

## **Improving Video Surveillance with Megapixel Cameras**

The advantages of using megapixel cameras with advanced IP video surveillance management software.

## **Milestone White Paper**

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## Introduction

Poor image quality and coverage has long been a problem and often an embarrassment for video surveillance, keeping it from living up to its promise. How many times, for instance, have you seen on television or in newspapers grainy, blurry video surveillance images of criminals that are worthless for identification?

Fortunately, this situation is changing fast. The combination of megapixel IP network cameras and full-featured IP video surveillance management software is enabling much greater image quality, camera control and coverage — all keys to more effective video surveillance, evidence collection, and prosecution. What's more, this same combination is allowing businesses, governmental organizations, and educational institutions to cover more area with fewer cameras, achieve greater automation in their surveillance activities, and realize significant cost savings.

This paper will discuss why many video surveillance systems don't perform the way they should and how megapixel IP network cameras controlled by robust IP video surveillance management software provide a much better solution. We'll also explain how a system using megapixel cameras can actually save money over a system based on lower resolution cameras.

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## Many video surveillance systems don't perform the way they should

For years, fuzzy, low resolution images of people, license plates or other potentially incriminating evidence from video surveillance cameras have prevented successful investigations and convictions. A 2007 study of Britain's much heralded video surveillance system, for instance found that 80 percent of its CCTV (closed circuit TV) footage is of poor quality and that most cameras are being simply used to observe people and traffic, not crime-fighting — even the cameras purposely placed in crime hotspots. The report concluded that the



Bank robbery in Phoenix, Arizona.

CCTV “may not be of sufficient quality for police to use in criminal investigations.” It went on to say that “without a better understanding of the degree of coverage, or a clearer and supported end-to-end process, future guidance around common standards in all the areas of concern ... will fall far short of what is required to ensure a meaningful strategic direction.”<sup>1</sup>

A similar Glasgow study found that “cameras appeared to have little effect on the clear-up rates of crimes and offenses generally.” Comparing statistics before and after installation of the cameras, the clear-up rate increased slightly from 62 to 64 percent. Once figures were adjusted for general trends, however, the research analysts concluded that the clear-up rate actually fell from 64 to 60 percent.<sup>2</sup> The

1999 date of this study indicates the cameras studied were low-resolution models.

For concrete examples, all one has to do is look at the news. For instance, on March 6, 2008 in New York, a video camera caught the bicyclist who rode up to a Times Square military recruitment center and planted a bomb. Unfortunately, according to the Associated Press (AP), the private security video was “too murky for police to get a clear description of the cyclist.” Another surveillance camera caught a July 2005 double killing in California park. The city of Pinole reported that the images of a woman accomplice with the captured suspect were so grainy they weren't useful. The police could not even generate a sketch. (A frustrated city council later ended up replacing all 47 cameras and upgrading the software.)<sup>3</sup> In 2006 a surveillance camera

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<sup>1</sup> Johnstone, Philip, “80 Per Cent of CCTV Images Ineffective,” Telegraph, October 20, 2007

<sup>2</sup> The Effect of Closed Circuit Television on Recorded Crime Rates and Public about Crime in Glasgow, Crime and Criminal Justice Research Findings No. 30, Scottish Office Central Research Unit, 1999 (hereinafter “Glasgow Study”).

<sup>3</sup> White, Lisa P., “Smile, You're on Camera,” Contra Costa Times, February 23, 2008

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caught a suspected terrorist in Cologne, Germany planning to set off explosives on a train. The resulting image was broadcast all over German television, but its blurriness made it impossible for anyone to clearly identify the terrorist. Fortunately, he was caught by other means.<sup>4</sup> In Cincinnati, police outright admitted their cameras were not effective. According to Captain Kumberly Frey, "We've never really gotten anything useful from them ... we've never had a successful prosecution."<sup>5</sup>



Casino robbery in Ledyard, Connecticut.

