H.264: Is it always the best compression fit?

Bandwidth, storage savings touted, but unpredictability, limitations exist

BY L. SAMUEL PFEIFLE

At IFSEC 2007, when the video compression standard H.264 was starting to be touted by manufacturers, the knock against it was that it was too processor intensive to be economically competitive. Just three years later, Axis Communications general manager Fredrik Nilsson is confident H.264 is ready to become, if it isn't already, the compression standard that will be used for the foreseeable future.


Paul Bodell

Raul Calderon, VP of strategic relations at Arecont Vision, went a step farther: "Not only do Fredrik and I agree, so does Steve Jobs. When he introduced the new iTunes platform, he announced that H.264 is the greatest compression standard in the history of the world, and he's platforming everything on H.264 because of its robustness. If it's good enough for the consumer market, it's got to be good enough for the security market."

Not everyone in the market is so sure of H.264's imminent ubiquity, however.

Rick Ramsey, CTO at Avigilon, which trades in high-megapixel cameras, and so values good compression, acknowledged "it's a straight-up evolution from MPEG-4." But, he said, "it gets to be more complex of a discussion when you compare it to compression standards other than MPEG-4. It becomes much less valued."

"Apples to apples, high frame rate to high frame rate, if you have a limited amount of bandwidth, you'll get more H.264 frames than you will with motion JPEG," Paul Bodell, VP of marketing at IQinVision said. "As far as image quality goes, though, if that's paramount, the only types of H.264 that even approach MJPEG are the very high-end profiles, and that's not what's in security cameras."

APPLES TO APPLES

First, it's perhaps best to back up and give a little background on compression technologies for the less initiated. The more initiated can skip this section.

The flavors of compression that include the word "JPEG" involve distinct frames, captured as JPEG images, and streamed together to create video. If you were to examine any individual frame, you'd get a still image much like a photograph. These types of compression reduce file size by degrading the quality of each individual image in a uniform way. On the other hand MPEG, of which H.264 is a type, is able to perform the wonders of file compression by taking periodic reference frames and then keeping only those pieces of images in between that change. Thus, H.264 is able to toss aside repetitive information in the file, making it smaller and smaller the less things in the field of view change.

The result is that the JPEG flavors give you a steady stream. You set the frame rate, you set the image quality, and you get a predictable data stream that will take up a predictable amount of storage. With H.264, you can set the frame rate and the desired image quality, but as the scene being recorded varies, the data stream will vary. If more happens, more data will be needed to capture what's happening.

APPLES TO ORANGES

As you delve into H.264, you begin to see what it is that Bodell is referencing: There are different "profiles" of H.264, which include everything from "constrained baseline profile," which is used in applications like video conferencing and mobile video, to "high profile," which is used by broadcasters and the Blu-Ray Disc storage format. As you might imagine, video surveillance manufacturers use just about everything in between.

"H.264 is like the Bible," said Bob Kusche, security solution advisor for systems integrator Ojo Technology, "everyone interprets it differently."

"We use what's called the main profile," said Bodell. "Some companies use baseline and constrained baseline, and that's the equivalent of saying yeah, a motorcycle is a motorcycle is a motorcycle, and they all have different CCs. You can't say all those things are the same, and everybody has left out those specifics in the marketing hype."

Further, even though there are these stratifications of H.264 defined, many manufacturers have their own flavor of H.264 that exists outside of what might be considered "standard." For example, while many people feel H.264 is only appropriate up to the 1080p HD standard, the folks at Arecont Vision would strongly disagree: "We have the most scalable H.264 engine in the world," said Calderon, "and I can say that as a matter of fact. We not only have above 2 megapixels, we have up to 10 megapixels with H.264. We're not using off-the-shelf codecs. We're using our own intellectual property, a pipeline that's processing the image at a faster clip than just about anyone else."

This, said Kusche, leaves you with pros and cons for working with Arecont's cameras. On the plus side, he said, Ojo won a bid in San Jose using Arecont cameras to "make a big difference for the storage requirements ... We came in $100,000 under all the other bidders who didn't use H.264, and that was pretty early on in the development of the camera." On the con side, however, because the cameras were still pretty new to the market, "Milestone wasn't ready to handle the Arecont cameras, and it wasn't really

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H.264 standard examined

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Milestone's fault ... They were doing their best to make it work, and Arecont showed that it could work with their native software, so they kept at it. It was kind of touch and go until it finally did work in deployment."

