Wireless Networks for Security and Surveillance Applications

Implementing an Affordable,

Highly-functional Security System

Kocchi's®

Contents

Introduction	1
What's Next in Monitoring and Surveillance	1
What is Wireless Surveillance?	2
The Wireless Advantage	3
Analog or Digital, how can Wireless Help?	4
Wireless Surveillance in Action	7
Deployment Choices	xx
Choosing the right equipment	xx
CCTV and Rapid Deployment Examples	7
Common Misconceptions Related to Wireless	8
Image Formats Used for Surveillance	10
Kocchi's Overview	
Conclusion	15

Introduction:

As the use of CCTV systems for security and surveillance purposes grow, government and private sector organizations alike face many challenges. With the integration of legacy analog and newer "IP" based digital surveillance technologies into the surveillance, security or traffic monitoring systems of an organization potentially requiring co-operation between both Public Safety and IT departments, the requirements either party places on their choice of a systems implementation could differ greatly.

To aid the decision process for these organizations this White Paper sets out to simplify one of the more taxing considerations – Network Design and Availability. With Rapid deployment and mobile requirements becoming more commonplace with a security network, Wireless technology has made an entry into the Security and Surveillance industry. However, developments in Broadband Wireless technology over the recent 12 – 18 months have delivered a range of solutions that allow integrators to consider Wireless as an active component , and a potential replacement for Copper or Fibre connections.

This paper attempts not to favor one type of camera or recording technology over another, but offers an explanation of consideration for both – and how to use the benefits of Wireless to aid deployment.For any enterprise or organization that has been challenged by outdoor conditions, distance, lack of network connectivity, or simple fear of "new" technology when implementing a monitoring and surveillance system—Wireless IP-Surveillance is in your future.

What's Next in Monitoring and Surveillance

More than ever, 9/11 and its aftermath have made security for organizations and enterprises worldwide a major priority. World events and organizational demands have hastened our search for better, more cost-effective security applications. In many instances, rapid deployment of security systems has become essential.

As critical as improved security has become, budgets to accomplish this goal are by no means unlimited. In fact, while many organizations have placed greater emphasis on security management, budgets have not always kept apace. When installing security and surveillance systems, equipment represents only one of the cost components. System installation represents a whole additional cost consideration. For installations that cover expansive territory and/or require that all data be transferred to a distant, central monitoring station, the

feasibility of running wire is often limited. Fiber optics is always an alternative, but for many enterprises this can be cost-prohibitive. What then?

Against this backdrop, we are experiencing many fast-moving developments in security and related technology areas. For example, security applications are increasingly migrating from analog to digital technology; meanwhile, the IT and security markets are rapidly converging. These two developments have lead to increased interest and viability for IP network-based solutions. However, the many legacy analog based systems currently in use, their picture quality and ease of operation implies that they will not be totally replaced overnight. The challenge for the Systems Integrator therefore is to select the best available technology for each requirement, integrate it seamlessly and offer the support and management required to ensure longevity in the investment.

Whether it's establishing video monitoring for a highly visible bridge or creating an affordable surveillance system for your company's far-flung car park, a fast emerging solution is the integration of established IP or analog surveillance technology with Broadband Wireless. Some readers may observe that Wireless has been utilized for CCTV for some time; short range low bandwidth connections have been available to connect small numbers of cameras to a control centre. Today's Broadband Wireless solutions however offer significant benefits and advantages over this old, proprietary technology, making them a viable solution for extending town centre and metropolitan deployments.

In this white paper, we will explore these advantages, answer the integration questions and clearly define what Wireless Surveillance is, how it functions, where it is being used and why it is a powerful tool for not only Rapid Deployment projects, but a suitable alternative to cable.

