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White Paper

Modern Surveillance Market Pressures and a Server Platform to Master Them

Media Cloud Server MCS-2080



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SUMMARY

While surveillance continues to show remarkable growth, especially in traffic applications, rising resolution, quality, and analytics demands are pushing organizations to support next-generation compression methods, most notably the H.265 standard. However, accommodating these critical technical demands may be more than many server platforms can handle. ADLINK's MCS-2080 provides a dense, redundant, high-performance solution able to handle a demanding range of surveillance applications with cost-effective flexibility.

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Introduction

Traffic surveillance remains the highest growth application in the already booming surveillance market, according to Transparency Market Research, with an expected compounded annual growth rate of 21.2% through 2019. This trend stands out against a background of even larger expected growth in surveillance camera sales of 46% in the same period. Market research firm Technavio cites traffic surveillance as the key driver for growth in the homeland security surveillance market, a field currently led by the Americas (41.96% share), but still well represented across the Europe/Middle East/Africa (35.03%) and Asia-Pacific (23.01%) regions.

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With respect to surveillance solution integrators, these projections are actually deceptively low because they oversimplify the growth situation. Integrators face not only an increase in unit sales but also the performance levels each solution must support. Consider just these few historical points for reference:

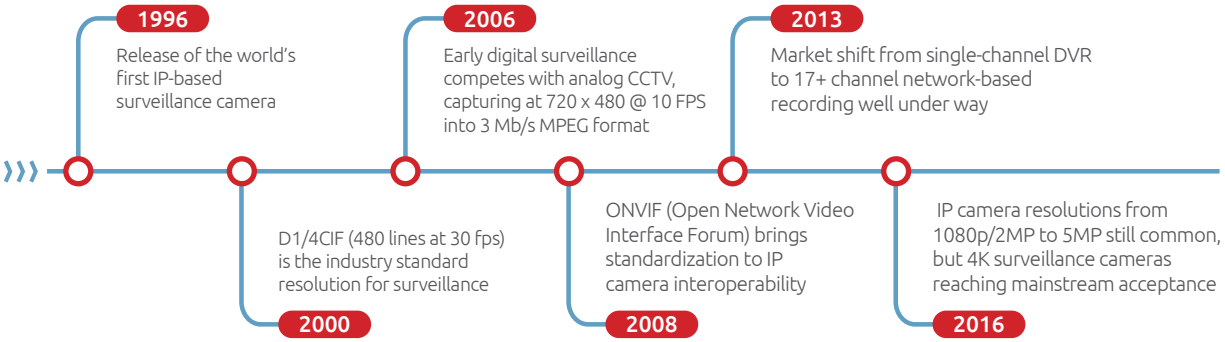


Image 1: A few historical points of surveillance

In short, surveillance industry trends point to IP-based communications replacing analog, an increasing number of surveillance streams feeding into network-based storage servers/appliances, and a rising number of cameras supporting ever higher resolution. Within the traffic surveillance market, increasing image resolution can be particularly critical, as cameras tend to be located a significant distance from passing vehicles, and only higher resolution (backed by high-quality image sensors) will deliver the level of detail necessary to identify information such as license plate characters, car body damage, or driver facial features. Higher resolution image resolution requires higher video stream bandwidth and storage requirements.

Additionally, higher image resolution means that camera manufacturers must find ever more efficient ways to encode information into each second of video stream transmission without noticeably impairing image clarity. At the receiving end, increasing numbers of such video streams must be decoded accurately and in real-time to prevent recording delays and data loss. Traditionally, large increases in visual processing meant heavy investments in servers laden with specialized, discrete graphics processors, but these costs often proved prohibitive for small/medium-sized businesses and budget-constrained public organizations.

