Emerging infrastructure: The future of video analytics

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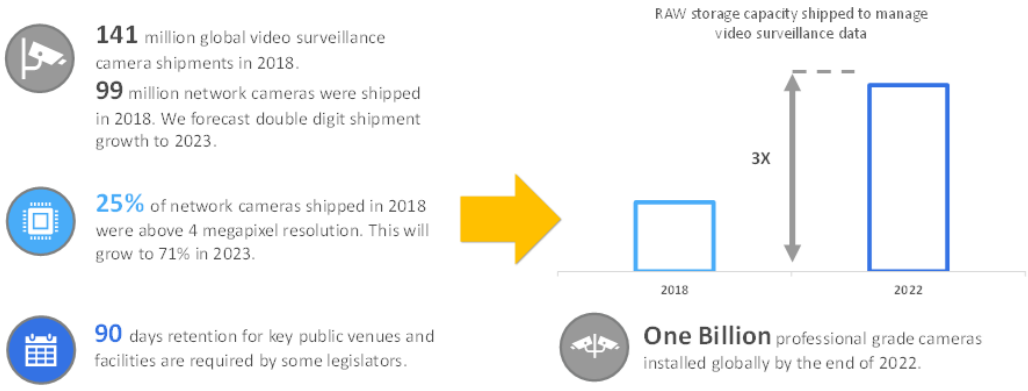
Introduction

Omdia estimates that in 2019, camera manufacturers shipped 141 million video surveillance cameras, of which 99 million were network cameras. Forecasts show that with continued double-digit growth in camera unit shipments over the next few years, there will be over one billion cameras installed globally by the end of 2022. Combined with the advances in the resolution of cameras, and increasing legal requirements to retain data, there is an increasing amount of video data produced. Driven by developments in artificial intelligence (AI) and increased capabilities of video analytics, the ability to analyze this data and derive insight from it, is becoming one of the most important aspects of a video surveillance system. However, there are many ways this data is processed. This report discusses the various emerging infrastructure architectures for video analytics

Exhibit 1: Global video surveillance camera shipments

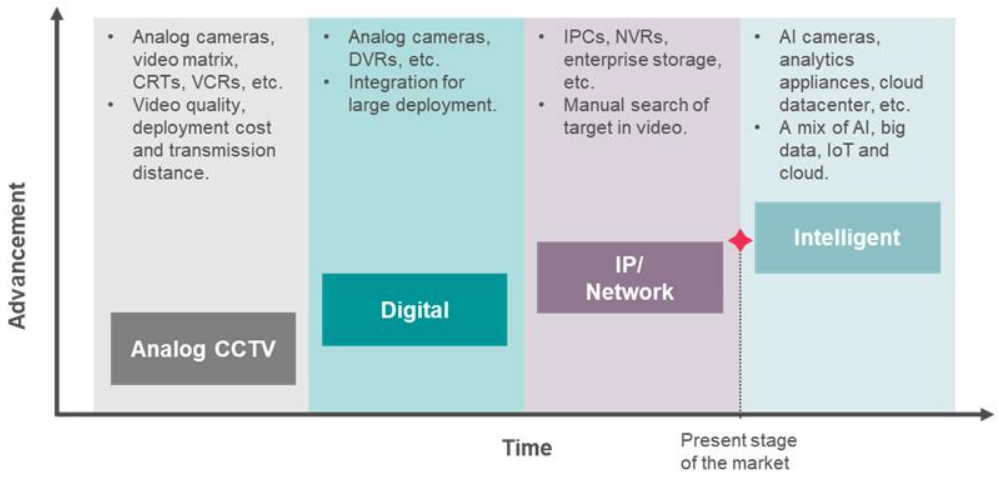


Source: Omdia – Video Surveillance Intelligence Service – 2019

The age of intelligence

Since its first documented use in Germany in 1942, video surveillance is evolving with developments in technologies and the video surveillance technologies available today are very different from earlier versions. The journey of video surveillance can be split into the phases below.

Exhibit 2: Development of the video surveillance industry



Source: Omdia – Video Surveillance Intelligence Service – 2019

Analog CCTV (Closed Circuit Television)

This is the first generation of video surveillance that consisted of equipment including analog cameras, video matrix and CRT video monitoring wall. CCTV was first used for live monitoring until video cassette recordings (VCRs) was introduced and CCTV system was thereafter more widely adopted in both public and private sectors. The limitations for analog CCTV were costly cable deployment, limited video quality and constrained transmission distance.

Digital video surveillance

Advancements in digital technology led to further improvements in the video surveillance industry. During the digital transformation of video surveillance, analog camera is still the major front-end equipment, but at the backend, Digital Video Recorders (DVRs) which encoded footage to a hard disk drive, replaced VCRs to eliminate the need for video tapes. Integrating increasing amounts of cameras onto one system has become the constraint for large-scale deployment.

