Wireless Video Surveillance

Introduction
As an integral component of numerous organizations' safety and security priorities, video surveillance has demonstrated its value and benefits numerous times by providing real-time monitoring of assets, property, environment and people.

As security risks increase, the need to visually monitor and record events in the most remote areas becomes even greater. Moreover, the value of video surveillance has grown significantly with the advancement of high resolution megapixel video recording and video analytics. High quality megapixel H.264 video recording, combined with video analytics & intelligent sensors, bring forth the newest generation of powerful digital security systems for the 21st century. Integrated megapixel H.264 video, analytics, and sensors help authorities make better decisions and drastically improve response times.

As security equipment moves away from closed standard resolution analog systems to open digital high resolution systems using IP, the network that connects all aspects of the system becomes critical. A network-based security system is only as good as the network that connects it, to share and relay time-sensitive security information between each functional component.

As the video & IP standard develops, security professionals face many choices in cost-effective reliable transmission medium & video performance for their video security system. Fiber optics, Ethernet cabling and wireless methods are among the most widely used as transmission medium and megapixel or high-definition as the video resolution. High resolution security video wireless networks was overlooked in the past because of a reputation for poor performance and reliability, have become accepted as an option. In many remote security applications, it is the only option.

The Economic Case
IP video, also known as networked video, over a wireless medium is not a new concept. With the industry boom in unlicensed WiFi and fixed wireless broadband, economies of scale in these 802.11-based hardware has led to less expensive, more rugged outdoor and long-range radios. Saving money and lowering project cost is perhaps the largest benefit of deploying a license-free wireless video network. Lower cost barriers allow security professionals to place cameras in areas that are difficult or impossible to hardwire. Faster deployment is another benefit. Security professionals can tackle large outdoor video surveillance projects in shorter project lifecycles, creating a faster return on investment and a more satisfied customer.

Wireless IP networks provide more flexibility and scale compared to other video surveillance network transport media. They make temporary surveillance applications

possible because they easily can be uninstalled from one location and reinstalled at a new site. From construction sites to public safety at seasonal city events, wireless video surveillance networks have demonstrated value by lowering crime.

The flexibility of wireless networks for security applications opens more remote security and many other applications once too costly to even consider.

MIMO & H.264 Technology

802.11n technology's breakthrough speed is possible due in part to the contribution MIMO (multiple-in, multiple-out) technology. MIMO antenna systems are used in the most current 802.11n wireless standards and other popular standards, including 3GPP LTE, and mobile WiMAX systems. The technique supports enhanced data throughput even under conditions of interference, signal fading, and multipath. The demand for higher data rates over longer distances has been one of the primary motivations behind the development of MIMO communications systems.

MIMO communications channels provide an interesting solution to the multipath challenge by requiring multiple signal paths. In effect, MIMO systems use a combination of multiple antennas and multiple signal paths to gain knowledge of the communications channel. By using the spatial dimension of a communications link, MIMO systems can achieve significantly higher data rates than traditional single-input, single-output (SISO) channels like 802.11a/b/g. A receiver can recover independent streams from each of the transmitter's antennas. A 2 x 2 MIMO system produces two spatial streams to effectively double the maximum data rate of what might be achieved in a traditional 1 x 1 SISO communications channel. MIMO enables the video capacity in 802.11n transmission to accommodate high resolution security video cameras.

Megapixel also known as high definition or high resolution video security over network or IP was not popular among security professionals due to inefficiency with old video technology like MPEG-2. High resolution streaming requirements using old video technology can easily exceed hardwire network capacity requirements for a single camera. With the advances in video compression standard, 2.0 megapixel Inscape Data security video IP camera can stream 1920 x 1280 live video streams over a network at 3 mbps with high quality results.

Without compromising image quality, an Inscape Data H.264 encoder can reduce the size of a digital video stream by more than 80% compared with the Motion JPEG format and 50% more than MPEG-4 Part 2 standard. This means that much less network bandwidth and storage space are required for a video stream of equal or greater picture quality. It also means much higher video quality can be achieved for a given bit rate than Motion JPEG or MPEG-4. In the video surveillance industry, H.264 is the video compression of choice for applications where demands for high frame rates and resolution, such as in traffic surveillance, homeland security, public transits, manufacturing, airports, casinos, and more. This is where the economies of reduced bandwidth and storage needs will

deliver the biggest savings. Megapixel cameras are also benefiting from the adoption of the H.264 compression technology. There are tradeoffs, however. While H.264 provides savings in network bandwidth and storage costs, it will require higher performance network cameras and monitoring stations due to the increase in CPU processing demands. But thanks to the low cost high performance PC & server market, it is now very cost effective to implement video security systems using the latest H.264 video technology.

Wireless Reliability and Capacity

There remain a number of myths about wireless communication, fueled in part by experience with analog systems. The first myth is that wireless is unreliable and complicated. The truth is, digital wireless video links, when deployed correctly, can offer reliability equivalent to or exceeding wired installations. Wired installations are prone to cable or interface corrosion and disturbances and are costly to replace. Wireless video links have the added feature of link redundancy, base station failover and testing, and experience has demonstrated reliability of 99.9999 percent.

Radio transceivers operate in point-to-multipoint mode, allowing a single base station to communicate with multiple wireless transceivers. That makes adding new camera nodes to a wireless surveillance network as simple as adding a new wireless transceiver and video camera system.

