No Need To Compromise

WITH THE H.264 SOLUTION, USERS DON'T HAVE TO GIVE UP QUALITY FOR BANDWIDTH

Arecont Vision's H.264 Megapixel Cameras offer 25 times higher compression than M-JPEG at a lower bandwidth requirement.

By Raul Calderon

H.264 compression of megapixel surveillance cameras may be the most important advancement in IP camera technology since IP cameras were first introduced. Essentially, H.264 allows for high-definition megapixel cameras to use bandwidth and storage comparable to that of standard-definition VGA cameras.

In order to take advantage of the benefits of IP-based systems, security professionals must understand the nuances of IP video. There are two issues relating to IP video (and more specifically megapixel video) that need to be addressed. They are the limitations of bandwidth and the fact that high-definition digital video data requires greater amounts of storage/recording space. The key to striking the right balance comes down to one critical factor – compression. The emergence of the H.264 standard is significantly changing the demands of megapixel video on bandwidth, and consequently, storage utilization. For this reason, the limitations are becoming much less of a factor.

Let's look at a typical scenario one faces when considering a network video solution. Less compression results in greater picture quality and larger file sizes. Increasing compression results in smaller file sizes, but lower picture quality. The issue has become critical as conventional high-performance megapixel IP cameras gain further traction for general video surveillance. The criteria one needs to consider are as follows: image quality (compression), the size of the images (resolution) and cropping and the number of images recorded or displayed per second (frame rate).

For example, let's compare two separate images set at the same picture quality settings using M-JPEG-based compression — a conventional VGA image with 640 x 480 resolution versus a 3-megapixel image with 2,048 x 1,536 resolution. Each image is transmitted at a rate of 15 frames-per-second (fps). The 3-megapixel image stream might use 18 to 25 Mbps while the VGA stream might require only 2 to 3 Mbps. If one starts adding cameras – perhaps several hundred cameras – then bandwidth requirements quickly escalate. For large systems with multiple megapixel cameras, it can be challenging to transmit and store such large volumes of data without sacrifice, even with the proliferation of Gigabit Ethernet configurations and the rapidly decreasing price of storage.

The compromise typically made when confronted with this bandwidth and storage barrier in regard to megapixel imaging is to downgrade to lower resolution solutions such as D1 or VGA. However, using H.264 provides 5 to 12 times compression efficiency on average compared to M-JPEG implementations. This depends on the amount of light in the scene, which causes more or less noise, and the amount of motion in the scene. Let's assume a conservative H.264 compression efficiency of eight times — a 3-megapixel video stream now results in a bandwidth requirement of between 2.25 and a little more than 3 Mbps. This is similar to the bandwidth requirement of IP VGA cameras at the same frame rate using M-JPEG. And, the H.264 3-megapixel stream still maintains the intrinsic benefit of 10 times the pixel density of VGA.

The need to compromise resolution for bandwidth and storage is significantly reduced using H.264, in effect giving users another reason to take advantage of high-definition megapixel video.

At other times, a frame rate reduction approach is taken with megapixel video in order to reduce bandwidth. However, there are no frame rate reduction compromises required with current implementations of H.264 megapixel cameras. Megapixel video now achieves the same real-time frame rates as VGA at near VGA bandwidth requirements, e.g. 30 fps at 1,280 x 1,024 and 24 fps at 1,600 x 1,200. Moreover, at higher frame rates, H.264 becomes more efficient than at lower frame rates while M-JPEG does not.

If reducing the video frame rate is unacceptable, many times, decreasing the picture quality (increasing compression) is used to compensate. However, increasing the compression increases the amount of noise and picture artifacts. At some point, this will render the image unusable. It's a delicate balance. With H.264, the desired balance is achieved to result in high compression, full frame rates and high-definition resolution.

An additional consideration is the system components themselves. Servers or computers have their own limitations, including the ability to process data rapidly. This can be considered "internal" bandwidth. It is a misnomer that the CPU load is necessarily greater to decode H.264 versus M-JPEG. The mathematical complexity is in encoding H.264, which is done in the camera. The complexity of decoding M-JPEG and H.264 is similar. In fact, real applications show a reduced CPU load due to smaller stream sizes under similar quality settings.

The H.264 solution

The introduction of H.264 compression for video surveillance is marginalizing the degree of compromise between image size and resolution versus bandwidth and required storage capacities – especially when considering the use of megapixel IP cameras.

H.264 megapixel cameras offer a marked improvement in overall performance, and related devices greatly alleviate earlier tradeoffs between bandwidth utilization, streaming capabilities, file size and image quality for large-scale recording and transmission.

About the Author

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