The Promise
of Edge-Based Strategies

Network video surveillance has traditionally relied on a network of cameras that feed data back to a central server with a video management system. While this remains the most common architecture, the adoption of high-resolution technology and IP cameras has increased costs as much as it has increased capabilities

Among these capabilities that have captured a great deal of attention is the promise of moving the intelligence of the VMS server to the surveillance cameras and delivering feeds from the edge directly to the viewer. But leveraging such capabilities requires a thorough assessment of both the promise and the process of technology. In the above example moving video beyond the local area network and out over the internet requires informed decisions about resolution, compression, and security. Incorporating these decisions into a coherent strategy requires an understanding of edge-based technology.

Essentially, edge-based technology records video directly to SD cards on surveillance cameras. This direct recording eliminates the cost of a server and of constantly moving high-definition video over a network. The strategy also introduces enhanced capabilities such as fault-tolerant recording, unique deployment capabilities, and better bandwidth management.

Industry manufacturers are excited about the prospects of edge technology, and rightly so. But responsible companies are also paying attention to the limitations that we can already identify. Just as high-definition cameras did a decade ago, every technology delivers solutions to existing challenges while introducing a new generation of challenges unique to itself. Edge-based technology must be considered in the framework of each application to deliver the promise of the edge.
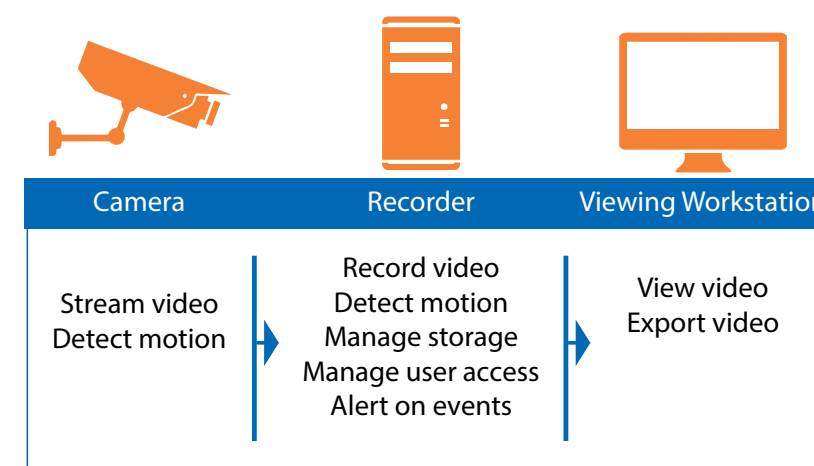
Defining the Edge

The digital electronics that have made vast contributions to the world economy in the past fifty years have also revolutionized the capabilities and practice of the security discipline. These advances were forecast by Gordon Moore, founder of Intel and Fairchild Semiconductor. Moore famously predicted in a 1965 paper that the capacity of semiconductors would double every 18 months for the next decade. But as the industry adopted his vision, embracing what they called "Moore's Law," this pace continued for more than five decades. It was complemented by other new corollaries; memory prices halved every two years, memory capacities doubled every two years. In the security field the number and size of pixels fueled wave after wave of new possibilities. Only now after 50 years is that furious pace beginning to slow.
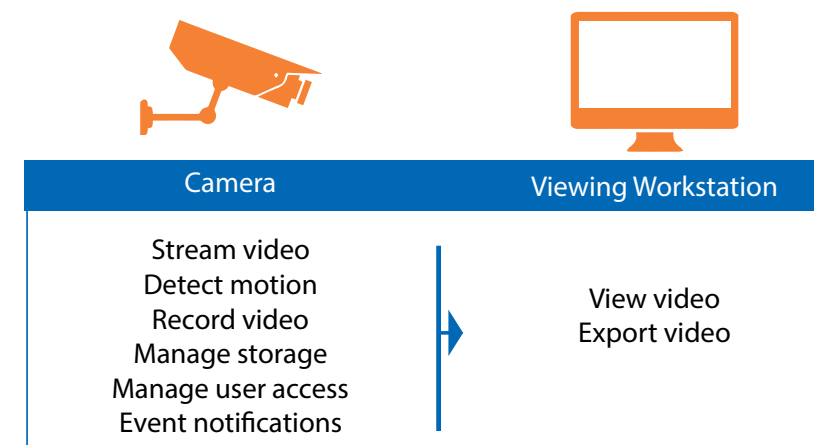
Stanford Professor Jonathan Koomey identified a lesser-known but equally important trend in energy efficiency that has a direct impact on surveillance technology. Koomey's law describes a trend in which the number of computations per joule of energy has doubled approximately every 18 months since 1946. This decrease in the required power took computers out of vast rooms and put them in the palms of our hands—and into the small form surveillance cameras with onboard computers and storage.

