

Enabling Video Analytics

The advantages of an open platform IP video surveillance management solution for enabling video analytics.

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Introduction

Digitalization and IP networking are transforming the way that video surveillance and monitoring is used. Businesses, organizations and municipalities worldwide are increasingly looking to IP network video to improve the performance of their video surveillance and video-enable their operations. One of the most amazing ways IP network video can do this is by taking over the “seeing.”

Video analytics, video intelligence and video content analysis are all terms for the ability to mathematically detect, recognize and analyze objects and events using digitized video.

As video analytics has dramatically improved its effectiveness as a tool for providing real-time, actionable intelligence in security installations, it’s getting serious attention for other uses as well. Its versatility provides excellent return on investment for a wide range of applications, including business intelligence, factory automation, loss prevention, public liability assessments, training, consumer behavior analysis, monitoring traffic flow, and more.

The growing interest in video analytics is fueling new innovations and products, and will continue to do so for some time to come. A report from IMS Research predicts that the video content analysis market will grow to an estimated USD 3.4 billion by 2010. But this is just the tip of the iceberg for the IP video surveillance industry as a whole. According to ABI Research, the video surveillance industry is at a key inflection point between analog and digital technologies and could expand from USD 13.5 billion in revenue in 2006 to USD 46 billion in 2013.¹ This means many more businesses and organizations will have the ability to video-enable their operations.

This paper will provide you with an overview of the state of video analytics today and where it’s headed in the near future. We discuss the importance of building your video analytics capabilities on an open platform IP video surveillance management solution. We also include a brief case study of a recent installation running a video analytics application on a Milestone XProtect IP video management solution.

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¹ “Video Surveillance Systems: Explosive Market Growth and New Market Opportunities,” ABIresearch, 2008

The need for video analytics

One of the most difficult and expensive aspects of video surveillance has always been the need to have people monitor the cameras. Without someone watching what the cameras are recording, there's no opportunity for immediate intervention or action. After all, what good is recording a shoplifting incident unless someone is observing it and can initiate an apprehension? What good is recording a break-in if you can't mitigate property destruction and theft by responding quickly? Prosecution after the fact is valuable, but not as good as being able to respond to an incident as it is happening.

No matter what the usage, it's getting increasingly difficult and expensive for people to monitor the growing number of video surveillance cameras. Consider all the people you'd need to monitor the 4.1 million surveillance cameras in the United Kingdom – the most watched society on earth. As you might expect, many of these cameras aren't monitored. They just record. And record. And record.

What about motion detection? It hasn't been much of a help. Its poor ability to discriminate what it sees leads to many costly false alarms.

The fact is, as video surveillance systems grow in complexity and scale, they become increasingly demanding in their monitoring requirements. Today advanced compression algorithms, such as H.264, promise to enable even more image data to be transmitted and stored. This makes it easier to have video systems with more channels, but who is going to monitor them? The author believes that by 2012 the volume of video traffic on the Internet will outpace all other traffic from voice and other data. A lot of this will be video surveillance. The million dollar question is who will be doing all the watching?

Even if you could get enough people to do it and afford paying them, chances are, they wouldn't be very effective. Research in the U.S. has shown human observers start showing signs of viewing fatigue after as little as 12 minutes, overlooking up to 45 percent of all activity in the scenes. After 22 minutes, they overlook up to 95 percent.²

There's also the issue of all that recorded and stored video. It contains a lot of valuable information for everything from prosecuting crimes to performing market research. But even though video surveillance systems have been around for many years now, extracting useful information is still labor-intensive, time-consuming and tedious. It's an extremely hard task for people to review hours of video surveillance data from dozens (or, in some cases, hundreds) of cameras to find a particular incident that happened in a street, campus or building.

² Robert Moore, citing a 2002 study published in Security Oz Magazine in his article "What are the latest trends in intelligent video and analytics?" SP&T News, June 6, 2008. See: www.sptnews.ca/index.php/Editorials/Ask-the-Expert-Smarter-AI/menu-id-106.html

Making video surveillance more effective

All security footage records one of three events: no activity, inconsequential activity, and security issues. The biggest innovation in the surveillance industry today is the increasing success in teaching computers to distinguish among these three events through video analytics and provide real-time alerts.