The lesson? With H.264, as with any new technology in the marketplace, you've got to do your homework. "You have to be very careful that the recording mechanism will match the camera that supplies the output," Kusche said. Just because a DVR says it can handle H.264 doesn't mean it can handle every H.264 stream. "It's that Bible analogy again," Kusche joked. "We don't have 64 versions of Catholicism for nothing."

APPLICATIONS

So, as long as you figure out which cameras work with which recording mechanisms, is H.264 appropriate for every application? Many people say, yes, why wouldn't you want to use less bandwidth and storage? "The standard is very well suited for the security market," said Calderon.

And there are integrators who love it, too.

"I haven't had any issues with H.264," said Sean Woods, head of Valley Ag Software's security installation division. "I like it quite a bit."

But there are others who say while H.264 has its place, there remain applications better suited for the JPEG flavors.

H.264 is much less flexible than JPEG2000, said Dave Tynan, VP of sales for Avigilon. For example, if you're working with very large files, like the 16 megapixel streams created by Avigilon's cameras, JPEG2000 allows you to sample those images when you call them back from the storage device. If you are only looking at two megapixels of that 16-megapixel image, that's all that gets streamed across your network. With H.264, you get the whole file or nothing. There's no in between.

"The processing needs for H.264 at the work station become greater when you have larger and larger systems," Tynan said. If you imagine a system with 15 five-megapixel cameras, and you compress that stream with H.264 back to an NVR, when you then want to look at the stored images, "you have to request all those five megapixel images," Tynan said, and there's not a lot of client machines out there, short of powerful work stations, that can decompress 80 megapixels all at once. With JPEG2000, you're only occupying that one megapixel of information that can actually be displayed on the screen, so your client machines can handle that better, and the bandwidth for the request has gone from 80 megapixels to one megapixel."

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Stephen Grein, DVTel's global director of corporate marketing, said there are times, too, when you want to use something JPEG-based if you're in a constrained bandwidth situation. "I know you're scratching your head with that one," he said, "because didn't I just say that H.264 is much lower bandwidth consumption? And it is, but with MJPEG I know that I'm going to be able to allot a certain amount of megabits per second to that camera, and I can adjust to meet that exact bandwidth allotment."

"It's really important that you only use it when it's indicated."
—Bob Kusche, Ojo Technology

It's also true that, unless you're using one of the higher-level profiles, the images H.264 produces just aren't as good. "We're known as the image-quality guys," said IQinVision's Bodell, "and we're not the cheapest, so, at the end of the day, our customers want image quality. If we deployed baseline or constrained baseline, we don't think people would be pleased. So we puttered around with the baseline stuff, but for the 1080p camera, we went with main profile, and you get really nice image quality, but then you get the challenges with more data that come along with it."

"It's really important that you only use it when it's indicated," said Kusche, "like for small bandwidth or reduced storage requirements. If we want to record as long as we can, that's a case where H.264 is perfect. But the images are more blurry, and they're not as reliable as good old MJPEG. It's not as crisp for the screen shots people want to capture."

JUST HOW MUCH BANDWIDTH DO YOU SAVE?

Much of the debate surrounding H.264 centers around just how much bandwidth and storage the compression format actually saves. Yes, it depends on which profile you're using and thus the quality of the images being transmitted (there are ways to see as much as 90 percent reduction in storage and bandwidth usage, but that doesn't mean the video is any good), but even if everyone were to agree to use the main profile, or something higher, not everyone would see the same advantages because of the way the compression actually works.

More than one person interviewed described predicting bandwidth consumption with H.264 as "more of an art than a science."

Bodell tells a story of a school principal who had an H.264 system installed when school was out over the summer. He marveled at the amount of cameras that could broadcast over the network. Then, the kids showed up. The only time when the cameras were of use—when there were students in the hallways—the bandwidth usage spiked to the point they couldn't actually use the network. So, they switched the cameras to stream at a constant bit rate, and that left them with pristine images when nothing was happening and blurry images or low frame rates when the students flooded into the halls.

Others say this is just an example of bad system design and poor

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was based on a guide intended to aid in installation of video for verification purposes, but wasn't meant to be a technical certification for next-generation monitoring firms.

Chairman of the CSAA's Video Verification Standards Committee Jim McMullen, who is president and COO of C.O.P.S. Monitoring, agreed. "It doesn't get into any of the technical aspects. It's basic and it's designed for a central station dispatcher … so they can call the police and say, 'Hey, listen we've got video on this and we see a burglar there,' and the police are going to come out on a higher priority. It's not designed for manufacturers. We're not touching any of the technical specifications. We're just dealing with procedures for proper use of video for verification purposes."

