Optimizing Edge Storage in Mission Critical Video Surveillance Systems

White paper

Seneca
An Arrow Company

Video Data at the Heart of Surveillance Systems

Video surveillance continues to proliferate and evolve rapidly. Traditional video surveillance systems are being transformed into highly sophisticated systems thanks to advancements in camera and sensor technology and artificial intelligence (AI). These systems can now provide comprehensive security solutions in addition to capturing images.

Digital technology at the edge of a network and the internet of things (IoT) enables the collection of image and sensory data on a large scale. Data is housed both at the edge and in the cloud in unprecedented quantities. This data is now the fodder for deep learning and machine vision algorithms that enable insight and proactive monitoring paradigms that were not possible before. These developments are driving large requirements for storage capacity – both at the edge and in the cloud.

Transmitting, storing, aggregating, analyzing and protecting the massive amounts of data generated by high-resolution cameras and sensor networks puts new pressure on infrastructure stakeholders. Companies need to retain the collected data for extended periods to ensure regulatory compliance.

While many storage solutions are available in the marketplace, choosing the right video storage solution requires a comprehensive understanding of the requirements and trade-offs. Strategies to manage storage effectively are critical to building an efficient and scalable system that can meet current needs and allow the flexibility to adapt to future requirements.

Strategies for Managing Video Consumption

Camera technology is increasing in sophistication with higher resolution, multiple sensors, and other unique features that create larger files. These file sizes make streaming and storing video within the network environment challenging. Additionally, archiving, storage, and transmission of data increases bandwidth requirements, hardware costs, operational costs, and the overall complexity of data management.

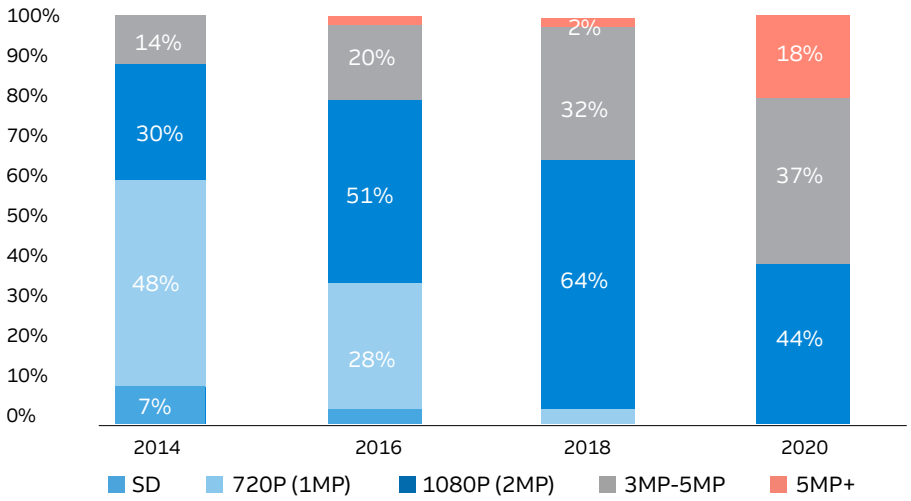
Remote use-cases like utilities, logistics, and transportation that transmit data from the edge to the cloud using cellular connectivity exacerbate the problem. The high cost of transmission and bandwidth availability can often limit the application's usability or adversely impact reliability.

The core technology that enables modern digital video surveillance is data compression. Video compression allows converting large, raw video streams into smaller video files that are more efficient to transmit, process, and store.

Several software-based video compression techniques are commonly used to resolve data rate and storage challenges. The three most common compression methods used in video surveillance are Motion JPEG (MJPEG), MPEG-4, and H.264/H.265. Stakeholders are increasingly opting for H.264/H.265 technologies due to their compression efficiency.

While H.264/H.265 encoding technologies can reduce bandwidth requirements, they may not be sufficient for cost-sensitive surveillance systems that need to store large amounts of data or stream video from the edge to central locations or the cloud via cellular networks.

Camera Resolution Usage Statistics



Source: IPVM

Correlations Between Data Volume and Camera Resolution

Results show that the surveillance data generated increases dramatically with higher camera resolution

Storage Consumption Examples*

Camera Resolution	MJPEG	H.264	H.265
1MP (1280X720)	27.5TB	4TB	1.3TB
3MP (2048x1536)	94TB	13.6TB	4.6TB
5MP (2592 x 1944)	150TB	21.7TB	7.4TB
8MP (4K)	464TB	67TB	22.8TB

Source: Western Digital Surveillance Storage Capacity Estimator Tool

* Consumption based on 12 cameras, 12 FPS, 24 hours a day, and archival period of 30 days. The actual bandwidth needed to transmit compressed video depends on many characteristics including video format, quality, frame rate, etc.

With data volume increasing exponentially, techniques that complement compression technologies to further minimize storage and bandwidth requirements are now becoming essential for building efficient surveillance systems.

Incorporating additional video stream optimizers can further reduce the bandwidth and storage space required per camera stream, and significantly reduce the total cost of ownership (TCO) while maintaining the integrity of the video resolution and frame rate.

Optimize Storage and Achieve up to 90% File Size Compression

Seneca's xCompress is a dedicated video compression appliance for mission-critical safety applications

Seneca's xCompress is a video stream optimizer loaded with state-of-the-art features that can help you get the most out of video compression.

