.

Security
Security is obviously an important element of an NVR. For example, connections themselves should be secure – such as filtered by IP address – and privilege options should be configurable enabling different user levels for access to live view, playback, audio and PTZ functions. Recorded data should be stored in a secure database and ideally backed up to a remote location regularly, as well as optionally being backed up on a secondary drive that can take over in the event of the primary drive failing. Equally important is the ability to protect the device in the first place from potential thieves, so it should be easily concealed and secured.

In Summary

About D-Link

In today's Internet world, IP Surveillance is the logical successor to traditional CCTV systems.

Ease of installation plus the ability to view and manage IP cameras remotely from anywhere with an Internet connection (or on local LANs/WLANs) make IP Surveillance a very flexible and cost-effective solution.

IP cameras themselves have improved the resolution of images with digital zoom facilities and motion detection making the recordings both more accurate and time sensitive. Combined with NVR technology, they provide an easily managed system with near infinite storage capabilities and instant access to any stored images.

As a means of providing monitoring of any location, indoors or outdoors, from anywhere in the world, cost-effectively, IP Surveillance is the logical solution now and going forward.

D-Link® is all about providing networks which meet the needs and future needs of the real-world. To us this means using innovative technology to provide green solutions which deliver greater connectivity, security, efficiency and value, whilst also doing our bit for the real-world green issues. Established in 1986 we have continuously evolved over the last 23 years to become a billion dollar global enterprise with 127 offices across 64 countries and are the global market leader in small business networking and Wireless N technology.

Our world-class product suite includes broadband, digital electronics and voice and data communications solutions for use by consumers and businesses of all sizes. Inspired by a positive vision of the future in which everyone connects, we're making our networks more natural than ever.