Cordasco felt CSAA's efforts were only a start. "They're trying to write a standard for video verification, but that's a half measure. Video verification, in my mind is really not anything like what we do at G4S," Cordasco said. "Unfortunately when you talk about video monitoring centers the likelihood is that 80 percent of them are going to be conventional monitoring centers that do video verification. There are so few of us that do real, primary video monitoring."

"I can see the traditional central station asking themselves, 'How hard could it be?'"
—Michael Hanlon, ViewPoint CRM

This lack of contemporaries is problematic on two fronts, according to Cordasco. First, without a huge demand from a large base of comprehensive video monitoring centers, UL may have less impetus to create the standard since there will be few companies applying for the listing and paying for the audit. Secondly, the fact that there is no standard could lead to more and more conventional monitoring centers attempting to dabble in video monitoring, which may lead to attrition through customers dissatisfied with over-promising and under-delivering. Such an eventuality would hurt the entire industry through the bad taste left in end users' mouths.

Hanlon agreed and noted it was the mission of the Remote Guarding Alliance, an industry association of video-focused manufacturers and service providers, to promote best practices. "I can see the traditional central station asking themselves 'how hard could it be?' … For every account that we've picked up where people have said to us, 'We believe in this, and we want to go with you,' there's a client who says, 'Oh we tried that and it doesn't work,'" Hanlon said. "The mission statement of the Remote Guarding Alliance is to say, 'Look, there are best practices and industry standards and the terms that are being kicked around somewhat carelessly need to be looked at with more precision.' We need to let people know that video verification and crisis intervention specialist are two different things."

The Remote Guarding Alliance—comprising charter members Elite Interactive Solutions, Rapid Response Systems, Smart Interactive Systems, Statewide Security, SureView Systems, VideoIQ, ViewPoint CRM and Visentry—debuted at ASIS 2007. Members of the Alliance are meeting at ISC West in Las Vegas this year. The Alliance's goal is to improve security and customer assistance services across a wide variety of industries through the use of analytics-enabled remote guarding.

"I don't see it coming in the near future. I'd love to see it, but I just don't. I think that we are—those of us who are seriously in this business are learning it every day—we are really in the early days. The use of analytics, the methodology, the transmission, the pricing, everything that's wrapped around video monitoring is really new. And anyone who tells you that they have a rich understanding of this is lying," Cordasco said. "We're changing each day and adjusting each day. So to write a standard now would be pointless because you'd have to rewrite it right away. Everything we know about monitoring now is included in the standards we have today, and those are applicable to both normal burg and video. Whatever standard ends up getting passed will be an adjunct, an amendment to what already exists. I mean the regular monitoring business has been around for like a hundred years."

A look at H.264

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salesmanship on the part of the integrator that sold the system.

"Does that effect happen?" asked Valley Ag's Woods. "Yeah. Is that a bad thing? I don't think so. As a network administrator, I look at what's happening on my network as a whole, not really a single stream. To nitpick one stream is getting a little too granular unless the stream is a problem. If it fluctuates a little bit, then it's the management of the bandwidth on the network. If you're building a fringe network, and you want that stability of MJPEG so you can do that equation of x cameras times y bandwidth, and that's how much you build, well, that's like saying I need a 15 foot wide semi truck to go through a tunnel, and then build the tunnel only 15 feet and one inch wide. Maybe you should build a bigger tunnel."

DVTel's Grein agreed. First, he said, H.264 is significantly better than MPEG-4, which spikes in the same way, but with H.264 it might be the same percentage spike, but it's a percentage of a much smaller number in the first place. "So it's like crying wolf when there's a cocker spaniel," he said. "Is it something you should be aware of? Absolutely. But sometimes you're your own worst enemy. You want to tell the customer the right thing, and capitalize on the hype that is H.264, but you need to be aware of the issues. You have two guys coming in and they want to top each other and eventually you've got someone saying he can put 6,000 cameras on one server and it's not physically possible and it leaves the customer in a bad position.

"But some of that lies with the customer," he continued, "to not buy into the hype."

Tynan agreed on this point as well. "How do we educate the entire marketplace to some of these nuances?," he wondered aloud. "If I'm an integrator, where do I get my education to deploy appropriately? Where do end users get that education? There's a lot of education in front of us."