In addition to video stream loads, video analytics places even more demands on surveillance solutions. Video analytics, the practice of performing pattern recognition and analysis of video footage to derive actionable intelligence, represents a significant opportunity for organizations willing to mine patterns, trends, and traditionally invisible trigger events from raw footage. It's no surprise that the research firm MarketsandMarkets pegs intelligent video analytics with an expected 33.7% compounded annual growth rate from 2017 to 2022. "North America is estimated to hold the largest share of the video analytics market in 2017," states the firm in its 2017 market study announcement, "with an increasing demand for technologically enhanced public safety infrastructure, availability of technical expertise, and ever growing requirement of organizations to get actionable insights in real-time."

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Transparency Market Research paints a similarly enthusiastic picture for video analytics growth, noting in its 2016 study that people recognition applications (especially counting the number of people moving through a given area) accounted for roughly 30% of the segment's total revenue. Other prominent applications include:

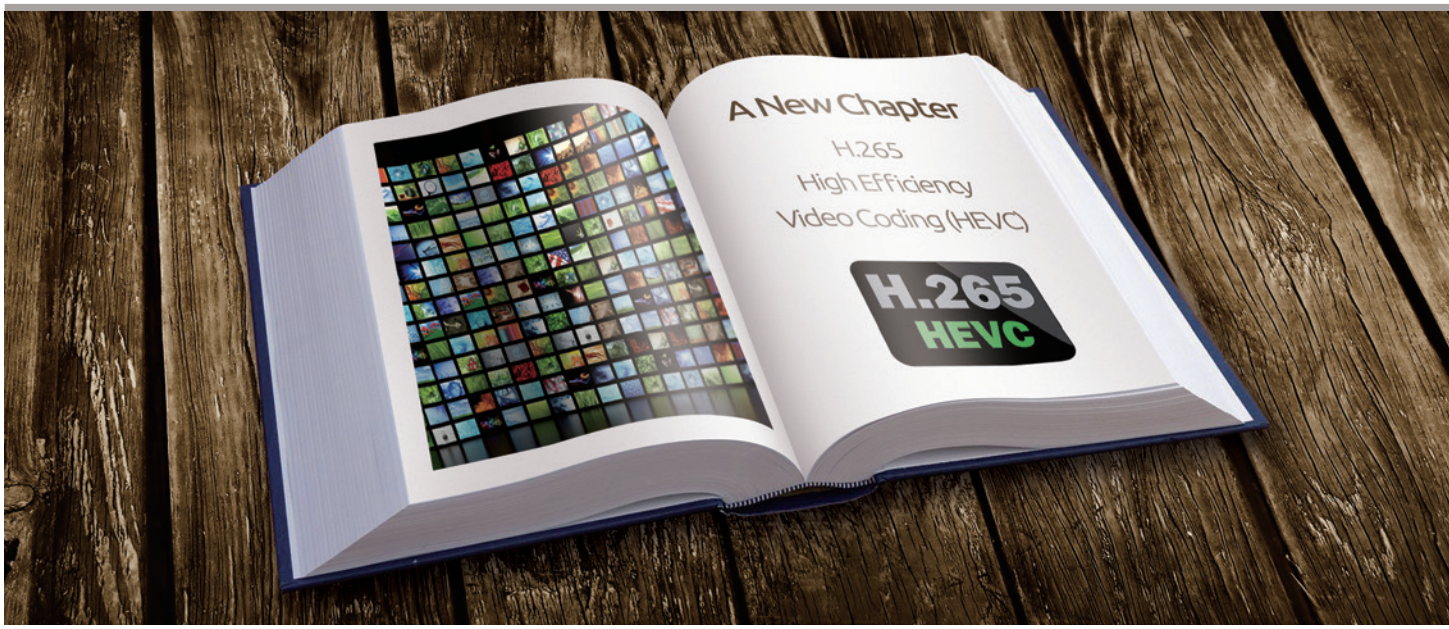


Image 2: Prominent applications in surveillance industry

The more video footage an enterprise analyzes, the greater the potential for positive results. However, as businesses aggregate ever more video sources, many of which feed in higher resolution streams, more and more strain is placed on storage and image processing infrastructure, both of which must handle not only the growing volume of data but also process it quickly enough to deliver satisfactory results. Increasingly, this need occurs in real-time.