Network based video surveillance

As network technology develops, network cameras and Network Video Recorders (NVRs) are introduced to the video surveillance industry in place of analog cameras and DVRs. The network video surveillance system works by encoding and processing video in cameras and then streaming the footage to NVRs for storage or remote viewing. At this stage, surveillance is primarily used for live monitoring and forensic (after an incident) investigations. Searching for specific target in video is still dependent on human operators.

Intelligent video surveillance

By applying transformational technologies such as deep learning video analytics, cloud data centers and big data analysis, the information embedded in the video can create more powerful intelligence. Deep-learning enabled analytics can quickly provide operators and end-users insights previously difficult to obtain. In the case of forensic post-event analysis, for example, video analytics can significantly reduce the amount of time taken to search through recorded data. When combined with other sensors within the IoT network, a holistic view of an incident related to people and things can be revealed.

For years, the reliability of video analytics had been extremely variable, with vendors struggling to develop algorithms that could function in complex scenes. However, the intelligent video surveillance phase has facilitated a significant leap in the capabilities of deep-learning video analytics. The last couple of years has seen a large increase in research and development in deep-learning neural networks, enabling analytics to understand the world around them, to identify people and objects, and to identify patterns and analyze data in a way not thought possible. However, these new capabilities require a lot of video and processing power.

Video analytic infrastructure deployment architectures

There are several ways in which to process video analytics. This can be at the edge on the camera, centrally on a recorder or on-premise server, in the cloud, or a hybrid approach of all of these. The following discuss the various processing architectures.

Edge based analytics

Edge-based analytics are installed on the video surveillance device such as a camera. It can analyze the video before sending it across the network. Edge-based solutions are useful in remote, low-bandwidth locations. The key benefits of embedded software are:

- The average channel price of the software is lower for edge analytics.
- Meta-data can be sent across the network to limit bandwidth requirements. In some cases, devices can send low-resolution video to a central storage location. When an alert is identified, full-resolution video can be sent to record what happens. This system works best in perimeter protection where there are long periods of inactivity.
- Recorder / server maintenance is not required. This includes virus upgrades and corporate maintenance requirements, which can add costs to the solution.

On-premise

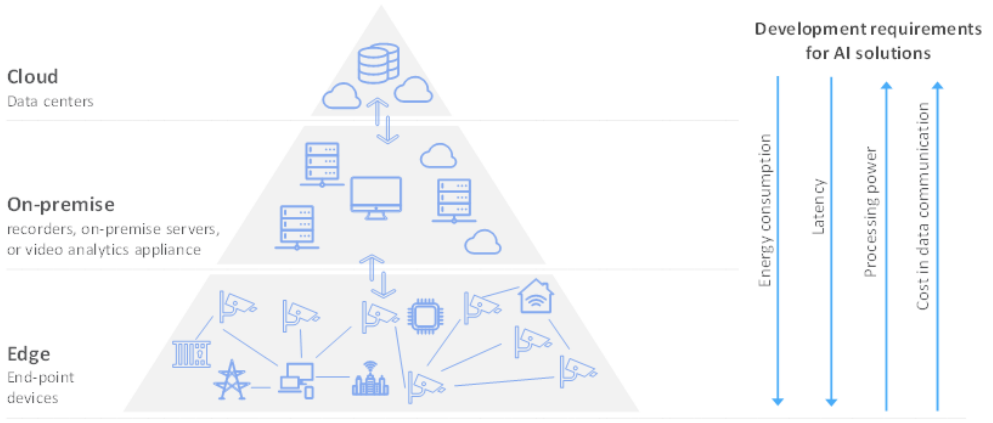
In recorder solutions, the analysis is usually done centrally with the full video stream being sent across the network. The term recorder in the following text refers to both recorders and servers, and is defined as a device that is designed to record video surveillance camera footage to storage.

The key benefits of recorder software are:

- No requirement to replace video surveillance equipment, as the recorder software can use the existing system (assuming the cameras are positioned correctly).
- Recorders provide more processing power and improve the performance of video analytics. This can be a limitation in embedded solutions. Although deep-learning algorithms are finding their way on to edge-based hardware, a server is the only hardware type that can run the more sophisticated functions such as video based search and synopsis.
- Easier integration with other security or business intelligence solutions.
- Ability to run more analytic functions per camera feed.
- Analytics using more than one channel, such as object tracking across multiple cameras, is easier to process centrally.
- In larger installations, it can be more important to re-analyze the data after the fact. Recorder solutions store all video centrally, where it can be more easily re-analyzed.