In truth, the fault for these failures lies not with video surveillance, but with the quality of the equipment and the way it is deployed. It's estimated that 90 percent of the surveillance cameras in use today are analog cameras. These low resolution, low-image quality cameras and their inability to provide good coverage over anything but the narrowest of scenes, are a major reason video surveillance images have a bad reputation for image quality. But they're gradually being replaced. And this trend is quickening its pace. The market research firm iSuppli Corporation declares that it's not a question of if, but when, higher resolution

IP network cameras will displace analog surveillance cameras. The firm estimates U.S. revenue for IP network cameras will grow close to \$6 billion by 2011, with analog revenues dropping steeply downward toward obsolescence. The good news is that today's megapixel cameras and IP video surveillance management software working together provide much higher quality images and better coverage with fewer cameras. Best of all, the combination of these cameras and software can save you money.

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<sup>4</sup> McKee, Peter, "Why the French Spot Terrorists Better than Americans," Law Enforcement Technology, January 2008.

<sup>5</sup> Ramirez, Christina and Hoffman, Lisa, "Video Becomes a Crime Fighting Tool," Capitol Hill Blue, June 23, 2006.

## How IP network cameras deliver superior images

Analog cameras have a great disadvantage in resolution compared to digital megapixel cameras. Analog resolution is limited by NTSC standards (used in North America) at 704 x 480 pixels and PAL standards (used in Europe and many other parts of the world) at 704 x 576 pixels. If you multiply these numbers you get the total pixels. ("Pixel" is short for "picture element" and generally thought of as the smallest single component of an image. Pixels are useful as a way of comparing camera resolution.)

NTSC and PAL standards limit analog resolution to a maximum of approximately 400,000 pixels or 0.4 megapixels. This is enough for general surveillance in the areas these cameras are generally asked to cover, but often not enough for forensic evidence. If they are tasked with covering an area wider than 16' wide, the resolution isn't sharp enough to identify faces and read license plates. What's more, due to technical and cost restraints inherent in the analog camera itself and in transmission through coax cable or video encoding/decoding from analog to digital and back to analog, you generally see much lower resolution from analog cameras by the time the video reaches the viewing monitor or printer. Remember, too, we're talking about the best analog cameras. Many analog cameras in use for surveillance today fall well below the maximum resolutions allowed by NTSC or PAL standards.

IP network cameras, on the other hand, have a distinct advantage because they record and transmit digital images with no analog conversion necessary inside the camera or any need for a video encoder. Consequently, they do not suffer any loss of quality resulting from these conversions. Thus, with IP network cameras you get every pixel you pay for. Instead of blocky, blurry images, you can get crisp, clear images of faces, license plate numbers, and whatever else appears before the camera.

## Megapixel cameras

The highest resolution IP network cameras are megapixel cameras. A megapixel is 1 million pixels, and is a term used not only for the number of pixels in an image, but also to express the number of image sensor elements of digital cameras or the number of display elements in a digital display. For example, a camera with an array of 2048 × 1536 sensor elements is commonly said to have "3.1 megapixels" ( $2048 \times 1536 = 3,145,728$ ). Megapixel cameras are cameras that



Example of a megapixel camera image. Source: IQinVision.

deliver one or more megapixels of resolution (video surveillance models rated up to 5.2 megapixels and more are available).

Most people are well familiar with the term megapixel from consumer digital cameras. Generally, the higher the number of megapixels, the higher the quality of the image and the more you can enlarge images for printing or zoom in on parts of the image for cropping without them becoming so pixelized they lose their image quality and usefulness.

The ultra-high resolution images you get with megapixel IP network cameras solve many of the

frustrations organizations have with current lower-resolution video surveillance cameras. Megapixel IP network cameras enable you to cover larger areas with a single camera, realize better picture quality, and digitally zoom in much farther for greater detail. In fact, some megapixel cameras can cover over 60 feet of area while providing good forensic detail (such as the ability to identify faces and read license plates).

Coverage is also an important advantage. By covering a larger area, megapixel IP network cameras significantly improve the viewing experience. Instead of having to monitor the images from several cameras to cover an area, you can monitor the image from a single camera.