A video solution capable of meeting today's needs and scaling up to tomorrow's demands requires two key elements: the highest possible software efficiency and a hardware platform able to provide optimized support for that software with high-ROI affordability.

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Efficiency: HEVC as the New Standard

As today's surveillance industry rapidly migrates away from legacy 480p and 720p formats towards 1080p and beyond to 4K, manufacturers must find ways to support these resolutions throughout the video stream path, from camera capture to analysis to archiving. At every point in this process, compression plays a critical role. The ultimate goal is to provide a satisfactory level of visual quality with the smallest possible bandwidth and file size. Whether this goal can be achieved through constant bit rate (CBR) or variable bit rate (VBR) encoding will generally depend on the content, expected client characteristics, and specific quality demands.

This struggle for efficient video compression has existed for as long as there has been digital video. For example, the seminal RealVideo format, released in 1997, was based on H.263 and played a highly influential role in the development of online video. However, H.263 was designed for low bit rate applications, and the format only provided acceptable visual quality in the pre-broadband era up to 352 x 288 (although the format supported resolutions up to 1408 x 1152). Mainstream connectivity and computing capabilities of the day simply couldn't support higher video resolutions. Similarly, the H.262/MPEG-2 Layer 2 standard of 1996 supports resolutions up to 1920 x 1080, yet the industry ultimately determined that the format's efficiency was best suited to DVD-Video, which tops out at either 720 x 576 (PAL) or 720 x 480 (NTSC).

Anyone who has played a DVD on a large, high-quality LCD or plasma display and then immediately compared the image quality of the same content on Blu-ray understands the leap in quality between the two formats. Blu-ray uses the H.264 standard, also known as AVC and MPEG-4 part 10. Format developers created H.264 with the intent to double the bit rate efficiency of H.263. This would allow H.264 to encode a given video segment with the same visual quality as H.263 but at half the file size.

These improvements derive from a host of algorithmic and other advances, but, for our purposes here, it's important to see size and quality as the two key, somewhat independent criteria involved. For example, roughly speaking, H.264 can create a video 100MB in size that, all other qualitative aspects being equal, would require H.263 to require 200MB. However, if size remains constant – meaning that our H.264 file is encoded for a 200MB target size – then we can increase the quality of the video by varying parameters such as bit depth, resolution and on the encoding profile used. This is partly why Blu-ray discs have a 25GB capacity compared to DVD's 4.7GB. That quintupling of capacity allows for significant jumps in resolution (Blu-ray's 1080p vs. DVD's 480p) and fidelity. Compression efficiency lies at the heart of the user's improved viewing experience.

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This brings us back to surveillance and the need to support higher visual quality (for accuracy and more detailed analytics) in the face of limited budgets and resources. Just because H.264 can support 4K video streams doesn't mean that the format does so efficiently. Lower efficiency means that connections from camera to surveillance server systems may not be able to maintain real-time throughput without dropping data. Lower efficiency may also mean that recorders/servers may not be able to decode high numbers of input streams in real-time. Excessive storage capacity required for those larger files may also become burdensome. In short, H.264 can support the specifications needed for next-generation surveillance, but it may not do so with enough efficiency to make the solution practical.

> "H.264 is good enough until your competition supports H.265. No matter the use-case, H.265 is massively better than H.264. The benefit of a 2x improvement in compression efficiency can be taken in one of several ways. Bandwidth can be cut almost in half, storage can be doubled, or video quality can be doubled over a fixed bandwidth or video file size."
>
> *– Tom Vaughan, vice president and general manager of video, MulticoreWare*

High Efficiency Video Coding (HEVC), also known as H.265 and MPEG-H Part 2, is the leading successor to H.264 and supports resolutions up to 8192 x 4320. Standardized in 2013, the new codec aims to halve the bit rate required by its H.264 predecessor when delivering the same subjective image quality.