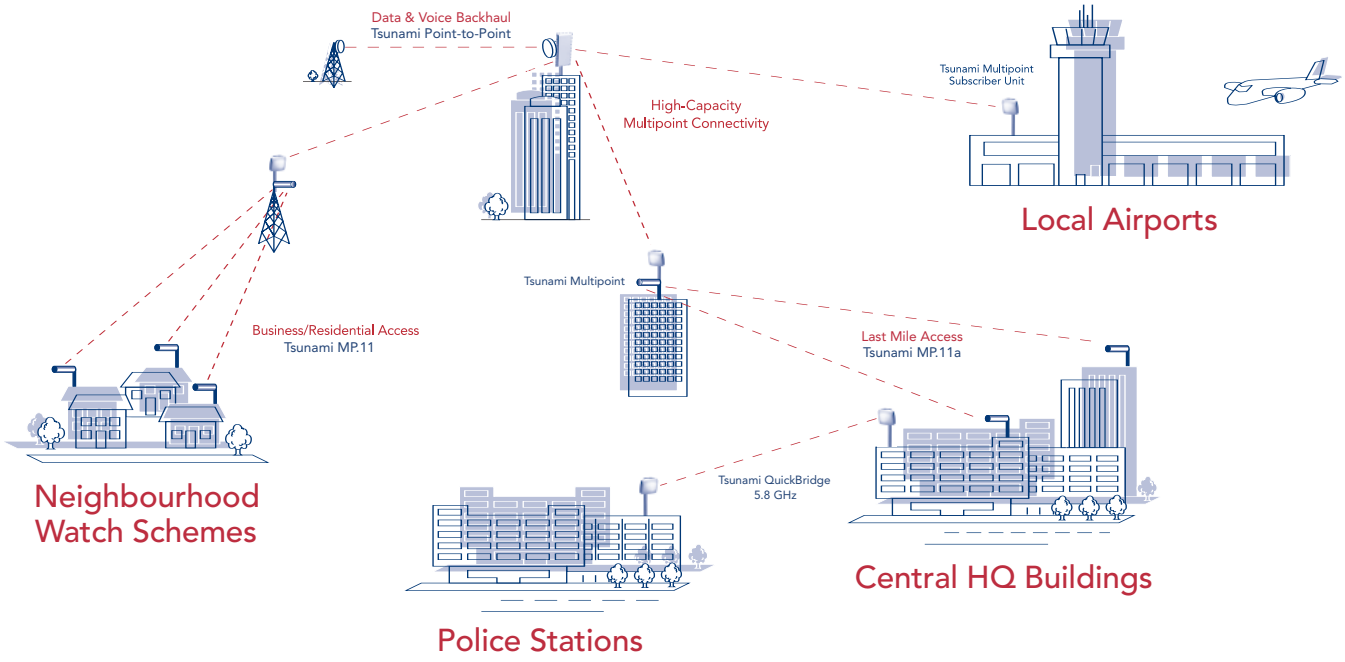
Finally, we will also introduce and debunk several myths, which have given end users pause in implementing such technology.

Wireless Surveillance is a surprisingly easy technology to understand. It is highly affordable, easily deployed and very secure. For any enterprise or organization that has been challenged by deploying a CCTV system outdoors, the costs associated with leased lines, trenching for new fibre and the timescales required to deploy are sometimes prohibitive. If this is you ,you, Wireless surveillance is your future.

What is Wireless Surveillance?

Wireless surveillance takes two proven technologies – Broadband Wireless transmission and networked video surveillance – and combines them to overcome many of the obstructions that end users face when attempting to deploy remote surveillance and monitoring systems today.

Whether you are deploying new digital IP cameras or analog cameras with telemetry features, capturing images and recording them locally or streaming data back to a central location, a broadband wireless network can help you extend your town centre or campus scheme to outlying locations rapidly.



Wireless Ethernet systems provide a simple elegant solution. Modern security and surveillance cameras and codecs can convert images into internet protocol (IP) packets that can be easily transmitted using wireless point-to-point and point –to-multipoint systems. Cameras at multiple locations are simply connected to wireless devices known as "subscriber units", which send the image data back to a wireless "base station" located on the users main network. If needed, high performance point-to-point solutions can be used to connect to a remote base station, giving extended reach kilometers from the main network itself.