In addition to recorder or server processing, there is also the opportunity to use Video Analytics Appliance - a dedicated hardware device which is designed primarily to provide compute to run video analytics on video surveillance feeds. Analytics appliances are pre-configured with analytics software from the same vendor. The benefit that Video Analytics Appliances offer is that the monitoring process has to be automated with huge amounts of footage and metadata being generated from hundreds or thousands of cameras deployed across airports, campuses and cities. Video analytics appliances are designed to do this and, unlike Windows and Linux-based recorders, their processing capability does not need to be shared with other functions. Despite this there remain barriers to greater adoption of video analytics appliances. Price is a major problem, but the lack of potential use cases to justify the ROI is a more challenging problem in the private sector.

Exhibit 3: A distributed intelligence pyramid



Source: Omdia – Video Surveillance Intelligence Service – 2019

Cloud

Cloud based video analytics, or video analytics-as-a-service (VAaaS), is an emerging trend in the video analytics market. A shift to the cloud and toward a recurring revenue model is occurring across the security industry; however, video analytics (and indeed video surveillance in general) may be one of the functions that could benefit the most from a cloud delivery model.

Cloud-based video analytics solutions offer similar functionality to traditional server-based analytics; but instead of the software running on servers on the premises, they are deployed on third-party cloud infrastructure from the likes of Amazon Web Services or Microsoft Azure. While it is currently a relatively small market, and a cloud-based solution would not be the right choice for many end users, these solutions are already being offered by several vendors.

The benefits of VAaaS over server-based solutions include:

- **Cost** – Much like video surveillance as a solution (VSaaS), the upfront cost of a VAaaS solution is typically far lower than that of a more traditional set-up. CapEx costs are instead, rolled into the recurring fee payment model. Furthermore, storage of video archives is one of the costliest elements of a video analytics solution. Cloud vendors are able to offer tiered storage structures based on the immediacy of the need for a given piece of footage, with lower priority footage stored at a lower cost. End-users with particularly spikey data requirements are able to purchase capacity when needed rather than pay for infrastructure that goes unused most of the time.

- **Functionality** – The complexity of set-up is substantially lower than that of a traditional analytics solution. A key benefit of cloud delivery is that it is frequently designed to be plug-in-and-play in its set-up and configuration. End-users can also make the most of the most current software, without the need to purchase another solution. If a variety of analytics is available from a particular cloud vendor, a user may be able to effectively trial it without having to commit to the purchase of an expensive software license.

However, cloud storage remains comparatively expensive, and bandwidth limitations restrict the volume of data that it is possible to transmit offsite. However, these costs will decrease, and video compression algorithms and network infrastructure will continue to improve. In the meantime, however, enterprise-level end users may find it more economical to deploy their analytics in a more traditional way.

Hybrid cloud-based solutions do exist, where storage is on the premises, but metadata is sent to the cloud for analysis. This significantly cuts down the network workload, but does require the purchase and maintenance of storage hardware.

Edge-to-Core analytics

In a similar manner to the management of metadata on edge devices the category of edge-to-core analytics is the next development in this. The power of edge devices is increasing and is expected to increase considerably over the coming years. However, Omdia expects that the use of distributed computational power networks will continually increase, edge analytics will further integrate with centrally processed analytics on recorders / servers, and even in the cloud. This will become particularly prevalent in more compute intensive algorithms, such as mass facial recognition, or widespread traffic monitoring and vehicle classification. In situations such as these the processing of analytics is shared across several devices.

With facial recognition, for example, the camera will perform the facial detection – the less compute intensive tasks – while this hash data is sent back to the central recorder / server to perform facial recognition.

The benefit is that it lightens the load on the recorders / servers allowing additional video feeds to be analyzed.

Omdia expects that this methodology will become more common over the forecast period as AI camera chipsets become more powerful and will be able to perform basic classification functions.

Which architectures depends on the user

The Intelligent video surveillance phase will not only bring about more and better cameras producing more video, this phase will bring about data and insight. This will allow different end-users to benefit in different ways, as not all architectures are suited to all analytics. In simple terms, the energy consumption for processing and the latency of processing analytics is lowest at the edge, while the processing power and the cost of data communication increases as the processing is moved to the cloud. As such, more basic analytics that have frequent occurrences and require quick responses, such as detection, tracking and alert analytics are best suited being processed at the edge. More complex, less frequent, and more process intensive analytics, such as classification, forensic search, and business intelligence analytics are better suited to central processing architectures.

Exhibit 4: Capabilities of different architectures

Capability	Edge	Center[1]
Detection	✔	✔
Tracking	✔	✔
Alerts	✔	✔
Classification and recognition	✔	✔
Search		✔
BI		✔
Anomaly		✔

1. Central location on premise or cloud

BreifCam - Emerging infrastructure: The future of video analytics - 2020

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BriefCam

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