Let's examine the benefits of HEVC from a data storage perspective and consider an organization operating surveillance cameras that record at 1080p, 15 fps. This business operates 250 such cameras around the clock and retains all footage for only 30 days (many enterprises are adopting retention times from multiple months to years, in part due to compliance requirements). With conventional video stream quality settings using H.264 compression, this amounts to over 337TB of data per month – enough to require 46 8TB hard drives. With HEVC, the number of drives could drop to perhaps only 23 drives, which at current price levels, represents a cost savings of over $6,000. And again, this represents only one month of retained footage.

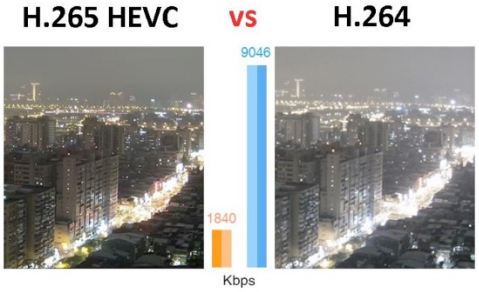


Image 3: H.265 and H.265

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Compression and Decoding

Video encoding and decoding places a large processing load on surveillance systems. Cameras require more powerful integrated processors to handle encoding and compression, but surveillance systems must then decode those incoming streams and, if the application requires it, do so in real-time without any quality degradation or dropped frames. Even in the days before high-definition surveillance and HEVC, systems would require dedicated discrete graphics processors designed to perform hardware accelerated decoding of specific video formats, such as H.264. The alternative was to put that image processing load onto conventional CPUs, which typically featured basic integrated graphics and thus had to perform resource intensive software encoding. Unfortunately, without algorithm-specific circuitry dedicated to image decoding, those processors were unable to meet the demands of handling multiple camera feeds in real time.

Intel began to transform the cost dynamics of surveillance servers in early 2011 when it introduced Intel® Quick Sync Video support in its 2nd generation Intel® Core™ processors – essentially delivering discrete hardware video encode/decode acceleration for free. Intel® Quick Sync Video builds on integrated Intel graphics technology to support hardware video encoding and decoding rather than consuming CPU resources to perform these operations in software. Intel® Quick Sync added H.264 support in 4th generation (2013), 8-bit HEVC in 6th generation (2015), and 10-bit HEVC in 7th generation (2016) Intel® Core™ processors.

According to Tom Vaughan of MulticoreWare, a leading software developer in HEVC/H.265 compression, Intel® QuickSync will provide "outstanding speed and power efficiency when compared to software encoding, although software encoders are capable of producing significantly higher compression efficiency." However, surveillance applications tend to place more importance on processing speed over incrementally smaller file size for a given image quality. With the already significant gains provided by HEVC with QuickSync hardware compression, the challenge then focuses on handling and storing more streams at lower costs.

> "H.265 is by far the best video compression format available today, and it will be the best video compression format available for several more years. New coding standards are in development, but they are not finalized, and it takes years after a standard is finalized for hardware and software implementations to be optimized and available."
>
> *– Tom Vaughan, MulticoreWare*

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Next-Generation Surveillance Server – Available Now

Organizations performing surveillance on street traffic, facial recognition in stations/airports, or any other application with high stream counts will confront a similar set of challenges when deploying server hardware:

- Performance sufficient for high data volumes and quality levels
- Broad software compatibility
- Physical footprint occupied by equipment
- Power consumption
- Upgradeability and scalability
- Downtime during maintenance
- High availability
- Multiple OS support for maximum flexibility

