Technical Brief

Understanding MPEG-4 Compression

BOSCH

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Compression technology has become a hot topic in the security and surveillance world today. In the early days of digital recording people were just happy to have a device that eliminated VHS tapes. It didn't matter what scientific algorithm the engineers used to compress and store the video on a hard drive. It should come as no surprise that the most expensive part of a recording system is the hard drives. As the amount of video being recorded increases, people are taking more of an interest in compression. It can mean the difference of several thousands of dollars, even tens of thousands in larger systems. All because of a few kilobytes difference in compressing video data.

The most popular recorders and cameras being developed now are using a compression technique called MPEG-4. This Technical Brief explains why MPEG-4 is better suited to modern-day CCTV needs.

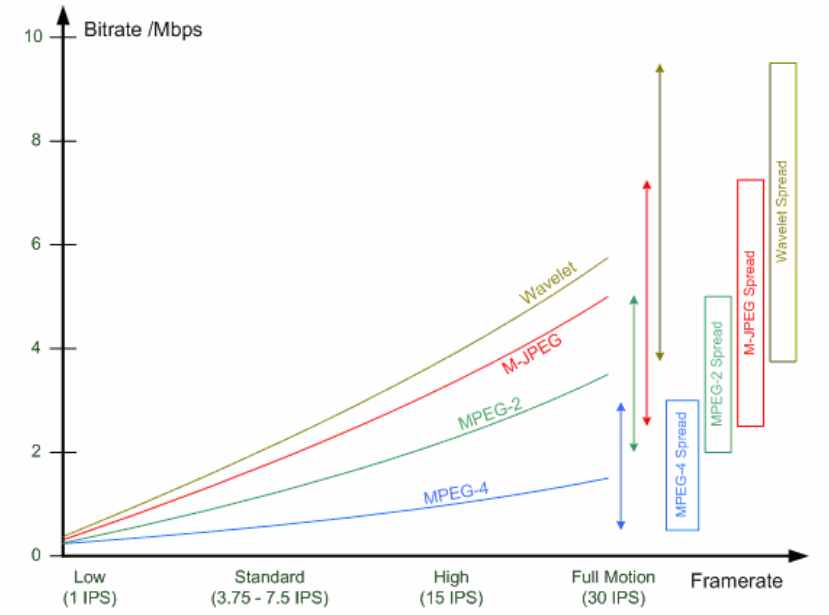
When we calculate storage requirements on a DVR today, we use simple spreadsheets, or the datasheet to get an idea of what typical storage times can be achieved with desired frame rates and quality settings. For example, in order to get 14 days of storage from a DESA I would need to answer some basic questions:

1. How many cameras are being recorded?
2. How many images per second per camera?
3. How many hours per day will recording take place? (Any motion recording)
4. What is the desired file size (quality)?

A simple calculation based on these answers results in the amount of time you can expect to store recorded video. Moving to MPEG-4 is going to cause you to change your thought process of calculating storage requirements. MPEG-4 doesn't work quite like JPEG or Wavelet because the file size is not only dependant on the quality selected, it also depends on the frame rate you wish to record at. Back to the DESA example; if the best quality and resolution are selected the average file size of the images will be around 12 kB. This 12 kB will not change no matter how many images per second (IPS) you select (1 to 30). MPEG-4 would not stay at 12 kB if the frame rate is changed. DiBos for example has an average file size of 2 kB to 4 kB at 30 IPS and 2 CIF resolution. If the IPS is changed to 1, the file size would jump to 25 kB per image.

"But I thought MPEG-4 was supposed to be more efficient than all other compressions."

Our tests, shown in the chart to the right, prove that it *is* more efficient than the other compressions in use today. MPEG-4 is based on a conditional refresh of images and the changes that take place in those images. This chart shows that at low frame rates it makes little difference which algorithm you use. But it also shows that at high frame rates Wavelet and JPEG use on average more than 5 times the disk-space.



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I Frames and P Frames

MPEG-4, a temporal compression algorithm, relies on I frames (index frames) and P and B frames. The I frames are whole images, which have larger file sizes. The P frames are the little changes that occur between the I frames. This makes for a tremendous advantage over Wavelet or JPEG at high frame rates since there are a lot of little P frames that bring the average image size down. In the example shown in Figure 2 below, frame 1 and 5 are index frames (I frames) and frames 2, 3, 4 are the changes from the last frame (P and B frames); together this sequence is called a Group of Pictures (GOP). The larger the number of P and B frames, the smaller the video stream will be.

Figure 1: *A Five-picture JPEG video sequence.*

Figure 2: *A Five-picture MPEG video sequence.*

What does this mean?

If the application is going to be using low frame rates, the difference in storage time may not outweigh the additional cost of a higher end unit. But, once the 1 IPS barrier is broken the efficiency of MPEG-4 is far superior to other compression algorithms.

In other words MPEG-4 is marginally more efficient at very low frame rates, but once recording rates reach 5 IPS, MPEG-4 is by far a more efficient compression technology. The "industry" has trained customers to ask for CIF resolution images and between 1 and 3.75 IPS frame rates (accelerating to 7.5 IPS on alarm) because older compression schemes were very inefficient and storage was therefore costly. Customers really WANTED higher quality images and higher frame rates. MPEG-4 allows us to deliver what the customer really wants at a price they can live with.

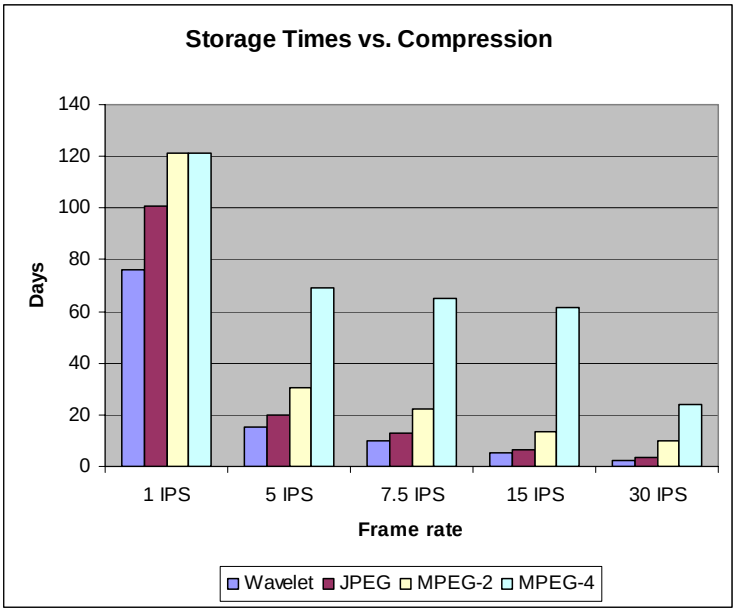

Chart is based on a 250 GB hard drive with 1 camera recording 24 hours per day, 2 CIF and a medium activity scene.

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