Megapixel cameras really shine in situations where you want to be able to identify people, objects, license plate numbers, and more. They provide the image quality that's been missing in video surveillance for forensics and applications like retail point-of-sale monitoring, building entries, metropolitan surveillance, parking lots, airports, schools and casinos.

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One advantage of some megapixel digital PTZ (pan/tilt/zoom) cameras (such as those from IQinVision) is that, while viewing an image live, their digital zoom enables you to record a full-screen image while you use a smaller digital zoom video window to move around in the large image and zoom in on various sections. This is much different from analog PTZ cameras which can only record what you zoom in or out on. With an analog PTZ camera, you zoom in on a suspect in a parking lot and you could lose seeing what another suspect in a different area of the parking lot is doing. This is not true with many megapixel PTZ cameras. While you digitally zoom into a selected area, you continue to film the entire scene. You don't miss a thing.

Another advantage of digital zoom is that it saves bandwidth. When you're accessing an image over a network (WAN) or the Internet, it doesn't need to be in megapixel resolution until you see something that interests you. When you zoom in, the megapixel resolution kicks in, providing more detail as you zoom farther and farther in.

## **IP video surveillance management software makes it a system**

IP network cameras (megapixel and otherwise) are essentially a camera and a computer combined in one unit. They have their own CPU and IP address. They capture and transmit live images directly over an IP network, enabling authorized users to locally or remotely view, store, and manage video over standard IP-based network infrastructure and the Internet. But just like any computing hardware, it's the software that makes it useful. And in the case of IP network cameras, it's the IP video surveillance management software you choose that really makes them a video surveillance system. In fact, not only does this software enable you to monitor and control your cameras, depending on the software you choose, it adds many capabilities.

Here's an example. Using IP video surveillance management software, intelligent IP network cameras can be programmed through video analytics (software technology used to analyze video for specific data such as the suspicious movement of people or assets) to recognize events such as a person entering the scene or a package being left unattended and trigger alerts that can be sent over the Internet to a desktop computer, laptop, PDA or even cell phone. This opens all kinds of opportunities for cost efficiencies. For instance, instead of using local security staff to view monitors, monitoring can be centralized nearly anywhere in the world. What's more, in many cases, video analytics can be used instead of people to watch over sites. Cameras can even be programmed to only keep video before and after an event to reduce the amount of captured footage and network traffic.

The alerting capabilities of IP video management software are particularly powerful. They can enable you to become more proactive in your response to situations. Imagine a camera filming someone suspiciously moving around parked cars. While it records, it sends an alert that goes to the nearest security officer. This officer, viewing the live footage on their laptop can decide how to respond. If the software offers digital zoom capabilities, then even if the camera is not a PTZ IP network camera, the officer could still zoom in on the person to observe more closely what they're doing and perhaps see whether he or she is armed.

The many capabilities that IP video surveillance management software alone can add to your video surveillance operations could fill a white paper. Or three or four. (To see more of our white papers, go to [www.milestonesys.com/support/documentation/white\\_papers](http://www.milestonesys.com/support/documentation/white_papers).)

## The dynamic duo: IP video surveillance management software and megapixel cameras

Coupling powerful IP video surveillance management software, like Milestone XProtect Enterprise, with powerful megapixel IP network cameras (like the IQeye from IQinVision) makes a whole that's much greater than its parts. Such sophisticated software offers many advantages when used with these and other cameras. One of its greatest capabilities is the ability to handle an unlimited number of cameras, even megapixel cameras, across multiple sites. This ensures a video surveillance system that can grow with your organization.

Another important advantage of robust video surveillance management software is that it makes better use of server resources (microprocessors and memory) to handle incoming video data more efficiently. The most advanced IP video surveillance management software enables simultaneous digital multi-channel video and audio recording, and live views of up to 64 cameras per server.