All of this power and efficiency has allowed security manufacturers to move surveillance out onto the edge of a network— to the cameras themselves. Tasks such as motion detection, storage management, alerts, and user access have traditionally been handled by dedicated recorders that lived between the camera and the viewing workstation. It is now possible to perform all of these tasks locally on the cameras themselves.

Traditional Server Recording

Camera	Recorder	Viewing Workstation
Stream video Detect motion	Record video Detect motion Manage storage Manage user access Alert on events	View video Export video

Edge-based Recording

Camera	Viewing Workstation
Stream video Detect motion Record video Manage storage Manage user access Event notifications	View video Export video

Server vs. Serverless Recording

One key advantage to a pure edge strategy is the savings achieved from having no middle hardware. Another advantage is decreased load on bandwidth because the recording is being stored locally on the camera rather than being continuously streamed over the network to the recorder.

Such benefits come at a potential cost though. In relying solely on the edge-based devices, the system is limited to the capabilities on the camera, possibly sacrificing some of the functionality found on state-of-the-art dedicated recorders. Another consideration: most installations in-

clude legacy cameras in the mix. It can be challenging to incorporate legacy devices or those from different brands into a single cohesive interface.

An Enhanced Hybrid Approach

Edge recording can also be used in conjunction with a server to make a security system more robust. Consider a system with a network recorder that also has edge recording capabilities. This configuration provides fault tolerance in the event of a network failure. Rather than simply losing the recordings during a network outage, the system would automatically store video locally on the cameras. When the network is restored the operator can recover the missing recordings and preserve a seamless video record. While cost-saving tactics get most of the headlines, introducing such resiliency into the system is a capability that was not previously available at any price.

VMS on Camera

Another hybrid approach is to embed the video management system (VMS) on the cameras themselves. In this configuration, eliminating the stand-alone server delivers immediate bandwidth savings while still retaining many benefits of a sophisticated VMS. While this has been technically feasible for years, the challenge has been getting that much processing power to fit on a camera in a small affordable package. This is where Moore's and Koomey's laws come into play, making computing power smaller, more efficient, and more affordable.

Cameras today are similar to smartphones not only in the sense of the size and power, but in their ability to run software, much as a phone

serves as a platform for apps. To achieve all of the benefits of VMS without burdening the network, low-resolution video is streamed to viewing stations while high-resolution video is recorded directly to SD cards on the cameras.

One solution that highlights the progress of processing power over time is Tyco Security Products' exacqVision Edge and Edge+ solutions. Unlike many software applications that use slimmed-down, less-capable versions of their VMS for edge devices, exacqVision recompiled to run on an IP camera is indistinguishable and managed identically to the VMS running on Windows or Ubuntu Linux servers. This solution also demonstrates the efficiency and flexibility that now allows a VMS to run in non-traditional environments.

Milestone Arcus offers edge-based VMS solution as a scaled-back version of its full software that is available for 3rd party cameras and targeted at what Milestone VP Lars Nordenlund Friis describes as the "low complexity, lower-end, low camera count" market.

Genetech offers a different approach it calls "trickling" that allows users to avoid network downtimes by recording locally to the camera and then uploading the data when service is restored. The concept of trickling can also be used to limit the impact on the organization's wide area network (WAN) by scheduling video uploads to non-business hours.

Limitations
Edge technology is not a replacement for a dedi-

> "Edge is not a replacement for all hardware VMS needs, but it is an essential tool in system design today. Where it excels is in challenging situations where cost, physical, or network constraints made video difficult or impossible."
>
> -Ryan Hulse,
> Tyco Security Products

cated network recorder in all situations. Despite advances in miniaturization, there are situations where more storage is required than today's SD cards can accommodate, particularly compared to the almost unlimited disk capacity of a server.

Often large complex environments also require other physical security systems to be integrated with the IP video system. In such situations it is ideal to have a single server as a hub rather than attempting to tie in every camera independently.

Finally, a dedicated server affords more sheer processing power as simultaneous tasks such as video management systems, analytics, event notifications, and the like are added to the requirements in specific environments.