Benefits Include:

- Up to 90% compression per stream (based on camera model)
- Reliable compression of video and audio recordings over unstable networks
- Interfaces with all VMS
- Centralized, easy-to-deploy model
- Remote configurability
- FIPS Certification (FIPS AES-256)
- Maintains video integrity for required forensics

xCompress works on top of existing camera protocols with video streams from any camera while maintaining video quality. Compressing the streams before sending them to the video management systems (VMS) reduces the amount of processing and storage space needed in the network video recorder (NVR).

This solution maximizes file transmission and video retention, lowering TCO without sacrificing video quality. xCompress, coupled with the Seneca appliance design, provides video file compression of up to 90%, allowing for longer retention and more efficient transmission of high-resolution camera data. The video integrity is maintained for chain of custody requirements and video forensics.

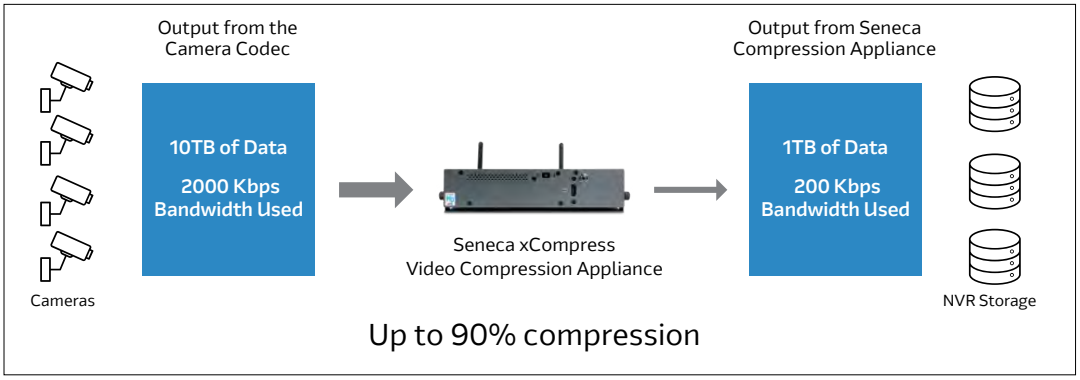
In scenarios where a camera is at the network edge and requires cellular connectivity, using xCompress before transmitting the stream reduces the bandwidth needed and lowers costs. The reduction in bandwidth also facilitates network transmission of videos that would otherwise be too large to send or take too much time.

The Seneca systems are powerful video compression appliances designed for mission-critical surveillance installations. The Seneca systems come in different hardware configurations with xCompress video compression software pre-installed. These systems enable optimal file compression and is compatible with industry-leading VMS.

Key features of the Seneca xCompress video compression appliance include:

- Turnkey solution with xCompress software pre-installed
- Intel® Core™ i3, i5, or i7 processors
- Support for 2, 4, 8, 12, or 16 cameras
- Ruggedized versions available
- Small form factor or 1U rackmount option

For more information, go to the **xCompress** webpage.



Video Compression Appliance with Integrated xCompress Software

Benchmark Data: xCompress Performance Testing

Please Contact Us for a detailed xCompress test report

The below table summarizes benchmark data from performance testing using xCompress. Detailed testing was performed on the xCompress Video Stream Optimizer tool to determine the bitrate while maintaining system stability or until a failure occurs. The target system had eight camera streams and the output from xCompress was sent to a Milestone VMS via an ONVIF driver.

Stability metric or failure is defined as:

- Compressor output FPS cannot be maintained within 2 FPS of the input FPS
- CPU utilization exceeds recommended threshold (80%)
- GPU utilization exceeds recommended threshold (90%)
- Memory utilization exceeds recommended threshold (75%)
- VMS client stream playback issue (frame rate decrease/missing i-frames/image tearing)
- VMS recording issue

Test Results

Camera	Resolution	FPS	Bitrate after the H.264 Video Codec (Kbps)	Bitrate at the output of xCompress (Kbps)	Compression Rate
Camera 1	1920*1080 (2MP)	25	3800	860	78%
Camera 2	(1920*1080 2MP)	25	5900	921	84%
Camera 3	1920*1080 (2MP)	25	4200	472	89%
Camera 4	1920*1080 (2MP)	25	6500	654	90%
Camera 5	1920*1080 (2MP)	25	5400	889	84%
Camera 6	1920*1080 (2MP)	25	9100	774	92%
Camera 7	1920*1080 (2MP)	25	2500	235	91%
Camera 8	5MP Fisheye	20	1950	228	88%

Hardware used

- CPU: Intel® Core™ i3
- GPU: UHD for 11th Gen
- RAM: 8GB

Resource usage

- CPU: 25%
- GPU: 57%
- RAM: 47%

Summary

Video surveillance is increasing in complexity and sophistication. Along with the proliferation of sensors and camera networks, the compute requirements for storing and transmitting video surveillance data are rapidly growing. Advanced compression technology enables new approaches to transmit high-resolution imagery and video at the edge and over the network while optimizing bandwidth and storage consumption. xCompress is a state-of-the-art video compression technology that can dramatically reduce the complexity, management, and costs involved in transmitting high-resolution video, even in scenarios where remote cellular connectivity is needed.

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