Video analytics enables video surveillance to do the watching and become a proactive tool that signals the need for immediate intervention by guards, police, or other personnel. Video surveillance systems become more efficient when they can recognize situations and trigger alarming and other actions (such as gate and door locking). With video analytics acting as a remote observer, patrolling guards can receive notification of an intruder or other event, and potentially act before a crime takes place.

Video analytics also turns surveillance video into a gold mine for recording human behavior for use in studying marketing effectiveness, creating training, improving building design, analyzing traffic patterns and many other purposes. Today's video analytics solutions not only can identify desired incidents, but also can encode video with metadata that makes it fast and easy to search through stored video for the clips that are pertinent to your needs. This can include even behaviors you may not have considered valuable to observe before the video was recorded. Instead of filling up hard drives with "mystery" video no one has the time to view, video analytics can turn surveillance video into a tool that organizations can profit from for everything from research to improving operational efficiency.

Earlier shortcomings of video analytics

In the past, the use of video analytics has been stunted by three primary factors: false alerts, high maintenance requirements, and high costs.

False alerts happen for a variety of reasons and in themselves can be very costly. Early video analytics systems would generate dozens of false alarms a day due to:

- Deployment in environments for which they were not designed.
- Environmental factors like rain, dust or snow simulating human forms and motion.
- Quick changes in light.
- Poor mountings and other installation issues.

False alerts are costly because each alert necessitates checking a monitor for the camera's current transmission (if responding to the alert immediately) or reviewing recorded video to ensure a real event has not transpired. This bleeds away the man-hour savings for which organizations buy video analytics. In the past, large video surveillance systems often generated dozens or hundreds of false alerts a day, significantly cutting into the labor savings.

Improper maintenance also often played a role in false alerts. Changes in the camera's immediate environment, weather, sun position, or condition often hurt the efficacy of the system.

Finally, because of high price, many organizations were reluctant in the past to purchase the higher quality video analytics systems designed to significantly reduce false alerts. The high cost per channel was prohibitive. The result was they settled for lesser systems that, due to their more limited intelligence, suffered these much higher rates of false alerts. This proved a false economy as the many false alerts significantly impacted the expected cost savings that drove the original purchase.

Two factors have significantly changed the game: better video analytics systems and growing recognition of the true value of high quality video analytics.

Video analytics has come of age

Video analytics have improved dramatically in recent years. What has changed is the high level of accuracy with which video analytics systems can perform and the increasing number of tasks they can accomplish for security and business/organizational processes.

Advancements in video analytics technology have increased recognition abilities, dramatically reducing false alerts due to weather, sun positions, and other environment factors. Even better, today's video analytics can not only distinguish between humans and animals, but between loitering and normal activity. Recent video analytics systems, for instance, can distinguish between someone walking directly from a car and someone hanging around cars – the difference between a customer and a potential thief.

Some of the many video analytics capabilities available today include:

- Character (e.g., alphanumeric) and inscription recognition for reading license plates, name tags, and containers
- Facial recognition
- Density of people, people counts, behavior (such as loitering, fighting, reading, sampling), slip-and-fall detection, gang activity, tailgating (vehicle or human) in restricted areas, a person coming over a fence
- Object removal and tracking
- Smoke detection
- Pattern recognition and directional motion
- Tampering (such as with ATMs or other devices)
- Illegally parked cars, unattended bags, spills
- Camera sabotage or malfunction

There's even more power when you link several of these capabilities together. For example, it's now possible for a port or transportation yard to install a system where a fingerprint is linked to a driver's face, to a tractor trailer's license plate number, and the trailer identification number. The system can recognize and require all to match before automatically opening an entry/exit.

Today's advanced systems can even spot potential problems by analyzing how people move. The French government uses technology that can distinguish sightseers from the 40 to 50 people who try to climb the Eiffel Tower each year based on the way a would-be climber acts. The Statue of Liberty in New York has a similar system. Software scans video streams from 96 cameras simultaneously, directing security officials, who would otherwise become bleary-eyed staring at screens, to focus on particular activities. In Beijing, to help keep the spotlight on the games and prevent protests or other disruptions, security firms are covering Beijing with smart video systems. These solutions will analyze live video from hundreds of thousands of cameras and flag suspicious people and objects.