For most, this may all seem a bit too good to be true. Below, we will examine these features and advantages more closely.

The Wireless Advantage

When it comes to providing security protection outdoors, organizations are often faced with major cost and installation nightmares. For a growing number of the most security-sensitive organizations, fixed wireless networks offer reliable, affordable surveillance networks that can secure the toughest outdoor environments. There are a number of reasons why more organizations are choosing wireless for their security networks:

- **Fast, easy to deploy.** Depending on the outdoor location, fiber is not always available. Wireless, on the other hand, can be deployed virtually anywhere, including bodies of water, rugged terrain, and remote locations. Wireless networks install in hours, eliminating long waiting periods and right-of-way issues associated with trenching for fiber.

- **Affordable.** Fiber costs significantly more to deploy than a wireless system. Just a few miles of trenching can cost hundreds of thousands of pounds

- **Flexible.** Wireless solutions provide unparalleled flexibility. Because the security network is wireless, cameras are not permanently fixed in one location. If necessary, cameras and subscriber units can be moved to a new location with minimal hassle and can usually be reconnected within minutes.

- **High capacity.** Wireless networks are available in a wide range of bandwidth capacities from 6 to 200 Mbps.

- **Reliable.** High-end wireless systems ensure up to 99.999% carrier class reliability, enabling virtually non-stop security.

- **Tiered wireless solutions.** A wide range of solutions means almost any organization can consider implementing a security network for a variety of applications. Carrier-class solutions are available for tough all weather, large scale deployments, while more economical solutions are idea. for smaller, more budget-conscious deployments.

- **Outdoor design.** Outdoor wireless networks are sometimes confused with wireless LAN technology that is not appropriate for outdoor use. Based on a special protocol (Proxim calls it WORP) that enables system scalability and the management required for outdoor deployments, outdoor wireless networks (or "wireless WANs") are versatile and powerful when used in security and surveillance applications. It is important that end users distinguish between indoor technology and those technologies designed for outdoor system demands.

    - **Low Latency.** An important feature of Broadband Wireless is its extremely low latency, typically 2 – 5ms per link. Telemetry requirements of PTZ type cameras are unaffected .unaffected.

    - **Mobility.** Due to the "broadcast" nature of various wireless products, mobile systems can be deployed easily. Providing large amounts of bandwidth to vehicles for monitoring or data collection purposes.

Analog Or Digital, How Can Wireless Help ?

IP-Surveillance, with network camera technology at its core, can have advantages over analog CCTV systems. The fast-paced growth in the network video market has been fueled by the highly impressive and comprehensive benefits using an IP based network and standards based IP Cameras and recording equipment. When deciding on a new CCTV installation the decision made has generally always been one of functionality and performance, allied to cost and ease of operation. However, using the data collected effectively must always come into consideration. Producing the original copy of a surveillance recording can be more difficult when stored on a hard disk drive on a computer than it can on a tape.

A comparison table of the key feature differences between Analog and Digital technologies is detailed below, combined with details of how utilizing Broadband or Wi-Fi Wireless can aid deployment, management or utilization of the system:

