

# HDTV IN EUROPE: THEORY & PRACTICE

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One of the great strengths of the DVB architecture is that the same generic specifications are used for the baseband signal regardless of the delivery medium. This means that the same DVB video and audio coding specification, TS 101 154, is used for any DVB HDTV service that is based on the MPEG Transport Stream whether this is delivered via terrestrial, satellite, cable or a phase 1 IP network. DVB specifications have supported HDTV since 1998 and the first commercial HDTV deployment in the DVB world began in Australia in 2001. However, it is only recently that major commercial HDTV services have launched in Europe. This means that Europe is now able to deploy second generation DVB systems, e.g. using a combination of DVB-S2 transmission and H.264/AVC video compression coding.

A key issue for broadcasters is deciding what bit-rate is actually needed in practice to give a reasonably good quality HDTV picture. This is a complex issue, as there are many factors to consider:

- Coding Specification - MPEG-2 or H.264/AVC or VC-1?
- Encoder implementation - single pass or multi-pass?
- Nature of content - talking heads or sports material?
- Video format - 720p or 1080i?
- Statistical multiplexing - constant bit-rate or variable bit-rate?
- Customer proposition - good picture quality or lots of channels?

Although the specifics depend on many factors, the general trend is one of improving coding efficiency over time. Within that, there are periods of evolution, due to improving encoding implementation within a specification, interspersed by moments of revolutionary change to a new algorithm, when a new decoder is needed. The primary driver for both the periods of evolution and the moments of revolution is that Moore's Law allows more complex processing to become practical over time.

In an attempt to translate the effects of Moore's Law into bit-rate, I came up with the modestly named McCann's Law, first described at DVB World in 2003. This states that the bit-rate required to achieve a given audio or video quality halves every five years, assuming that both evolutionary and revolutionary improvements are implemented as early as possible.

In the real world, improvements do not follow a smooth curve as legacy issues allow only infrequent changes of algorithm.

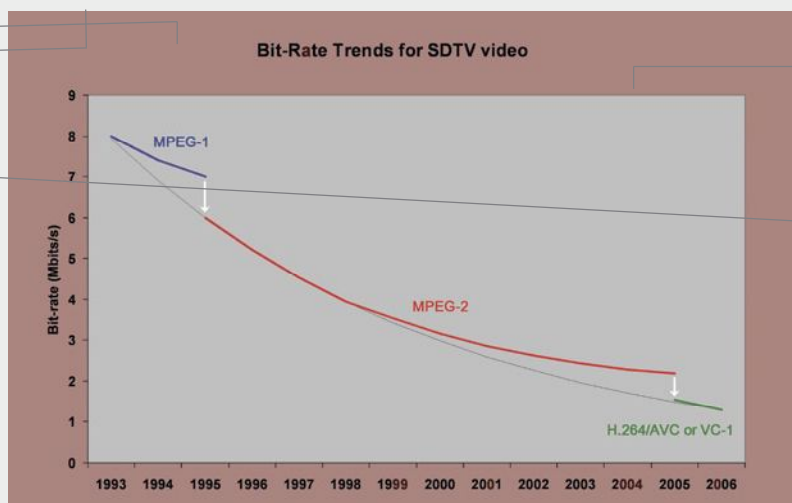
In 1993, a practical SDTV MPEG-1 encoder needed about 8Mbit/s to give reasonable quality. The first MPEG-2 encoders in 1995 needed about 6Mbit/s and since then there has been progressive improvement until today it's possible to get reasonable quality using MPEG-2 at an average video bit-rate of about 2 Mbit/s, when part of a statistical multiplexing group. However, the potential for further improvement with MPEG-2 is now reducing and to get back to the idealised curve requires an algorithm change to one of the advanced coding specifications: H.264/AVC or VC-1.

However, in the case of real-time HDTV encoders, the rate of improvement in practice has been significantly less than for SDTV. One reason for this is that the smaller number of channels per multiplex means that the introduction of



encoders to be better tuned. At DVB World this year I predicted that in a year's time the best implementations of the advanced coding algorithms should allow good quality HDTV video at about 8-10 Mbit/s for 1080i and about 6-8 Mbit/s for 720p.

But in the meantime, my plea to broadcasters is to avoid the risk of giving HDTV a bad name by prematurely cutting the bit-rate. HDTV is sold to customers on the basis of excellent picture quality and it's important that is what they get. With today's encoders that may mean initially allocating up to 15Mbit/s per channel.



statistical multiplexing techniques did not yield as much of a benefit for HDTV as it did for SDTV. But the main reason is that today's real-time HDTV encoders for H.264/AVC or VC-1 do not yet fully exercise all of the additional tools in the new algorithms, such as variable block sizes. Non real-time software encoding shows about a factor of two improvement over MPEG-2, whilst the improvement with real-time hardware encoders is only marginal.

Over the coming year I expect this situation to change significantly, as more of the new tools are included and improved understanding of how the various tools interact will allow the

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