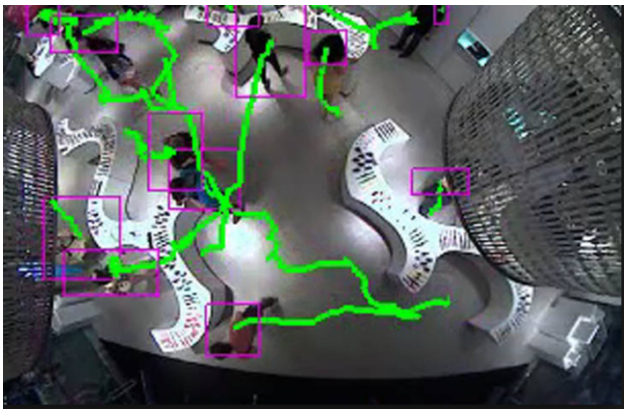


Image 4: Heatmap application in retails

Worldwide enterprise systems manufacturer ADLINK gave careful thought to how it could best address these surveillance market needs. The result became the flagship of the company's Intelligent Video Management Server family, the MCS-2080.

ADLINK's MCS-2080 uses a 2U rackmount form factor to house eight dual-system CPU nodes (the MCN-1500 shown at right). The chassis thus contains a total of 16 Intel® Xeon® Processor E3-1585 v5, each equipped with Intel® Iris™ Pro Graphics P580 supporting Intel® Quick Sync Video. Additional node and server specifications include:

- 4x DDR4-2133 SO-DIMM slots, up to 64GB (per CPU node)
- Intel® C236 Chipset
- 16x 1G node connections to backplane
- 2x 10GbE managed switch (MXN-0410)
- Broadcom 56150 managed GbE switch SoC (on MXN-0410 switch node)
- 4x 10GbE SFP+ to front panel (per switch node)
- 3x 1GbE to front panel (per switch node)
- 2x 2130W/1600W high-efficiency, redundant, hot-swappable power supplies



Image 5: Compute node MCN-1500 of Media Cloud Server MCS-2080

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Many server platforms offer only a single- or dual-processor platform in a 1U form factor. A 16-processor surveillance solution might occupy 8U of rack space or more, with each chassis containing one or two power supplies. With the MCS-2080, ADLINK packs the same compute capability, leveraging Intel's current-generation, highly efficient microarchitecture into a fraction of the rack footprint and power profile.

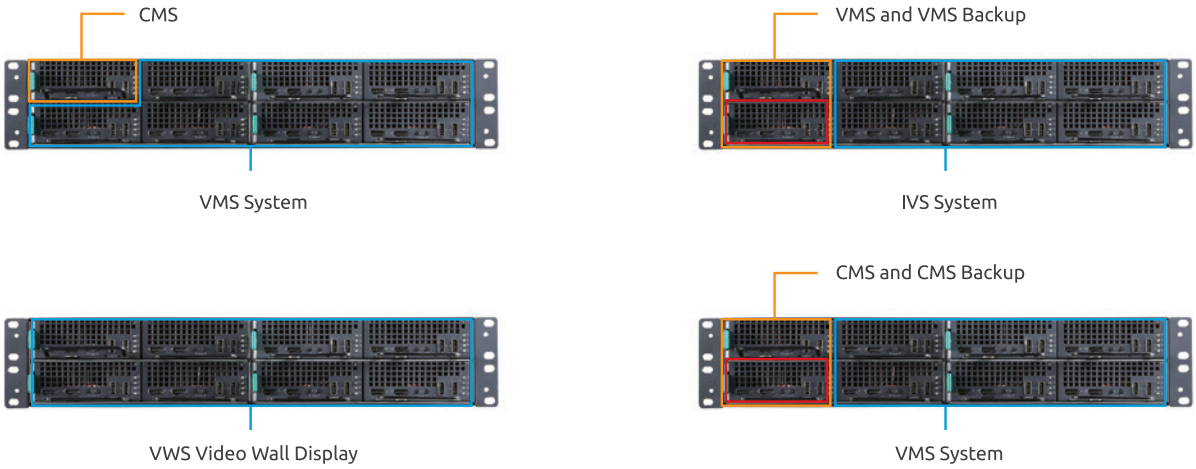


Image 6: Examples of application combinations

Having eight dual-system nodes comprising up to 16 servers within one chassis opens a wide array of use case options. Administrators could conjoin all 16 Xeon E3 v5 processors to create a single surveillance video wall, or perhaps four nodes might fuel a surveillance system, two perform analytics, and the remaining two handle client management and redundancy.