Comparing Analog and Digital Systems

	Network camera-based system	How Can Wireless Help?	An analog camera-based system
Access	As open or closed access as needed. Remote access to live images and remote administration of a network camera are possible from anywhere using a standard Web browser on any PC.	Offers both highly secure transmission for outdoor use with the flexibility of Network based administration.	Closed circuit. No possibility for remote access. Highly Secure.
Ease of Use	- You can administer and view the images remotely using a standard Web browser on any PC. - Images can be recorded on a hard disk, enabling easy search possibilities, easy storage and no image degradation or wear. - The hard disk can be located at a remote location for security purposes. - For admissible evidence purposes, the hard disk must be removed from the Storage PC.	Wireless connections can be deployed in hours, not weeks or months as with cable. Cameras can be moved quickly if necessary. Integration with Analog or Digital systems is seamless.	- Remote administration or monitoring is not possible. - Images must be stored on video tape cassettes, which require constant changing and lots of storage space. The quality of recorded images deteriorate over time. - The video cassette recorder must be located near the camera. This could potentially enable unauthorized persons to have access to the video tape. - Original copies are easy to produce in court
Quality	Digital images do not lose quality in transmission or storage. A digital picture is created using Motion-JPEG or MPEG. Once created, the image is free from degradation. Each frame within a video stream is sharp.	Sufficient bandwidth and low latencies ensure high quality images of any kind.	Image quality is lost when using long cables and the resolution of a magnetic tape is normally quite low .Quality of the recorded video deteriorates over time.
System requirements	Everything needed to stream live video over networks is included in the network camera. Simply connect the network camera to a network. View, record and administer from any networked PC (located anywhere).	Ethernet connectivity at both ends of the connection.	Connection to a coaxial cable, to a codec or multiplexer, to a video or time lapse recorder, and to a locally placed CRT monitor. Integration with IP Codecs is also possible.

Installation	Connect a network camera to the nearest network connection and assign an IP address.	Connect a Wireless device both ends of the connection, register them with each other, walk away.	Attach a coax cable to each camera and connect to the multiplexer.
Cabling	 One standard UTP (unshielded twisted pair) network cable can forward images from hundreds of network cameras simultaneously. Outdoor remote cameras require one cable per camera. Power can also be supplied over Ethernet.	Wireless systems offer point to point (for single links) or point to Multipoint (for large camera deployments) solutions. Aggregation of signals and backhaul can also utilize Wireless.	 One cable can transport video signals from only one camera at a time. If you have two cameras, you have to have two cables. This often means large cable trunks filled with thick and sensitive cables that are connected to a locally placed control room.
Scalability	Adding more network cameras to the system requires an IP address and an Ethernet connection.	Adding more Network or Analog cameras requires another subscriber unit.	Each analog camera requires its own cable. Image quality is lost when using long cables.
Cost	A high quality network cable typically costs 30 to 40 percent less than a standard coaxial cable. An IP-based network infrastructure is often already in place, which means the cost is reduced to only that of the network camera(s).	No digging, no planning permission or right of way issues. Fraction of the cost of cable.	Expensive coaxial cables. A classic RG59 75 Ohms coaxial cable typically costs 30 to 40 percent more than a high quality network cable. In addition, more cable is required. Each analog camera requires its own cabling.

It would seem therefore that the adoption of one particular technology over another can be very application specific. Whereas digital IP surveillance cameras and network video recorders offer incredible flexibility and scalability, analog systems are generally the incumbent technology within the law enforcement community, legal obligations sometimes applying to the way an event is recorded and presented.

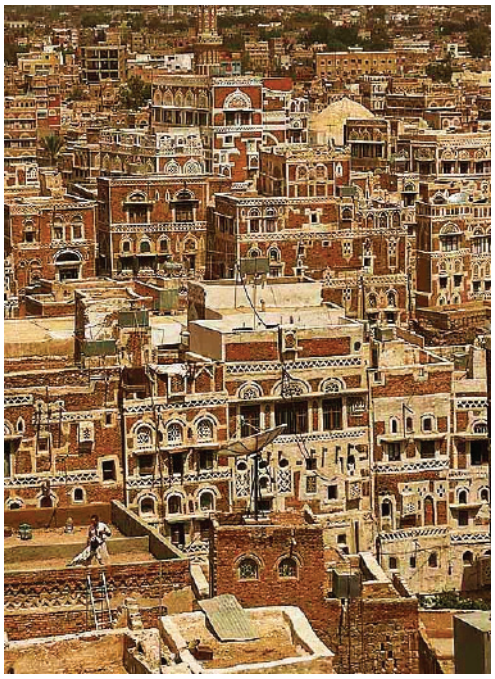
In summary, utilizing a network based surveillance system can save you money and increase the flexibility of camera deployment. However, utilizing your IP network that potentially also runs voice and data requires good quality of service management (QoS) to ensure high availability and reliability. Analog systems are well known and easy to operate. Although they require "intensive care" with their installation and maintenance, and that high leased line costs for remote cameras may also be an operating expense that reduces deployment numbers, they offer the "non-network" operator a solution.