Equally important to look for, is how efficiently a software product uses client hardware resources (microprocessor, memory and graphic cards) on the system your staff will use for viewing. This will determine how many megapixel images you can view on a client at a time. The best software makes maximum advantage of client capabilities on a variety of platforms.

The best IP video management software will also make your security staff more efficient by providing a more productive user environment. Features like multi-stream views, for instance, allow multiple people to access the same camera's live views and even independently zoom into different parts of the image. This can be important when both local and remote staff are monitoring a situation. Advanced IP video surveillance management software even allows one view to have multiple windows open with different zooms from the same camera.

Another feature you'll find in such full-featured software is *digital zoom* for even fixed cameras. With this feature, you can zoom in on live images provided by cameras that have no zoom feature. Naturally, the higher the resolution of the camera, the higher the quality of the image obtained by the zoom. On a megapixel camera, the results can be stunning. Another feature to look for is ability of the software to keep and record the big picture view while you zoom in on one aspect of the image. With advanced IP video surveillance management software, you can even make printouts or AVI movies of each independent image — the zoom view and the full view.

Another thing to look for in software is whether it's designed to deliver the best use experience on a wide range of devices. The best solutions use video quality optimization to automatically maximize live and playback windows for the device on which they're being viewed. To save storage space, some IP video surveillance software products enable you to receive at a higher frame rate while recording at a lower frame rate.

## Deciding where to use megapixel cameras

Obviously, not every camera in your video surveillance system needs to be a megapixel camera. In fact, one advantage of the best IP video surveillance management solutions is that they enable you to build a hybrid system that incorporates everything from your existing analog cameras to many models and types of IP network cameras. This enables you to get the most out of your current investment while you take advantage of today's technology and even more capabilities coming in the future. The interesting thing is that as megapixel camera prices fall and their capabilities grow, they're making more and more sense for a wide range of surveillance needs.

To better understand where megapixel cameras are most cost effective for good image quality and coverage, let's figure out the camera options for a typical installation. In this case, a parking lot.

The first step is to determine the type of video surveillance you want to do. For simplicity, we can narrow it down to three categories.

1. **General Surveillance.** These are applications where you don't need detail for live or recorded video. For instance, you may be watching a road and looking for traffic jams, but don't need to read license plates. You may be looking to see what a crowd is doing, but don't need to recognize faces. Or, you simply want to detect when someone is in a restricted area so you can respond immediately.
2. **Forensic.** These are applications where you need to see, record, and recognize images like license plates and faces, so you can go back "after the fact" and determine exactly what happened and identify perpetrators.
3. **High Detail.** These are applications where you want to be able to see a great deal of details, such as not just read a license plate, but also the model of the car. In a retail or banking context, you might want to clearly see the customer's and employee's faces, as well as identify the currency in their hands.

### *Determining Coverage*

For this parking lot, let's say you want forensic video surveillance. You want to be able to identify a perpetrator. Our next step is to determine what kind of coverage that requires. Coverage is the amount of area a camera "sees."

To determine coverage, you need to consider the appropriate pixels/foot for the desired surveillance quality. The following chart shows the pixels/foot required for good coverage for each category of surveillance.

Surveillance Category	Pixels/Foot Required
General	20
Forensic	40
High Detail	80

Now let's apply this to our parking lot. Let's say you want to cover a parking lot that is 100 feet wide with forensic detail. When we do the math we find 100 feet x 40 pixels/foot = 4,000 pixels. This is the resolution you would need to be able to recognize detail like license plates and faces.

The next step is to determine what resolution cameras you want to use. You determine this by dividing the number of pixels you need (4,000) by the number of *horizontal* (columns) of pixels provided by your camera. In a 640 x 480 camera, the first number is the horizontal, the second number is the vertical.