In fact, redundancy throughout the power supply, networking, and processor components helps to make the MCS-2080 a remarkably robust, high-availability platform that is ideal for a spectrum of surveillance applications. Moreover, because Intel® Iris™ Pro Graphics P580 also supports OpenCV acceleration, the MCS-2080 excels with a wide a range of video and analytics applications based on OpenCV enhancements.

One of the top value points for any would-be surveillance buyer is the MCS-2080's processing capability. The following table showcases the server platform's video decoding performance:

Channels	IP CAM	SW Function
256	4K	Real Time Video Wall Display
512	1080P	
768	720P	
1024	4MP	Instant Video Analysis

Image 7: Processing capability of MCS-2080

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To further illustrate, ADLINK ran a proof-of-concept test in which the MCS-2080 performed real-time decoding of 64 channels of HEVC-encoded video (720p at 15 fps):

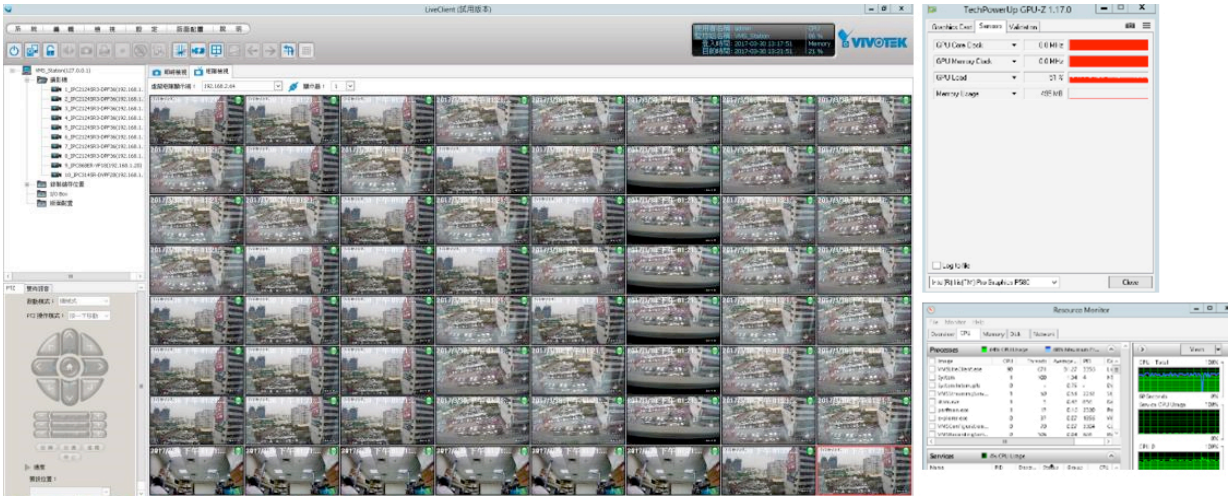


Image 8: Performance test with surveillance software

Under this sustained load, the platform ran with an average CPU utilization of 70% to 90% and GPU utilization of 30% to 50 percent (integrated Xeon® processor graphics). In a different configuration, the MCS-2080 can support a video wall of up to 16 (4 x 4) 4K displays. Or, used for intelligent video surveillance (IVS), the platform can perform real-time analytics on up to 512 channels of 4MP video feeds.

Conclusion

Compact and cost-effective, the ADLINK MCS-2080 utilizes high-performance, industry-standard components to ensure compatibility with most video management software (VMS) options. The platform integrates easily with many existing surveillance architectures and applications. Nodes can be configured for instantaneous failover and hot swapping, which keeps administration smooth and services highly available. While suited for most surveillance applications, traffic agencies and organizations in particular will find the MCS-2080 an ideal fit for environments upgrading legacy infrastructure to provide ever more functionality and returns for tomorrow's security initiatives.

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