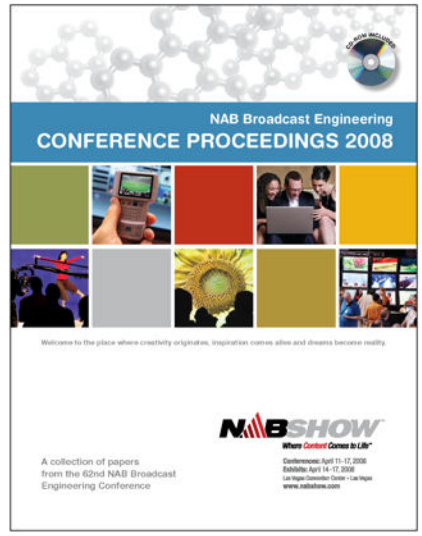
NAB TV TechCheck

The Weekly NAB Newsletter for Television Broadcast Engineers

April 28, 2008

Bridging the Gap with HD Transcoding

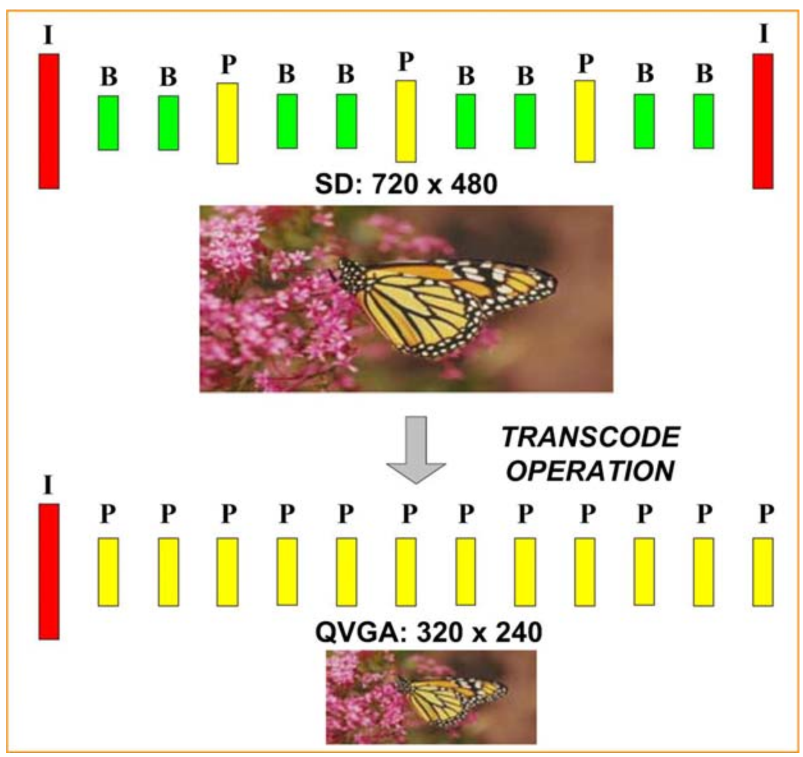


With the variety of content coming into the home today from cable, satellite, and the Internet, the need arises for a versatile platform that can transcode MPEG-2 and H.264 content from a variety of resolutions ranging from HD to QVGA (Quarter Video Graphics Array, 320 × 240 resolution). A session at this year's NAB Broadcast Engineering Conference (BEC, held from April 12-17, 2008, at the 2008 NAB Show in Las Vegas, NV) entitled "Codecs, Compression Systems & Scaling for Video" included a paper (excerpted here) by Tim Simerly (Texas Instruments, Dallas, TX) that addresses how transcoding HD/SD content can be done in a single silicon device without having to go through a complete "brute force" transcode operation by a set-top box (STB).

INTRODUCTION – it's not just the different ways of accessing audio and video content that are changing. Whereas the STB and DVD have similar processing and display capabilities, there is a wide disparity in capabilities between these and portable devices. This disparity widens immensely with the introduction of HD into the home. With over six times the number of pixels as SD, transporting HD content in the home becomes costly. And with the added complexity of H.264 over MPEG-2, the disparity between processing power of the STB/DVD and portable devices widens even further. To allow these devices to interoperate, a means of transforming the video and compressed formats between these different devices is required. Transcoding is the process that performs this much needed operation.

