MPEG-2 vs. MPEG-4 vs. H.264

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There is a lot of confusion about the various encoding technologies in the ITS market today with regard to established standards and forthcoming standards.

MPEG-2 is still the de facto standard for ITS systems throughout the United States. MPEG-2 is an International standard established many years ago, known for providing very high quality, but also requiring substantial bandwidth. Think of MPEG-2 as the following: DVD's, Comcast Digital Cable, Direct TV Digital service. This technology is used extensively throughout multiple markets due to its quality and its recognition as an International standard. MPEG-2 is the first video standard to have been adopted by both the MPEG committee and the ITU standards organization.

As the MPEG-2 technology matured, hardened MPEG-2 encoders started being deployed in ITS circa 2001. Since the vast majority of ITS networks utilize fiber, 100M or 1G Ethernet backbones are commonplace, and bandwidth is not an issue. The high quality is preferred for TMC applications where videos are displayed on large wall screens, and for sharing the video with other agencies like television stations which want a very high resolution video feed.

Additionally, many MPEG-2 manufacturers made their product with ITS in mind. The products are temperature hardened and the data ports are true terminal servers and are not tied to the video stream. The latter function is very important when dealing with other field functions and devices like PTZ, radar detectors, DMS, etc.

MPEG-2 comes in three basic streams: Elementary (video only), Packetized Elementary Stream (video + audio) and Transport Stream (multi-channel video + audio). Virtually all MPEG-2 encoders for ITS are either or both Elementary and Transport streams. While there is no interoperability between Elementary and Transport stream, many vendors interoperate at either Elementary stream or Transport stream.

While MPEG-2 suited the ITS market and high quality video market (DVD, Digital cable, etc.), it did not suit getting video to the Internet, nor did it suit the traditional security industry which was accustomed to multiplexed video at sub-30fps frame rates. The MPEG committee started working on a new standard which was to be called MPEG-4. The goal was to provide video at the same quality as MPEG-2 but with less bandwidth. They also were targeting very low bandwidth applications such as Internet video and PDAs. During the development of MPEG-4, the MPEG group realized they could not meet their goals working in the current direction, and started a second group to work exclusively on H.264 as the new International Standard.

MPEG-4 has 16 different types, with 3 variants within each version, making interoperability a rare occurrence. In addition, manufacturers will often include proprietary data encapsulation, locking users into their solution. These products are often acceptable in a security application where only a limited number of internal users have access to the video. In ITS applications, where numerous users are present and video is expected to be shared between various organizations, proprietary MPEG-4 solutions are simply not acceptable.

What we call MPEG-4 in ITS is more commonly known as Type 2 – Advanced Simple Profile (ASP). MPEG-4 ASP is a MPEG committee standard, but not an international standard. By definition, it offers a CIF resolution (320x240, ¼ image). Some vendors have quadrupled the stream to be 4 CIF, which should be close to MPEG-2's full D1.

MPEG-4 became popular in security markets due to its low cost and its ability to operate at a reduced frame rate for video recording. MPEG-4 started being used within ITS in locations that were bandwidth limited (wireless networks, DSL, etc.). MPEG-4 video, even at 4CIF, does not provide as good a video as MPEG-2; however, it is well suited in low bandwidth applications.

There are many more players in the MPEG-4 arena because it is a much broader marketplace (security), but many products do not adapt well to ITS. Having data port(s) that are not true terminal servers presents problems with full use of the data port. Most software programs simply open a socket to an IP data port for control, but if the data port is tied to the video, this control cannot be managed.

We sometimes see MPEG-4 in Internet video (ala Apple's QuickTime and iTunes). It is not used in high end consumer applications like MPEG-2. There is also a fallacy that MPEG-4 can be streamed from an encoder direct to the Internet for the general public to view. This is not the case, and we will discuss streaming video to the Internet in more detail shortly.

At this point, MPEG-2 is used predominantly in ITS and MPEG-4 is also used primarily in low-bandwidth applications or where cost is a strict factor. The MPEG committee continued development on the H.264 front (which is also called MPEG-4 Type 10 – Advanced Video Codec). H.264 became the next International Standard in 2007. Along with MPEG-2, H.264 is the only other video standard to have been adopted by both the MPEG committee and the ITU standard organization. Since its introduction as a standard, the technology has lowered in price, and hardened units are on the near horizon.

When we consider H.264, we should think – Blue-Ray DVD, Comcast HD Digital Cable, Direct TV HD service, etc. It is the next standard and it will replace MPEG-2 and MPEG-4 in the future. MPEG-2 will remain in use longer due to the vast deployment of systems currently utilizing that standard. MPEG-4 will most likely become an obsolete technology in much shorter term.

H.264 will provide MPEG-2 quality at a lower bandwidth. It will also allow scaling to MPEG-4 low bit-rated and/or frame-rates for bandwidth limited applications. It should also come in at a price point lower than or equal to MPEG-2. We expect to start seeing full scale deployment of H.264 in mid-2009. It will take some time for products to grow to all of the functionality currently built-into MPEG-2 and MPEG-4 devices, but most of that should be upgradeable with simple firmware updates.

One of the most interesting features of H.264 is its ability to provide a native stream direct to Streaming Media Servers (reflector services) for general viewing on the Internet. Let's consider this in more detail, as there is a growing interest to replace MPEG-2 snapshot JPG traffic views with streaming video.

MPEG-2 is not suited for Internet usage due to its high bandwidth. The only way to get MPEG-2 to the Internet would be to transcode it – decode the MPEG-2 and re-encode into another low-bandwidth format. For a large system, this solution is not cost feasible.

MPEG-4 stream can be viewed using Apple's QuickTime player. There are several limiting factors to MPEG-4 which makes it an unattractive solution. First, the QuickTime download is very large and usually wants to install iTunes. And there are frequent upgrades that are also large. More importantly, the Streaming Media Service (reflector service) for MPEG-4 is called "Darwin" and it is a free, non-supported product. Most public entities will not incorporate a non-supported software platform for a feature such as this.

Over the last few years Adobe Flash has become the dominant solution for internet video streaming,– thanks largely in part to YouTube. It is estimated that 98% of computers in the world have Flash player installed, thus making any flash based solution seamless to the end user. Anticipating the wide adoption of H.264, in early 2008 Adobe released its new flash server and player with built in native support for H.264. Adobe has created Streaming Media Services which takes a native H.264 stream and converts it to RTMP for use with Adobe Flash. Other companies have followed Adobe's lead in offering very inexpensive, fully supported services, so we will see a lot more traffic video streaming on the web once H.264 is deployed. Wowza is a company that has demonstrated live video streaming using H.264 RTSP-based video encoders. RTSP standardizes the transport of compressed video over an IP networks.

In summary, H.264 will be the next technology adopted by and implemented within ITS, allowing streaming video to the general public via the Internet. We will see both MPEG-2 and MPEG-4 enter the end of their technology lifespan, but the full transition will still take some time.