A host of new digital products and solutions are enabling security and other departments to benefit from the latest technology. These include

intelligent video codecs (computer programs that shrink large video files and make them easy to play and exchange on a network), intelligent IP cameras, and open IP platforms that enable anyone on the network who is authorized to access the feeds and stored video of various cameras. More powerful digital signal processors (DSPs) are enabling cameras to execute considerably more demanding software algorithms and identify specific objects or actions. Server-based video analytics software products using highly specialized algorithms to analyze IP streaming signals are allowing image processing on the fly. Artificial intelligence is even enabling video analytics software to learn on the job. In response to these developments, false alarm rates are dramatically dropping and the ability to make fine distinctions in what is being seen is rapidly improving.

Adding greater business value and return on investment

Video analytics provides excellent return on investment (ROI). Waste Management, a U.S. recycling and waste management company with 2,200 locations, calculates their video analytics system saved them \$7.5 million in 2007.³ The system enabled them to reduce staff, travel and equipment, plus achieve faster response to incidents.

But that's only part of the picture. Video analytics also enables repurposing video for business intelligence. The same company (Waste Management) reports its accounting and operations departments use video analytics for business optimization activities such as monitoring point-of-sale displays and improving traffic patterns.

Retailers are a large market for video analytics. They use it to obtain information about customer flow, hot spots (places within the store that are most frequented by customers), line lengths, product placement, and in-store advertising effectiveness. Video analytics has advanced enough to actually identify customer "eyeball connections" with merchandise.

Other typical uses of video analytics include:

- Companies in the U.S., such as Brickstream and Shoppertrak, install video analytics systems to collect information about customer behavior in banks, retail stores, grocery stores, gasoline stations, and other locations.
- The Smithsonian Museum uses a new camera system with video analytics to track traffic patterns and devise ways to increase museum store visits.
- Advertising agencies use video analytics to measure the impact of an ad to a passerby or bystander. These solutions can detect a face (including if it's male or female) as well as the face's movement – whether it's looking at the ad on the wall, and if so, for how long.
- Toll roads employ video analytics to study vehicle flow and respond to traffic incidents.
- Chicago METRA Electric District (METRA) in Chicago, Illinois (one of North America's largest city transit companies) is installing high resolution cameras and video analytics to continuously inspect METRA's train pantographs (the metal frame on top of an electric locomotive that picks up electricity from cables hanging above the track). The video analytics detects suspicious anomalies suggesting defects.

There are hundreds more examples. One important key to success and good ROI in implementing video analytics is finding a solution provider who can understand your needs and effectively integrate analytics into

³ "Video Analytics Means Lots of Savings, Little Waste at Waste Management Inc.," Security Systems News, April 2008.

your operations. This is a relatively new field and it's important for vendor and customer to work closely together to achieve the best results.

The place to start: An open platform IP video management solution

One challenge in video analytics today is integrating user interfaces when video analytics solutions are used with a video surveillance system. This is particularly true if you are deploying several video analytics products (or plan to add new ones in the future). You don't want to overburden your staff with learning several different interfaces.

Open platform IP video surveillance management software like Milestone XProtect™ provides an invaluable framework for integrating and managing a wide variety of video analytics products under one interface. This is important because most video analytics systems offer one, or at most two, types of detections per camera, and the same one or two detections for all cameras in the system. Thus, to build a flexible system capable of detecting many types of security threats or collecting a variety of types of business intelligence, you need an open platform IP video surveillance management system that gives you a central console for controlling, operating and collecting data from all your video analytics solutions.

An open platform IP video surveillance management solution also enables greater integration between security systems such as an access control card reader and your surveillance cameras. By having video analytics watch an entry, you can reduce manpower while increasing accuracy. For example, if two people gain access by one card (tailgating), video analytics can alert a patrolling guard or central command station and provide a video clip for identification of the unauthorized person.

Naturally, one of the biggest advantages of an open platform IP video surveillance management solution is that it enables the use of commercial off-the-shelf computing hardware. It gives you a platform where components from different manufacturers can be combined, added and upgraded over time to suit your needs and budget. This lowers your total cost of ownership (TCO) and provides greater flexibility in meeting your evolving security or other surveillance needs.

The fact is, each manufacturer of a component of a security system – whether it's an intelligent IP network camera, video analytics software, access control system, etc. – is good at producing their component, but someone needs to provide the overall interface. It is this central interface that enables the user to unlock all the power of using these devices and use them together as a total solution. That's the role of the platform. And that's why you need to carefully select it right from the beginning or make a transition to a more comprehensive platform if you find yourself limited by your current one.