Here are all the ways you could get the resolution for forensic detail in a 100-foot wide parking lot. We round up in cases when there's a fraction of a camera. (There's a handy calculator at [www.iqeye.com/ppfcalc.php](http://www.iqeye.com/ppfcalc.php))

Number of Cameras	Megapixel Resolution Per Camera	The Math
<b>13</b> 320 x 240 cameras	0.07	4000 ÷ 320 = 12.5
<b>7</b> 640 x 480 cameras	0.31	4000 ÷ 640 = 6.25
<b>4</b> 1280 x 1024 cameras	1.3	4000 ÷ 1280 = 3.125
<b>2</b> 2048 x 1536 cameras	3	4000 ÷ 2048 = 1.95

Note that just two 3-megapixel cameras can cover the same area as seven standard 640 x 480 cameras. This becomes more remarkable when you consider cost.

If we use 2008 prices taken from online sources, a high quality camera made by an established manufacturer that delivers a 640 x 480 image has an MSRP of about \$350 (all dollars figures are USD). A high quality camera made by an established manufacturer that can deliver a 2048 x 1536 image has an MSRP of about \$1249. In the following price comparison tables, we've priced the corresponding "extras" similarly for both camera types.

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***Standard IP Network Camera (640 x 480)***

<b>Item</b>	<b>Price</b>	<b>Quantity</b>	<b>Total Cost</b>
640 x 480 camera	\$350	7	\$2450.00
Housing	\$225	7	\$1575.00
Cable	\$20	7	\$140.00
Labor	\$100	7	\$700.00
		<b>Total</b>	<b>\$4865.00</b>

***3 Megapixel IP Network Camera***

<b>Item</b>	<b>Price</b>	<b>Quantity</b>	<b>Total Cost</b>
2048 x 1536 camera	\$1249	2	\$2498.00
Housing	\$225	2	\$450.00
Cable	\$20	2	\$40.00
Labor	\$100	2	\$200.00
		<b>Total</b>	<b>\$3188.00</b>

As you can see, the megapixel camera option is actually the lower cost solution in this case. While the individual cameras cost more, they also cover more area and in situations like this can save you money.

What about storage costs? Well, all things kept the same in terms of compression, two images from 3-megapixel cameras will typically take up less storage than seven images from the seven 640 x 480 cameras.

## **Summary**

Obviously, there are many more factors to consider in any video surveillance installation. But this paper is a good start in understanding the advantages of megapixel cameras and advanced IP video surveillance management software solutions for forensic and high detail applications. The bottom line is that megapixel cameras represent a very cost-effective solution for providing excellent camera coverage and better image quality with fewer cameras. Even better, the right IP video surveillance management software adds many advanced capabilities that enable you to better take advantage of the full capabilities of these cameras, as well as turn them into a powerful video surveillance system.

## Case study: Loyola University's campus-wide security upgrade

### 1. The Challenge

Faced with the typical patchwork security system comprised of analog cameras, VCRs, DVRs, and various types of access control readers spread over two of its three Chicago campuses, Loyola University sought to improve its security system to one more in keeping with its rank as a top national university. The university wanted to both better protect its students and improve administrative efficiencies.



Megapixel image. Source: IQinVision

### 2. The Solution

To improve its video surveillance in critical areas, the university chose to upgrade to IP video surveillance using software by Milestone Systems and adding 200 cameras. Megapixel cameras from IQinVision were chosen for top-priority areas. An advantage of the Milestone software was its ability to integrate existing DVR equipment to enable remote viewing of camera views from both the existing analog cameras and new IP network cameras.