Many current wireless deployments are based on WiFi technology, the common term for wireless services meeting the 802.11 standards. Up to now, the best available data speeds leveraging 802.11a, -b, or –g standards reach raw data rates of 54 mbps. It was adequate to transmit standard definition security videos but hardly meet the capacity requirement to transmit high definition megapixel security video streams. With the latest wireless video bridge from Inscape Data Corporation, high capacity wireless video networks are possible using the most advance 802.11n technology with capacity of 300 mbps of raw data rate. With the Inscape Data next generation 802.11n wireless video transmission link, a wireless video network can scale to accommodate large high resolution megapixel outdoor camera systems reliably. With advancement in 802.11n wireless technology, 600 mbps raw data rate is the next target for wireless performance and is a cost-effective alternative to hardware wiring. Table 1 compares open IP standard and its video camera capacity.

Transport Medium	Technology	Maximum Data Rate/Speed	Max No. of Megapixel IP Camera
Wireless	802.11	2 Mb/s	0
	802.11b	11 Mb/s	1
	802.11g	54 Mb/s	4
	802.11a 20MHz	54 Mb/s	4
	802.11a 40MHz	108 Mb/s	8
	802.11*n* 2x2	300 Mb/s	30
	802.11*n* 4x4	600 Mb/s	60
Hard Wire	Fast Ethernet	100 Mb/s	14
	Gigabit Ethernet	1000 Mb/s	140

Table 1 Network speeds based on Network Technology

Top-level Wireless Encryption

Another myth is that wireless is insecure. True, the wireless encryption protocol used on the first-generation digital wireless LAN networks was easily defeated. But that was more than 10 years ago. The latest software tools and wireless sniffers are able to derive the network key within just minutes of sampling a communication link.

The latest generation Inscape Data outdoor wireless video transceivers use chipset technology with strengthened security measures. Advance Encryption System (AES) is a standard feature on all digital transceivers from Inscape Data. AES is a standard recognized by the government for transmittal of classified information.

AES is the highest level of wireless encryption available to the public. The most significant advantage of AES is that every time data is sent it is encrypted with a unique key. Breaking AES encryption is almost impossible, but according to industry experts, the time required to break WEP is less than 10 minutes. Table 2 compares three of the most common wireless encryption method based on worldwide installed user base.

Wireless Security	Analog Scrambling	WEP	TKIP	AES
Key Length	Weak	40 or 128 Bit	128 Bit	256 Bit
Time needed to break encryption	Several Minutes	10 minutes	4×10^{20} years	More than 4×10^{20} years

Table 2. Encryption Comparison

Wireless encryption based on AES is secure not only for video applications but also for corporate and government use. AES accommodates 128-bit, 192-bit or 256-bit keys.

Wireless Challenges
To obtain the most benefit out of wireless video deployment, end users must understand the challenges that come with a successful deployment. Equipped with wireless fundamentals, overcoming wireless obstacles and maximizing available bandwidth are keys to a successful deployment. Wireless signals are invisible. Making them visible enough to manipulate requires learning and practice.

Wireless signals spread out and get weaker as they leave the antenna. They lose significant strength when they encounter with an obstacle or reflect off the ground, bodies of water or a building. A wireless signal operates optimally line of sight on the same channel between two base stations. This configuration, however, lowers overall wireless network capacity, which means it accommodates fewer cameras.

One of the common mistakes of outdoor wireless video network deployment is the default use of omni-directional antennas. Omni-directional antennae radiate wireless signals in all directions and are ideal for maximizing a coverage area. However, since antennas also function as a receiver, they will pick up noise and potential interference from all directions as well. Care should be taken when selecting the type of antenna. Many systems are designed with a mix of directional and omni-directional antennas; each affects the signal. Radio engineers work with “link budgets,” which measure both the capacity and strength of a radio link and the amount of degradation it can sustain before complete loss of signal.

Remote wireless video surveillance for distances beyond a few miles is also possible with unlicensed wireless. Long-range remote wireless video surveillance makes it possible to centralize video surveillance from several remote areas. In parts of the world, base stations can use solar power. This allows deployment of video surveillance cameras almost anywhere.

Armed with wireless fundamental knowledge and deployment confidence, numerous application possibilities are brought fourth by long-range digital wireless transceivers. The commercial parking lot video surveillance project once thought too costly may be revisited. Border and port protection projects become more manageable.

Going Forward
Not every wireless transceiver can do a good job at delivering video. Low power radios like the ones used for indoor networks are limited to 80mWatts compared to Inscape Data outdoor wireless video transmitters at up to 600mW and even 1000mWatts for some models. Higher power radio enables stronger wireless video links, which results in more consistent and faster data speeds. Wireless video transmitter with lower power provides inferior links and more prone to outdoor interference and link drop issues. Inscape Data

high power wireless IP video system provides high quality rugged solution for demanding video security application.

High resolution wireless video surveillance will continue to evolve. Remote surveillance applications will become more integral to an organization's video surveillance roadmap. As digital IP-based security technology advances, the use of reliable high speed high resolution wireless IP video products will continue to increase, shifting from a functional role of few standard resolution systems to full multi-megapixel remote video surveillance for campus and city wide projects. For more information on this article or high resolution wireless IP video surveillance systems from Inscape Data, please contact sales@inscapedata.com.