Server-based or on-camera (edge) analytics? Which is better?

As processors in cameras get more powerful and video analytics algorithms demand less processing power, many types of video analytics can be performed either at the server or at the edge (on camera). Performing video content analytics at the edge helps conserve overall processing capacity since the video analytics is done before the image is compressed. This means that the image will not need to be decompressed again at the server again for video content analysis. Instead, metadata (data about data) provides the necessary information for easy identification and retrieval. A truly future-proof solution is one that enables some part of video analytics at both points – server and edge. This is partly because some types of video content analysis will always require the greater processing power and speed of a central server and also because we will see more and more edge products with the capability of performing some video content analysis. As this happens, the need for a strong video management system with an analytics framework will become even more evident as the value of querying across metadata from different edge devices from different vendors will be very high.

On-camera analytics

Performing video analytics at the edge can significantly reduce bandwidth demands. You can set up your system to store only video identified as being “of interest” – such as clips indicating a security breach, unauthorized entry or fulfilling other criteria. In this case, you manage by exception to normal events, collecting what the on-camera analytics are designed to recognize. On-camera analytics can be a solution to two of the biggest deterrents to the widespread adoption of megapixel (high resolution) cameras: bandwidth and storage. In fact, the two work hand in hand. Megapixel cameras provide the detail necessary for many video analytics products to perform complex operations. On-camera video analytics can make sure you only disseminate through the network and store video of interest.

Today’s on-camera analytics are capable of processing images in real-time and encoding archived video with metadata in MPEG or other formats. This metadata enables indexing of the relevant image content for fast retrieval. In fact, adding meta tags for user-defined events allows retrieval within seconds of specific events from hours of video from thousands of cameras.

The latest generation of IP network cameras combine recent chip design advancements with better compression technologies (such as H.264) to enable high definition with less bandwidth. This further paves the way for large-scale surveillance systems using megapixel cameras and on-camera analytics. In addition, advanced digital signal processing (DSP) technologies bring even better on-camera video analytics within reach. Hardware accelerators do the heavy lifting of encode/decode and display, enabling the DSP to handle the intense

processing requirements of video analytics. Several DSP makers have teamed with different video analytics developers to release camera reference designs, and there are several standardization attempts in the marketplace today. Standard reference designs – and recent efforts to put analytics on board cameras using one chip instead of two or more – promise to lower the price per channel over time.

Server-based analytics

On-camera analytics makes sense for the images coming from one particular camera. When you need to perform analytics or correlate metadata on live or stored video from hundreds of cameras, you need the greater processing power and central management capabilities of a server-based solution. Server-based analytics enable more complex analytics and fast searches through archived video. Server solutions are critical for making a variety of video analytics tools available to various departments, from security to HR, operations and marketing, and allowing searches for after-the-fact criteria or analytics (such as facial recognition or object identification) that are beyond the capabilities of on-camera solutions.

A relatively new solution, image processing over IP (IPoIP) technology, distributes the image processing responsibilities between camera and server. The video analytics algorithms are segmented into two parts and divided between the video encoder hardware and the central image-processing server. IPoIP retains the strengths of both distributed on-camera and server architectures, while avoiding their limitations.

How should you set up your system? This ultimately comes down to your needs, as well as the IP video surveillance management solution you choose, the cameras, the video analytics solutions, and the various hardware components. A qualified solution provider will be able to help you make the right choices.

How Milestone is helping accelerate the implementation of video analytics

Milestone has developed a Video Analytics Framework – XProtect™ Analytics 2.0 – that collects metadata from video analytics products (server-based and on-camera) in a standard database and correlates them in real-time or afterwards. Part of Milestone's open platform solution, XProtect Analytics seamlessly integrates video analytics tools from different manufacturers under a single, easy-to-manage interface. This gives users a powerful, future-proof framework for implementing and managing different video analytics applications. It addresses some key industry issues, such as an organization's need to easily correlate alerts between different analytics tools. Using the correlation tools, security staff can rapidly search across alerts and events to easily find relevant video evidence about security incidents from multiple sources. Milestone's query engine provides fast analytic searches of the metadata, allowing organizations to find video of interest fitting a number of criteria or particular events.