### 3. The Advantages

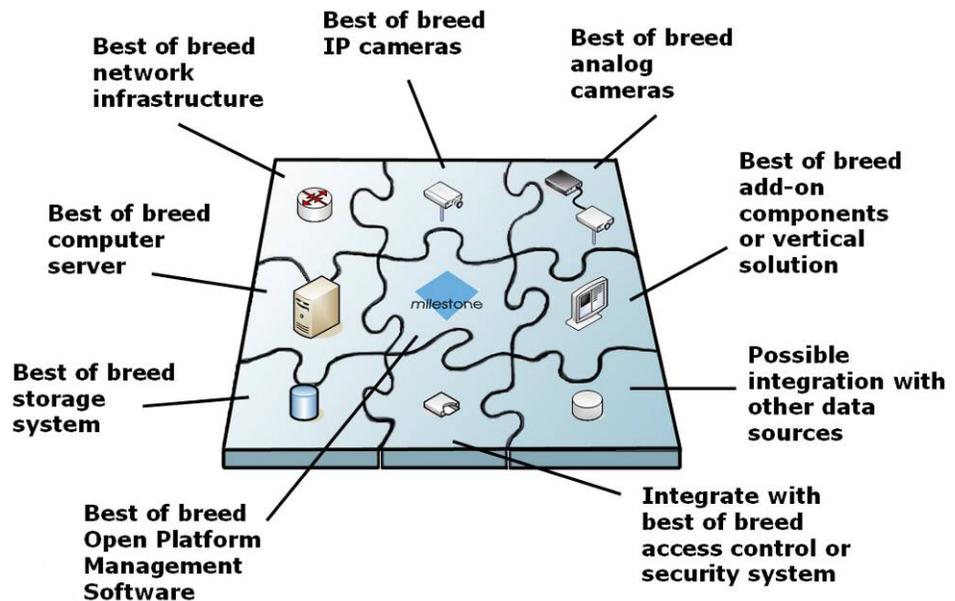
All camera views go to a central server via the Milestone IP video surveillance management software and then are routed over the security network to a variety of viewing stations and the central command and control center. Some of the best viewing comes from the IQeye megapixel cameras by IQinVision. According to Frank Dale, Loyola's manager of electronic security, "Among the 15 different IP camera models, our committee felt the IQeye was the best camera for the cost, but it also had the best image quality overall." These cameras and the Milestone IP video surveillance management software played a role not just in the massive, campus-wide security upgrade at the university, but also in helping it win the 2007 Security Innovation Award from *Security Technology & Design* magazine.

## Milestone Systems

**Innovator.** Milestone Systems is internationally recognized as an innovator and thought leader in open platform IP video management software. Milestone's XProtect products operate as the core of surveillance systems: connecting, sharing and managing all devices through a single interface that is easy to learn and operate.

**Easy to use.** The XProtect platform is easy to use, proven in operation and scales to support unlimited devices. XProtect products support the widest choice of network video hardware and are designed with an Application Programming Interface (API) that integrates seamlessly with other manufacturers' systems.

**Best-of-breed.** Using XProtect, you can build scalable, "best of breed" solutions to reduce cost, optimize processes, protect assets and ultimately increase value in a company's products and services.



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Milestone Systems is a global thought leader and developer of open platform IP video management software. The XProtect™ platform gives users a powerful surveillance solution that is easy to manage, reliable and proven in more than 35,000 customer installations. With support for the industry's widest choice in network hardware and integration with other systems, XProtect provides best-of-breed solutions to "video enable" organizations – reducing costs, optimizing processes, and protecting assets. Milestone software is sold through authorized partners in approximately 90 countries.

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## **IQinVision**

IQinVision is the world leader in megapixel IP video. Since 1998, IQinVision has been designing, manufacturing, and marketing the IQeye family of high-performance network cameras, intelligent cameras. Committed to leading the industry with highly-valued products and customer service, IQinVision was first to market with HDTV and megapixel cameras and has received numerous awards from Frost & Sullivan, *ST&D*, *Detektor*, *IIPSEC*, and others.

IQeye network cameras are renowned for image quality, stability, and reliability in the most demanding network conditions and environments. The IQeye cameras integrate with third-party NVR and video analytics software for enterprise-wide deployments. IQinVision products are available as IQeye-brand, private-labeled, or OEM models, and have been widely deployed in city center, property management, education, retail, casino, government, transportation, and a number of other vertical market applications.

IQinVision is a privately-held corporation headquartered in San Juan Capistrano, California with regional offices in Lancaster, Pennsylvania and Utrecht, Netherlands. For more information: [www.IQeye.com](http://www.IQeye.com)