

# High Definition Stream Management (HDSM)<sup>™</sup> – Maximum Scalability and Bandwidth Management

## Challenges

### As your video surveillance system expands in camera count and image resolution can your video management system keep up?

The scenario repeats itself all too often: the hourglass or spinning icon when accessing live or recorded video, waiting for the system to catch up. Slow, choppy and blurry video as it struggles to deliver required resolution and frame rate. These are the familiar symptoms of a video management system (VMS) unable to handle the demands of a growing high definition surveillance architecture.

While improved compression technologies like H.264 have provided bandwidth savings over predecessor standards, the overall performance of your VMS is not determined by compression alone. As you expand the count of high resolution cameras within your system, the strain on network and other computing resources undoubtedly increases.

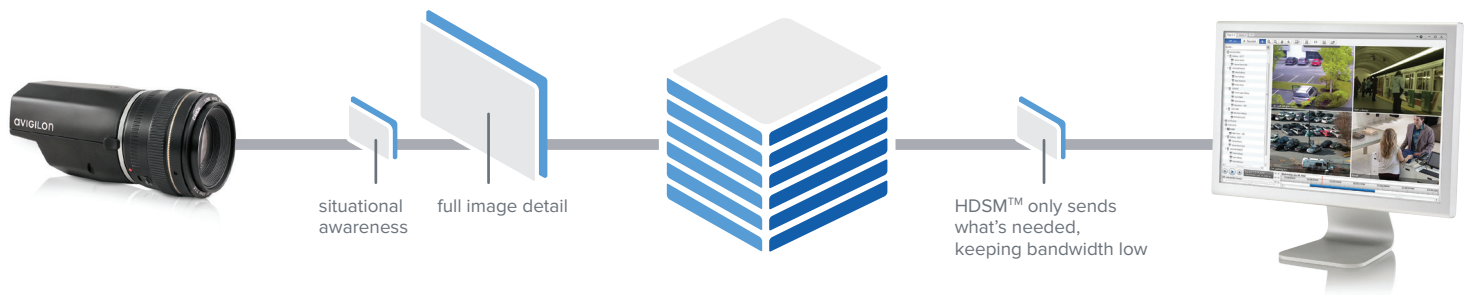
To address the challenge of system scalability and bandwidth management, Avigilon has developed High Definition Stream Management (HDSM)<sup>™</sup>. HDSM<sup>™</sup> is a proprietary stream management technology that drastically reduces server-client bandwidth requirements and makes optimal use of client computing resources, enabling greater scalability and increased camera resolution.

## How it works

While other VMS systems are dependent on leveraging video compression, multicasting and multi-streaming for bandwidth management, Avigilon Control Center software employs HDSM<sup>™</sup> purpose-built bandwidth management technology, which reduces overall network load by an order of magnitude more than traditional technologies.

HDSM<sup>™</sup> stores the video information on the server as small packets. Simultaneously, HDSM<sup>™</sup> separates the video into multiple useable segments: lower resolution and smaller size streams for situational awareness, and much larger streams for full image detail. HDSM<sup>™</sup> then intelligently manages these streams based on what the user is viewing.

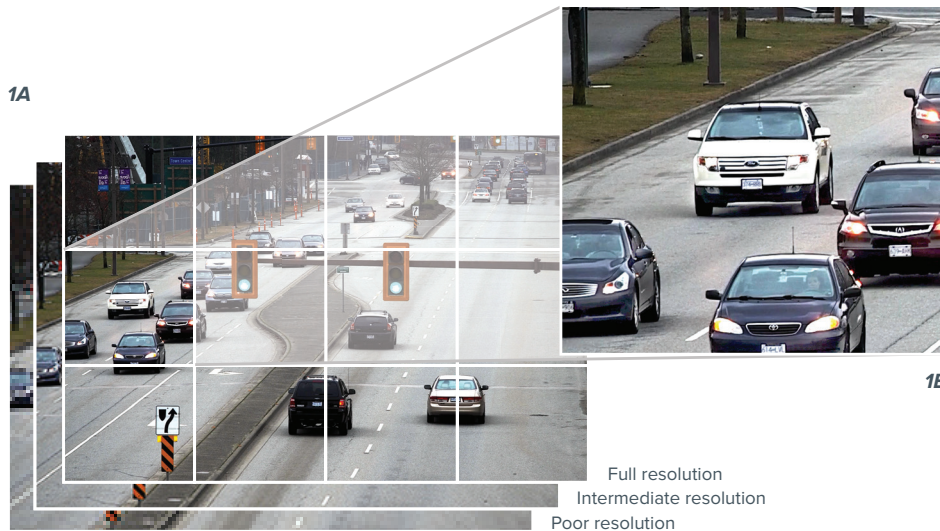
For example, if multiple cameras are being displayed in Avigilon Control Center with full field of view, the lower resolution stream is sent from the server to the client. When the user engages a camera and digitally zooms in for greater detail, the higher resolution stream is provided. However, only the portion from that region of interest is sent. This dramatically reduces the amount of information exchanged between the server and client, by only providing the information that the user needs at that time, regardless of resolution.