A combination of advanced analytic tools and optimized IP-based video technology based on Milestone's open platform, XProtect Analytics enables analytics at the edge (on camera) and at the server, minimizing processing power and adding value to archived video. Using XProtect Analytics users can correlate events from generic tools such as license plate recognition, facial recognition and traditional real-time access control with alerts from video content analysis tools, such as object detection, etc. Users can build strong, accurate evidence by cross-matching events in real-time and/or from archived video.

Enabling users to easily integrate intelligent video analytics from different manufacturers, both at the edge and at the server, helps decrease false alerts, reduce operating costs, and make the system much easier to operate. Using Milestone's Video Analytics Framework organizations have easy access to critical information they need to make proactive decisions and take preventive measures to mitigate the consequences of a security incident.

Milestone's Video Analytics Framework enables best-of-breed solutions by providing greater freedom of choice in video analytics products. This enables you to protect and extend your video surveillance investment. What's more, through its open platform IP video surveillance management software – Milestone XProtect™ – Milestone provides the necessary architecture for ensuring interoperability between various components of a video analytics system. Milestone uses application programming interfaces (APIs), the most common external interfaces for supporting requests from software, such as video analytics programs. By providing a software development kit (SDK), training and consulting, Milestone enables video analytics developers to easily tap into the power of its video surveillance platform. The result is a "whole that is greater than its parts" solution that enables businesses, organizations and municipalities to derive far greater value from their video analytics product investments, while

also taking advantage of the many open platform benefits described in this paper.

The shape of things to come

Many people are still skeptical about the reliability of video analytics systems, and indeed, the industry needs to be careful about promising too much too soon. It must be understood that most video analytics solutions are designed for specific controlled environments and are less effective if implemented in less controlled situations. In other words, they're most effective in the environments for which they are specifically designed.

Video analytics solutions are best at detection. They can't interpret at the level people can. Where they do surpass people is attention span and spotting specific actions, events or behaviors.

The speed of innovation is making it hard for security departments to keep up with the latest developments. But this innovation is generating great values. Camera manufacturers are using the continually growing processing capabilities of their cameras for value-added features like video analytics, giving customers more for their money.

One thing the industry must do is keep driving towards open platform solutions. The security industry has long been one full of proprietary systems. This needs to change and is changing rapidly with IP video solutions. Most customers want their video analytics solutions to be seamless and interoperable with other security devices and operate within their video surveillance management software. The key to this is open architecture and standards-based solutions. Applications need to be building blocks, not solitary solutions. Creating open solutions and developing standards for the industry will make it easier and more lucrative for developers to create video analytics applications for various markets.

Three of the largest IP camera makers – Bosch Security Systems, Sony and Axis Communications – have teamed up to work on a standard for the interface of network video products. It is expected to comprise interfaces for specifications, such as video streaming, device discovery, intelligence metadata, and other IP-surveillance integration. Products incorporating the standard could be available as early as the second half of 2009. Other companies are joining their forum. Another group, the Physical Security Interoperability Alliance is supporting the interoperability of all devices in the physical security industry. The National Retail Foundation is also working on an analytics standard.

Exciting new developments will drive new increased interest in video analytics in the years ahead. For instance "click and search" functionality is beginning to appear. This technology enables you to click on an object, such as a package, in an image and then search for all instances of that object in your stored video from all your cameras.

Gadi Talmon, Co-Founder of Agent Vi, a developer of enterprise video analytics software solutions, predicts that "in 10 years every video surveillance camera on earth will have some kind of intelligence. Some of them will have basic capabilities like motion detection and some others will have very sophisticated capabilities like recognizing suspect

faces in crowded environments and automatically tracking them when moving between cameras.”

These are exciting times. It’s not too early (or too late) to start using video analytics in your business or organization. In fact, the time is ripe for letting your video surveillance system do the watching.