Use Cases
Edge technology truly shines in current environments where network bandwidth is constrained or the use of physical recorders is impacted by physical space or cost restrictions. The Southwest Fisheries Science Center in La Jolla, California, provides a useful illustration of a system that had strict space and cost requirements that dictated the use of edge technology. The center required a surveillance system for its new Ocean Development Technology Tank that would accommodate live animals in the only thermohaline-controlled tank in the world. Among the scientists' strict requirements were high-quality images and forensic review without using cables or wires.

Isolated environments with bandwidth issues—such as power substations and out-buildings or mobile facilities such as trains and ships—are another example where edge technology can allow security systems to deliver in ways

they have not been able to before. The National Oceanic and Atmospheric Administration recently equipped a research vessel with edge cameras that allow researchers to correlate data from underwater echolocation with images of corresponding surface conditions to document habitats in ways that weren't feasible before due to both bandwidth and physical space limitations.

Another creative application is to use edge technology to create recordings that are independent from the rest of the security architecture. As an example, some Tyco clients have begun to use camera-based VMS recorders to monitor sensitive areas such as the server rooms where all other video data is stored. In this scenario, someone who might gain access to the server room with the intent of erasing video data would be independently monitored by the edge camera. The same strategy would apply to bank vaults or any other secure environment in which redundancy would substantially improve the resilience of the system.

Finally, any tightly confined environment would be an ideal application. In a retail mall

kiosk, a dedicated server would take up space more profitably used for inventory. Using edge technology, the footprint for surveillance required to prevent shrinkage is no larger than the small cameras mounted on the ceiling.

SD Cards: What You Need to Know
Secure Digital (SD) cards come in a broad variety of grades, types, capabilities, and speeds. The task of continuous recording is unique to surveillance and can create unexpected malfunctions in lower-quality cards. Some key considerations in purchasing SD cards are:

- Quality matters: Use high-endurance SD cards

- Speed matters: Use at least Speed Class 10 or UHS Speed Class 1 rated cards for full HD continuous recording

- Ensure SD cards are capable of functioning in the environment of the camera (temperature, humidity, etc.)

- Leverage record-on-motion features of the VMS or camera to maximize the retention of useful video and the life of the SD card.

Edge Recording Time Estimates

	5 MP Fisheye	2 MP 1080p Dome	2 MP 1080p Bullet
Storage	64 GB	32 GB	32 GB
Min/Max typical storage*	4-16 days	3-13 days	2-10 days
Typcial endurance, motion recording**	> 3 years	> 3 years	> 3 years
Typical endurance, continuous recording***	> 1.5 years	> 1.5 years	> 1.5 years

* TabEdge Recorle estimates are based on SanDisk endurance specifications and may vary dependent camera FOV content
** Max storage: 20% daily motion based recording, 25% scene change, quality setting 4, 15 FPS
*** Min storage: 50% daily motion based recording, 75% scene change, quality setting 7, 15 FPS

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Looking Ahead

The core challenges of delivering the most advanced security solutions in the enterprise are different today than they were yesterday—or they will be tomorrow. Edge technology is an essential tool for today: one that meets core challenges of cost- and bandwidth-efficiency, resilience, and scalability. And yet, according to a recent survey, 54% of companies have not taken advantage of the technology. Many are simply not yet aware of the possibilities. Others have questions or need to discuss potential use cases with experts who can speak to them outside of the traditional sales environment.

If this describes your sitaution, take the opportunity to watch the free webinar Ryan Hulse and Joel White recently conducted on Moving to the Edge: Leveraging Edge-Based Technology in Every Environment. The webinar goes into greater depth on the subjects touched in this paper and explores new areas that are not contained here. If you have questions after viewing the webinar you may advance the conversation by e-mailing a Tyco expert at: exacqsales@tycoint.com

Additional Resources:

Illustra Edge Complete Edge Recording Solution

Illustra Edge Product Specs

Video: Illustra Edge

tyco
Security Products

CASE STUDY: NOAA Southwest Fisheries Science Center

The Southwest Fisheries Science Center located in La Jolla, California needed a video surveillance system for experiments conducted in its groundbreaking, new Ocean Technology Development Tank. This the first and only large, thermohaline-controlled test tank facility in the world that can accommodate live animals.

This unique installation required a surveillance system that fit within the Center's strict needs without using cables and servers. Additionally, it wanted to ensure they had high-quality images and the ability to go back and easily review all activity happening in the tank during experimentation.

DOWNLOAD THE CASE STUDY HERE TO READ MORE