Wireless Surveillance in Action

CCTV and Rapid Deployment Examples:

Securing a City – Sana'a, Yemen

The capitol city of Yemen needed to deploy a citywide surveillance system providing system providing their security forces visibility at security checkpoints and at strategic traffic intersections.



In planning the deployment, the decision was made to use an entirely wireless IP system from the local telecomm provider with possibly provide sufficient bandwidth at all the necessary locations to run a security net.

Steve Sherman of the New Internationalist recently wrote that, "Yemen boasts one of the Majority World's most sophisticated… electronic surveillance networks at its ports and key installations." (March 2004 Google search)

The local government plans to expand their project to a dedicated, redundant control center and grow to 250 cameras at distances over 40km away.

California Transportation

Port of Oakland was in the design process a few months after CalTrans and they watched and learned. Their original $10m plan ended up being a $4.7m investment in the system by deploying Broadband Wireless instead of fiber.

Port of Oakland

Common Misconceptions Related to Wireless and IP-Surveillance

We've seen that Wireless IP-Surveillance technology offers an impressive array of end user benefits in addition to a very attractive total cost of ownership (TCO). However, as with any relatively new technology, there may be a number of misconceptions regarding technology performance that may give potential users pause in implementing Wireless or IP-Surveillance. Below are important clarifications addressed to several common misperceptions regarding -his technology

Security

IP-Surveillance:

Although primarily used as a domain for public information, the internet can also be used to transfer all types of sensitive information—provided the correct security measures, such as firewalls and password protection are implemented.

With an increasing number of banks arid financial institutions regularly using the Internet as a medium for global money transactions, it has emerged as a proven medium for others secure applications like surveillance and security monitoring. In combination with. an organization's firewall, IP-Surveillance technology allows product security to be tightly maintained using available internal password-protected security settings.

Wireless:

Security can be an area of concern for those considering the use of fixed wireless devices to transmit data. Because fixed wireless bridges transmit signals into the "air," there is a perception that anyone could possibly "steal" the user's data. Top of the line wireless providers will incorporate a variety of counter-measures to ensure rigorous security of data. These include:

Password protection—protection at two levels, one for the monitor and one to provide monitor/modify privileges.

Transmission protection/ encryption—unique transmission signals that require the same maker's equipment at both ends for decoding.

In addition, "line of site" transmission, as opposed to omni-directional transmission ensures that only antennas firmly in the radio frequency target area can receive the data.

Data coding—potential intruders would have to obtain a unique transmission code set by the administrator to decode the data. Most potential data thieves don't have the several million years needed to run through all the codes so as to get to the data. Should someone try to capture the data, but not provide the proper codes at regular intervals, transmission is immediately terminated.

If further proof of the secure nature of wireless transmission is required, look to the many highlevel military installations that use it—they cannot afford to use a risky technology.

Bandwidth

Wireless:

Bandwidth is a natural concern when it comes to wireless transmission. Proxim's outdoor wireless networking solutions offer capacities ranging from 11 Mbps to 860 Mbps, by using different radio technologies. Basically, there are two major radio technologies employed for transmission—Frequency Division Duplex (FDD) and Time Division Duplex (TDD). TDD is typically used in multipoint environments, while FDD technology is used for high-speed point-to-point connectivity. By employing the right technology, end users can ensure sufficient bandwidth over required distances to support the number of cameras needed in any given deployment.

Reliability

Wireless:

The overall performance or reliability of a communications system is predicted and verified in terms of its "availability." Transmission availability is defined as the total amount of time, within a one-year period, the system transports (in both directions) voice, data or video information, with normal path interference. The most available systems are designed for 99.999% uptime. This translates into just over five minutes of anticipated downtime during a one year period. Kocchi's offers a wide range of reliable solutions to meet an equally wide range of budgets. Kocchi's wireless IP camera solution offer 99.999% carrier-class transmission availability, With this high level of availability, Kocchi's system ensures transmission of real-time images without the dropped packets

Image Formats Used For Surveillance:

Digital images and video are often compressed in order to save storage space and make transmission of images faster. Out of the many different types of camera and video products currently available on the market, all will employ one or more compression techniques.