TRANSCODING – there are basically three main types of transcoding:

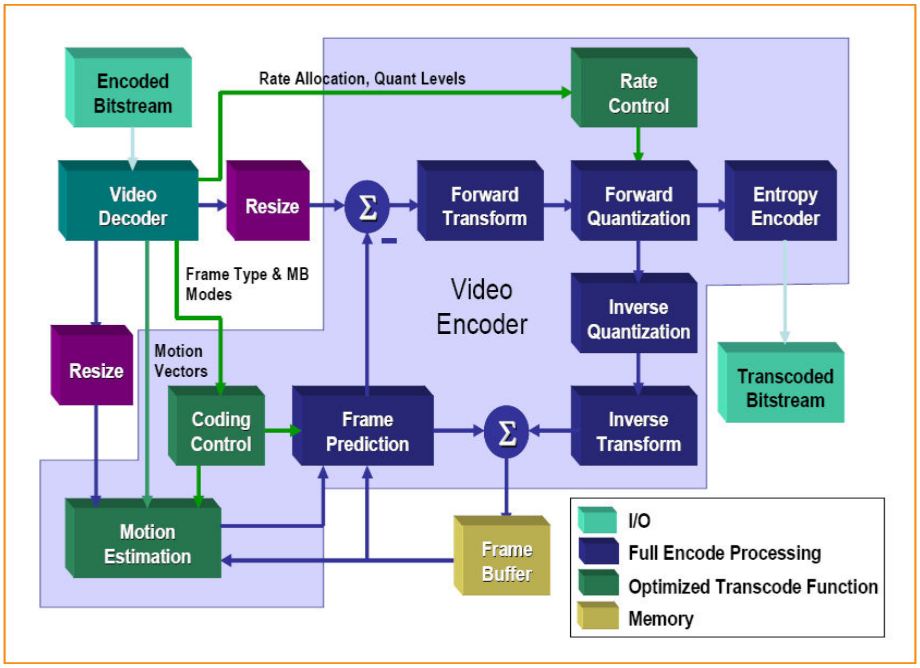
- *Transcoding (traditional reference)* – involves the conversion from one compression format to another, such as when converting MPEG-2 to H.264. This method involves the most changes to the original content; codec tools, image size, frame rate, and bit rate;
- *Transrating of content* – using the same compression format, but lowering the bit rate of the original content to allow it to be transmitted, stored, or used by a less capable device;
- *Transcoding of image parameters* – using the same compression format (same profile, different level), but reducing the original image size and frame rate to allow for playback on less capable devices.



THE MPEG-2 VERSUS H.264 CODEC – The improved compression efficiency of H.264 is a result of the introduction of newer and more advanced compression tools compared to those available in MPEG-2. There are two noticeable differences: the H.264 decoder has an added Intra Prediction and Loop Filter module; and, the Entropy Decode module for MPEG-2 is a variable length Huffman decoder

(VLD) while H.264 (Main/High Profile) uses a context-based adaptive binary arithmetic coder (CABAC). Further, H.264 uses an integer-based transform in lieu of the DCT used by MPEG-2, thereby preventing mismatches in the inverse transform between the encoder and decoder that occurs with MPEG-2. These differences account for noticeable improvement in bit rate reduction of H.264 over MPEG-2.

TRANSCODING EXAMPLE – the top portion of the diagram at right would be representative of a group of pictures (GOP) structure of a standard definition (SD) sequence associated with a broadcast application while the bottom portion is the resulting bit stream and GOP structure of a QVGA sequence as a result of transcoding this for a portable device. Here we can see the replacement of the bi-directional (B) frames in the original content with predictive (P) frames and the removal of the second intra (I) frame with a P frame with a corresponding reduction in image size. The reduction in image size and number of I frames will result in a reduced complexity bit stream at a substantially lower bit rate thereby enabling the cell phone to process the newly transcoded content. As a result of transcoding to a lower H.264 profile (i.e., Baseline Profile), error resiliency can be improved in the resulting bit stream by using additional H.264 tools such as FMO, ASO and redundant frames.



DECODER/ENCODER COUPLING – Having the decoder tightly coupled with the encoder reduces the overall complexity and results in a more optimal solution. An example diagram of such a coupled solution is provided in the block diagram. Here we can see the decoder providing frame type, macroblock types and modes, motion vectors, quant levels and bit rate parameters to the encoder in order to help it make better decisions on the transcoded bit stream that it creates. Although the encoder has to perform a full encode on the data, many of the modules have reduced complexity due to the *a priori* information provided to it by the decoder. This is especially true in the motion estimation process which is more of a refinement than a massive search. In the case where there is an image size change, image scaling can create the proper frame sizes prior to passing the frame off to the encoder and thereby decrease the memory required in the system, further reducing the overall cost of the transcoder.

This paper is included in its entirety in the 2008 NAB BEC Proceedings, available on-line from the NAB store (www.nabstore.com). For additional conference information visit the NAB Show Web page at www.nabshow.com.

SIGN UP NOW FOR NAB'S JUNE SATELLITE UPLINK OPERATORS TRAINING SEMINAR

Whether you are a satellite uplink operator, engineer or even a technical manager who just wishes to become more familiar with satellite communications, NAB's Satellite Uplink Operators Training Course is for you. This four-day course is designed to instruct students in the proper technical and operational practices that will ensure safe, successful and interference free satellite transmissions. The course will be offered June 2-5, 2008 in at NAB's headquarters in Washington DC. For more information call Cheryl Coleridge at (202) 429-5346 or go to NAB Satellite Uplink Operators Seminar.