



H.264 – the new video codec

BT's leading-edge implementation

Revolutionary video compression is here. The new video compression standard, called H.264 (also known as MPEG-4 Part 10 AVC) has been jointly achieved with both major standards bodies (ISO and ITU MPEG), and is fast gaining industry acceptance. BT has one of the highest performance, highest quality implementations to date.



Approved as a standard in May 2003, H.264 has attracted great interest in the industry by compressing video into lower bandwidth for the same quality, compared to existing video compression systems (e.g., MPEG-2 and MPEG-4, H.263 and Windows Media Player 9[®]). For example, for the same picture quality, BT's H.264 can compress video to one third of the size of MPEG-2 streams. Savings of this magnitude are achieved over the whole range of bit rates from the very low bit rate mobile channels of GPRS, through ADSL and beyond.

H.264 is a development of existing MPEG and H.26x compression schemes. It uses block transforms and predictive motion compensated coding. H.264 takes advantage of greater processing power now available (especially for encoding) with multiple reference frames and block sizes for motion compensation, a new 4x4 integer transform (better performance than previous DCT), ¼ pel motion compensation, improved entropy coding and in-loop de-blocking filtering. This

offers considerable improvement in compression, but requires more processing. Hence an efficient implementation is essential. With current products, there is wide variety in the achieved compression, picture quality and processing power needed.

Our implementation of H.264

BT has developed a software implementation of the standard, which currently runs on PCs (Windows or Linux), and mobile handsets such as the Compaq iPAQ and Nokia 7560. The core encoder/decoder has been written in standard C++ so that it can easily be ported and optimised for many platforms.

Our implementation is a virtually complete implementation of this very comprehensive standard, but can be tailored to specific needs. It is high performance in terms of compression efficiency, picture quality and processor utilisation.

Features of BT H.264 suite

Feature	BT Implementation
Profiles	All 4:2:0 8 bit profiles (Baseline, Extended ¹ , Main, and High)
Levels	All
Resolutions	Any, including: QCIF (176x144) CIF (352x258) 525 SD (720x480) 625 SD (720x576) custom
Frame rates	Any (typically up to 15fps for QCIF, 30fps for SD, 60fps for HD)
Bit rate	Any. Typically 10kbps to 4Mbps VBR or CBR
Video frame format	YUV 4.2.0 (4.2.2 can be handled, and is converted to 4.2.0)
Compressed video format	Various, including NAL stream. Will support the RTP format RFC 3984 (see ftp://ftp.rfc-editor.org/in-notes/rfc3984.txt). Can also be provided in various streaming formats.
Pre-processing	Scene change detection
Encode latency	1 frame
Conformance	Verified by bit-stream exchange and

¹ Data partitioning is not implemented as we believe this feature will be little used.

verification against JM9.3 reference
software.

Implementation and performance

Feature	BT Implementation	
Language	C/C++. Some elements optimised for specific platform instruction sets, but full C/C++ code is available.	
Platforms	PC (Windows and Linux) Pocket PC (ARM, including Compaq iPAQ) Symbian (including various Nokia and Motorola phones)	
Multiple speeds	Multiple speed encoding is provided, using SP-frames ² to allow switching.	
Decoder performance ³ (Generic C++ code)	2GHz Intel P4	QCIF @ 500 fps CIF @ 125 fps SD @ 30 fps
	Compaq 250MHz iPAQ	QCIF @ 15 fps
	Symbian (Nokia 7650, 100MHz ARM 9)	QCIF @ 12 fps
Encoder performance ⁴ (Generic C++ code with SSE for Motion Estimation)	2GHz Intel P4	QCIF @ 64 fps CIF @ 17 fps SD @ 4 fps
Toolkits	Various tools are available for encoding, decoding and quality assessment. The software is available as stand-alone applications, or code to be built into solutions.	

² Feature patented by BT.

³ These decoder performance figures are indicative figures with generic code. Tailored versions for specific features on specific platforms take advantage of features of the platform used, and significant improvement is achieved

⁴ See footnote above concerning decoder performance. Encoder results are for Baseline encoding with Quantisation Parameter equal to 30.

Quality measurement

One feature of H.264 that has become apparent is that not all implementations are the same. With MPEG-2, the difference in compression efficiency between various commercially available encoders is perhaps 20%. H.264 is newer and more complicated, and uses much more processing power. Commercially available encoders vary in performance by more than 100% (going by published information).

Beyond speed and compression, there is a third parameter that can be flexed – picture quality. This can be much harder to test. BT has a suite of tools for assessing perceptual picture quality, either with or without reference to the original (uncompressed) video. These tools allow automatic assessment of video quality, without having to use time-consuming (and expensive) human assessment of picture quality. BT's assessment model used in our full reference tool has recently been incorporated into proposed new ITU-T and ITU-R international standards for objective picture quality measurement.

Further information

Further information on our video coding and quality assessment technology is available from licensing@bt.com.

Innovative Research

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