# High Definition Stream Management (HDSM)<sup>™</sup> 2.0

Until now, HDSM<sup>™</sup> was most effective with the JPEG2000 compression standard. This was primarily due to the dynamic adaptability of the JPEG2000 compression standard with high-resolution imaging. While JPEG2000 provides coding flexibility and high imaging performance, it also produces higher average bitrate streams and less overall compression than H.264, and is not a widely used standard within the video security surveillance industry.

As a result, HDSM<sup>™</sup> 2.0 was developed to operate with the H.264 compression standard, simultaneously providing users with high-resolution imaging performance, further bitrate reduction of H.264 and the intelligence and flexibility of HDSM<sup>™</sup>. This technology pairing provides a unique and superior network performance over systems solely utilizing H.264 compression. The next section outlines how this works:



**Figure 1A**  
ACC server stores full resolution and low resolution streams

**Figure 1B**  
ACC client receives & decodes only the high resolution streams of the area being viewed

In figure 1A HDSM<sup>™</sup> is illustrated with the white line grid over a 16 MP image. The image is divided into 12 distinct areas. When a user zooms in an area for more detail, only that portion, in this illustration 1/12th of the total resolution, is sent from the server to the client. Not only does this drastically reduce the bandwidth between server and client, it reduces the required decoding resources, which enables improved system performance, responsiveness and overall user experience.

HDSM<sup>™</sup> also uses progressively lower resolutions. For example, if you were to display the full field of view of a 16 MP camera on your 1080p (2MP) monitor, you would receive an intermediate resolution since you only need 2 MP of data. And when a camera is being viewed within a multiple camera display (e.g. one of 9 cameras in a 3 x 3 grid), the lowest resolution is used. In the end, HDSM<sup>™</sup> provides only the resolution and detail you need when you need it.

## Conclusion

For system integrators and end users planning for their video surveillance system expansion, Avigilon Control Center with HDSM<sup>™</sup> technology is a solution that will provide them both increased performance and flexibility. With HDSM<sup>™</sup> 2.0, Avigilon has paired H.264 compression with intelligent bandwidth management technology to create an effective solution in enabling broad system scalability in both camera count and resolution.



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## Part 2: The Technical Details

Part 1 of the whitepaper “[High Definition Stream Management \(HDSM\)<sup>™</sup> – Maximum Scalability and Bandwidth Management](#),” covered the challenges of maintaining high-quality image resolution with expanding camera counts and the details of Avigilon’s HDSM<sup>™</sup> technology, a purpose-built bandwidth management technology. In “Part 2: The Technical Details”, we examine the foundation and key concepts of this revolutionary technology and detail the ways it efficiently manages high-definition video footage while maintaining superior image detail.

### Roots of HDSM: JPEG2000

When it originated, HDSM was a groundbreaking technology, developed to be most effective when applied to the JPEG2000 compression platform. This was primarily due to the dynamic adaptability of JPEG2000 paired with high-resolution imaging. Here’s why: JPEG2000 is a frame-by-frame, or intra-frame, compression technology that applies a compression algorithm to each frame captured by a camera. The resulting video is a series of individually compressed frames that do not require information from other frames. Therefore, each frame is accessible independently, enabling quick access to recorded video. A unique feature available with the JPEG2000 standard is “tiling.” With JPEG2000 tiling, the image is split into rectangular regions in varying sizes, which are transformed and encoded separately. Dividing an image into tiles in this way is advantageous because less processing power is required to decode only the necessary tiles.

HDSM<sup>™</sup> technology leveraged the granularity of the JPEG2000 standard so that the video, in various resolutions, could be stored, accessed and transmitted within specific portions and layers of the image.

### Transition to H.264

As the H.264 compression standard became more widely adopted within video surveillance system components, Avigilon developed its next-generation version of HDSM, HDSM 2.0, to be compatible with H.264 compression. HDSM<sup>™</sup> 2.0 technology embodies features similar to its original version but marries the advantages of the lower bandwidth of compressed H.264 video with the ability to split images into tiles.