At its most basic level, compression is performed when an input video stream is analyzed and information that is indiscernible to the viewer is discarded. Each event is then assigned a code - commonly occurring events are assigned few bits and rare events will have codes more bits. These steps are commonly called signal analysis, quantization and variable length encoding respectively. There are four methods for compression, discrete cosine transform (DCT), vector quantization (VQ), fractal compression, and discrete wavelet transform (DWT).
Discrete cosine transform is a lossy compression algorithm that samples an image at regular intervals, analyzes the frequency components present in the sample, and discards those frequencies which do not affect the image as the human eye perceives it. DCT is the basis of standards such as JPEG, MPEG, H.261, and H.263.

Vector quantization is a lossy compression that looks at an array of data, instead of individual values. It can then generalize what it sees, compressing redundant data, while at the same time retaining the desired object or data stream's original intent.

Fractal compression is a form of VQ and is also a lossy compression. Compression is performed by locating self-similar sections of an image, then using a fractal algorithm to generate the sections.

Like DCT, discrete wavelet transform mathematically transforms an image into frequency components. The process is performed on the entire image, which differs from the other methods (DCT), which work on smaller pieces of the desired data. The result is a hierarchical representation of an image, where each layer represents a frequency band.

Compression Standards

MPEG stands for the Moving Picture Experts Group. MPEG is an ISO/IEC working group, established in 1988 to develop standards for digital audio and video formats. There are five MPEG standards being used or in development. Each compression standard was designed with a specific application and bit rate in mind, although MPEG compression scales well with increased bit rates. They include:

MPEG-1

Designed for up to 1.5 Mbit/sec

Standard for the compression of moving pictures and audio. This was based on CD-ROM video applications, and is a popular standard for video on the Internet, transmitted as .mpg files. In addition, level layer 3 of MPEG-1 is the most popular standard for digital compression of audio – known as MP3. MPEG-1 is the standard of compression for VideoCD.

MPEG-2

Designed for between 1.5 and 15 Mbit/sec

Standard on which Digital Television set top boxes and DVD compression is based. It is based on MPEG-1, but designed for the compression and transmission of digital broadcast television. The most significant enhancement from MPEG-1 is its ability to efficiently compress interlaced video. MPEG-2 scales well to HDTV resolution and bit rates, obviating the need for an MPEG-3.

MPEG-4

Standard for multimedia and Web compression. MPEG-4 is based on object-based compression, similar in nature to the Virtual Reality Modeling Language. Individual objects within a scene are tracked separately and compressed together to create an MPEG4 file. This results in very efficient compression that is very scalable,scalable; from low bit rates to very high.

JPEG

JPEG stands for Joint Photographic Experts Group. It is also an ISO/IEC working group, but works to build standards for continuous tone image coding. JPEG is a lossy compression technique used for full-color or gray-scale images, by exploiting the fact that the human eye will not notice small color changes.

JPEG 2000

JPEG 2000 is an initiative that will provide an image coding system using compression techniques based on the use of wavelet technology.

DV

DV is a high-resolution digital video format used with video cameras and camcorders. The standard uses DCT to compress the pixel data and is a form of lossy compression. The resulting video stream is transferred from the recording device via FireWire (IEEE 1394), a high-speed serial bus capable of transferring data up to 50 MB/sec.

H.261

H.261 is an ITU standard designed for two-way communication over ISDN lines (video conferencing) and supports data rates which are multiples of 64Kbit/s. The algorithm is based on DCT and can be implemented in hardware or software and uses intraframe and interframe compression. H.261 supports CIF and QCIF resolutions.