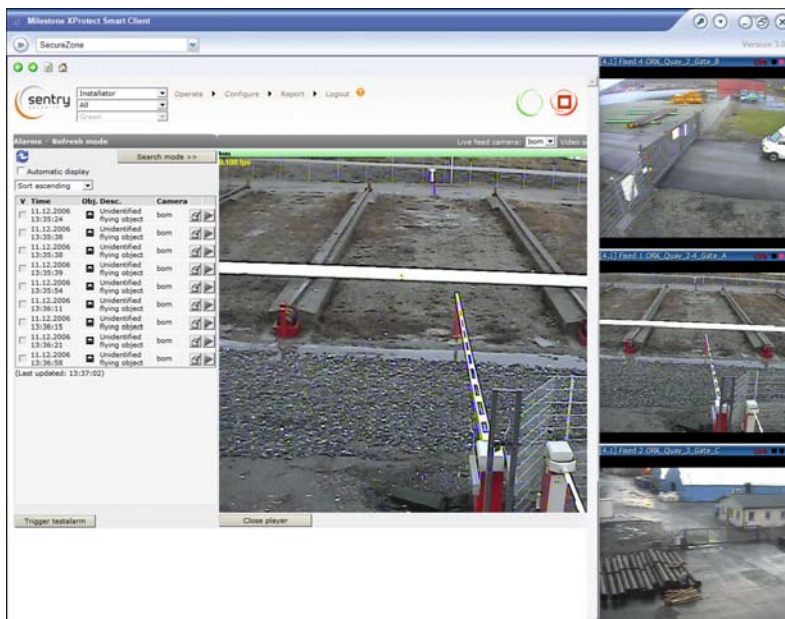
Case study: Trondheim Harbor guards its perimeter with video analytics

1. The Challenge

Trondheim is Norway's third largest municipality, as well as the center of its fourth largest urban area. Trondheim Harbor wanted a more efficient video surveillance system to guard its perimeter.

2. The Solution

Secure Zone is a Norwegian video analytics system developed by the Defense Research Institute and now adapted to the civilian market through the OPAX. Along with a company named Triangle, OPAX installed a Secure Zone solution at Trondheim Harbor. The program is



integrated into Milestone XProtect. The system covers most of the harbor surveillance. Object detection provides monitoring in a new dimension, one that not only responds to motion, but can isolate objects and classify them. Using rules that govern what types of movements activate alarms, the solution reduces false alarms significantly.

3. The Advantages

The system classifies objects and their motion. It can differentiate between small

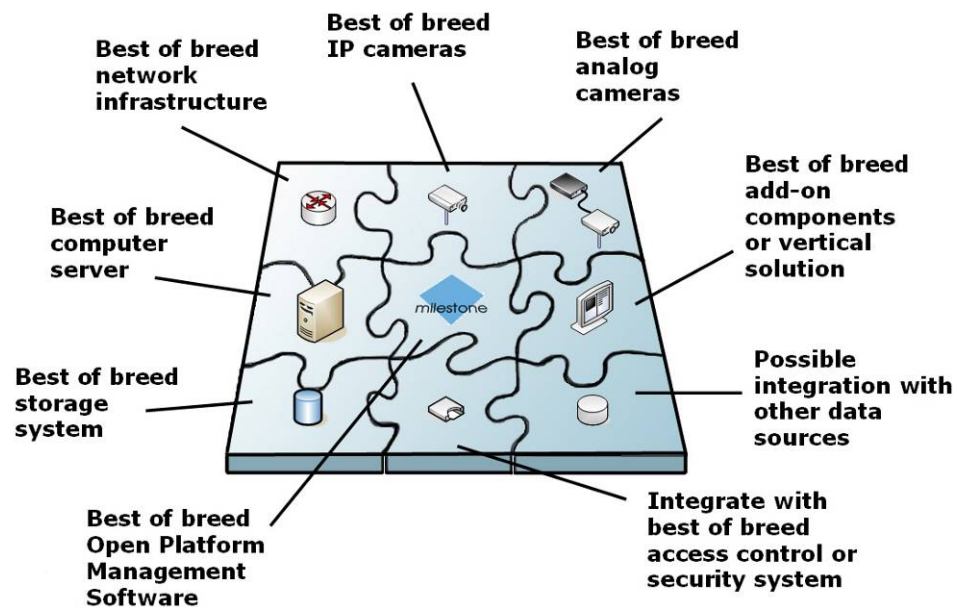
and large animals, group of peoples, walking, day-to-day people, and small and large cars. It can also be programmed to identify certain types of motion. For example it can differentiate between the cars that stop (and thus set off an alarm) from those that are in motion and will be ignored. Speed criteria can also be linked to the objects, such as: "All cars that stop outside an industrial plant will activate the alarm, but those that are running more than 30 km per hour will not," or "people who run at 10 km per hour will set off an alarm."

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.



Milestone Systems is the industry leader in developing true 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 worldwide.

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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