Although H.264 compression is a common standard that produces substantially lower average bitrate streams than JPEG2000, the standard presented technical challenges to implementing HDSM at the same level of granularity.

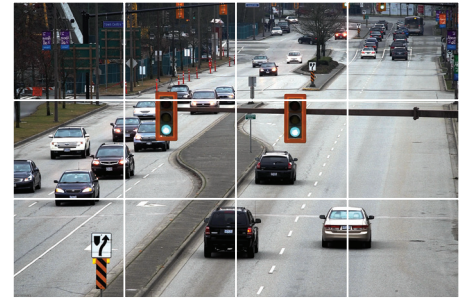


JPEG  
2000

H.264

As a temporal compression standard, H.264 inherently attempts to store only incremental changes between frames and whole frames at periodic intervals. The result is a stream of video that is compressed over multiple frames rather than a series of individual frames, as in JPEG2000.

HDSM 2.0 technology creates a similar tiling feature with H.264 compressed images as JPEG2000, a technological breakthrough for Avigilon. The tiling flexibility for image storage, access and transmission, coupled with the bitrate reduction of H.264, provides unique and superior network performance over systems solely utilizing H.264 compression. This enhanced performance is particularly beneficial when scaling to higher resolution cameras (e.g. 5 MP+) and higher overall camera counts.



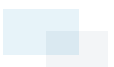
## HDSM versus Transcoding

Transcoding is not an element of HDSM™ technology but it is a popular conversion method throughout the video surveillance industry and beyond. Transcoding is usually applied in cases where a target device does not support the format or has limited storage capacity. Transcoding can also be used to convert incompatible or obsolete data to a modern format with better support. For example, in the video surveillance industry transcoding is commonly used between the video management server and an HTML and/or mobile device client session. Some argue that what most video surveillance technologies use is actually transrating, which is a process similar to transcoding in which files are coded to a lower bitrate without changing video formats. This provides the ability to fit given media into smaller storage space over a lower bandwidth connection.

However, there are limitations to using transcoding technology:

1. Transcoding is a processor intensive service. This is evident when users attempt to view video that has been transcoded or transrated, remotely or on their mobile device. The resulting wait times due to buffering or the need to PAUSE in order to reveal full resolution, does not translate into a positive user experience. HDSM technology avoids this challenge.
2. Sharing CPU resources with other software services can inevitably lead to performance limitations based on resource availability. HDSM™ technology is the core of the Avigilon Control Center (ACC) software for stream management and does not monopolize resources.
3. The use of dedicated hardware required for transcoding dramatically improves performance, but is difficult and expensive to scale to medium and large camera deployments. For example, each transcoding hardware device may only support one to four streams and only one session request at a time. HDSM technology does not require dedicated hardware for operation which enables cost effective and easy scaling to the larger deployment of higher resolution cameras.

In the end, transcoding is computationally expensive and can limit the scale and performance of the video management system.



## How HDSM™ technology benefits the rest of your system

HDSM™ technology effectively increases the efficiency of video stream management across a network without increasing network infrastructure.

For example, HDSM 2.0 does not require any additional processing power from your network hardware. In fact, the processing power required for an H.264 camera stream with HDSM 2.0 has been reduced from previous versions. Here's how:

1. Decoding on the client can be conducted in parallel on multiple CPU cores, enabling lower clock rate, which allows multi-core machines to be used more effectively for the Avigilon Control Center client.
2. In most cases, the client will never need to decode the entire field of view at full resolution.

Consequently, standard commercial off-the-shelf and existing Avigilon hardware running previous versions of Avigilon Control Center can leverage HDSM 2.0 functionality with a software upgrade.



### Video latency

HDSM 2.0 does not monopolize resources in a way that would increase video latency or negatively decrease image quality, which provides users with the flexibility to safely increase camera resolution and total camera count without jeopardizing video quality.

### Conclusion

For system integrators and end users planning video surveillance system expansion, the Avigilon Control Center software with HDSM™ technology is a solution that will provide both increased performance and flexibility. With HDSM 2.0, Avigilon has paired H.264 compression with intelligent bandwidth management technology to create an effective solution for enabling broad system scalability in both camera count and resolution. All of this is achieved without adding hardware with increased processing power, and without increasing video latency or decreasing image quality. As a result, users can safely leverage HDSM 2.0 with current hardware investments to achieve reduced bandwidth consumption while maintaining maximum image detail.