H.263

H.263 is based on H.261 with enhancements that improve video quality over modems. It supports CIF, QCIF, SQCIF, 4CIF and 16CIF resolutions.

Terms

Lossy compression – reduces a file by permanently eliminating certain redundant information,so that even when the file is uncompressed, only a part of the original information is still there.

ISO/IEC – *International Organization for Standardization* is a non-governmental organization that works to promote the development of standardization to facilitate the international exchange of goods and services and spur worldwide intellectual, scientific, technological and economic activity.

International Electrotechnical Commission is an international standards and assessment body for the fields of electrotechnology

Codec – A video codec is software that can compress a video source (encoding) as well as play compressed video (decompress).

CIF – Common Intermediate Format - a set of standard video formats used in videoconferencing, defined by their resolution. The original CIF is also known as Full CIF (FCIF).

QCIF – Quarter CIF (resolution 176x144)

SQCIF – Sub quarter CIF (resolution 128x96)

4CIF – 4 x CIF (resolution 704x576)

16CIF – 16 x CIF (resolution 1408x1152)

Now that we've completed an overview of the many compression technologies that are being used, what does this mean for implementing a Wireless surveillance system? What factors must the user and integrator consider?

- How high a frame rate is needed?
- What Image quality is needed?
- What Image resolution is needed?
- What is the available bandwidth for transmission?

The following table provides a comparison of some of the most common compression methods:

	MJPEG	MPEG-1	MPEG-2	MPEG-4	H.263
Target bit rate	N/A*	About 1.5 Mbit/sec	2 – 15 Mbit/sec	Constant or Variable (Selectable dependent on Bandwidth available)	64, 128, 192 kbit/sec up to approx 2 Mbit/sec
Supported frame rates (fps=frames per second)	Camera / Video Server dependent	25/30 fps	25/30 fps	Typically 6,12,16,25,30 fps (Variable)	Any, up to 30 fps
Resolution	Any	320 x 288 320 x 240	320 x 288 320 x 240 720 x 576	320 x 288 320 x 240 720 x 576	352 x 288
Image quality	Low to Very good	Good	Very good	Low to Very good	Low
Target application	Still images	Digital video on CD (VCD)	DVD, HDTV	DVD, Digital TV WWW delivery	Tele-conference
Basic algorithm	Digital Cosine Transform (DCT)	DCT with motion vectors	DCT with motion vectors	-	DCT with motion vectors
Standard	ISO/IEC 10918	ISO/IEC 11172	ISO/IEC 13818	ISO/IEC 13818	ITU-T H.263

The table demonstrates that the H261 / H263 method requires less bandwidth capacity, but this is achieved at the expense of lower image quality. The MPEG standards, on the other hand are focused on video at different resolutions and at good or very good image quality.

Kocchi's Technologies, Inc.

Kocchi's is a leading manufacturer of high-performance wireless local IP camera system and wireless wide area networking (WWAN) products. The company is a leader in the fast growing markets for 802.11b, 802.11a, 802.11g license- exempt fixed wireless networking systems. Kocchi's systems securely connect networks within buildings as well as between locations up to 20 miles apart, providing enterprises, service providers, mobile operators and venue owners, with unprecedented networking capacity and mobility. Kocchi’s high performance wireless networking camera products are currently in use by military bases, transportation systems and office buildings for both military-grade and enterprise-class security and surveillance applications.

Conclusion

CCTV and surveillance are indeed the security solutions for the future. But, as powerful as this technology is, there are markets and applications where distance and an absence of network infrastructure can hamper implementation.

For this reason, combining Kocchi's leading wireless technology with the solution has resulted in a combination no fixed line providers can match in terms of performance, cost, and availability.

In this white paper, we've shown that Wireless IP Surveillance is a relatively easy technology to understand. It represents an enormous market opportunity because of its cost and performance advantages. Wireless IP Surveillance is a fast, easy, and reliable security application that can be deployed in any organization within hours and fits a wide array of budgets and organizational needs.

Wireless IP surveillance, it's what's next in monitoring and surveillance.

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