



Beijing Olympics Networks Innovations & Initiatives

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Optimizing Network' Bandwidth

- The original plan was to transport about 15 - 20 HD feeds from Beijing to Canada.
- Compression rates of those feeds were key for making this possible within the available bandwidth.
- Using MPEG-2 compression it would require to have minimum bit rates between 30 and 60 Mbps for sports content.

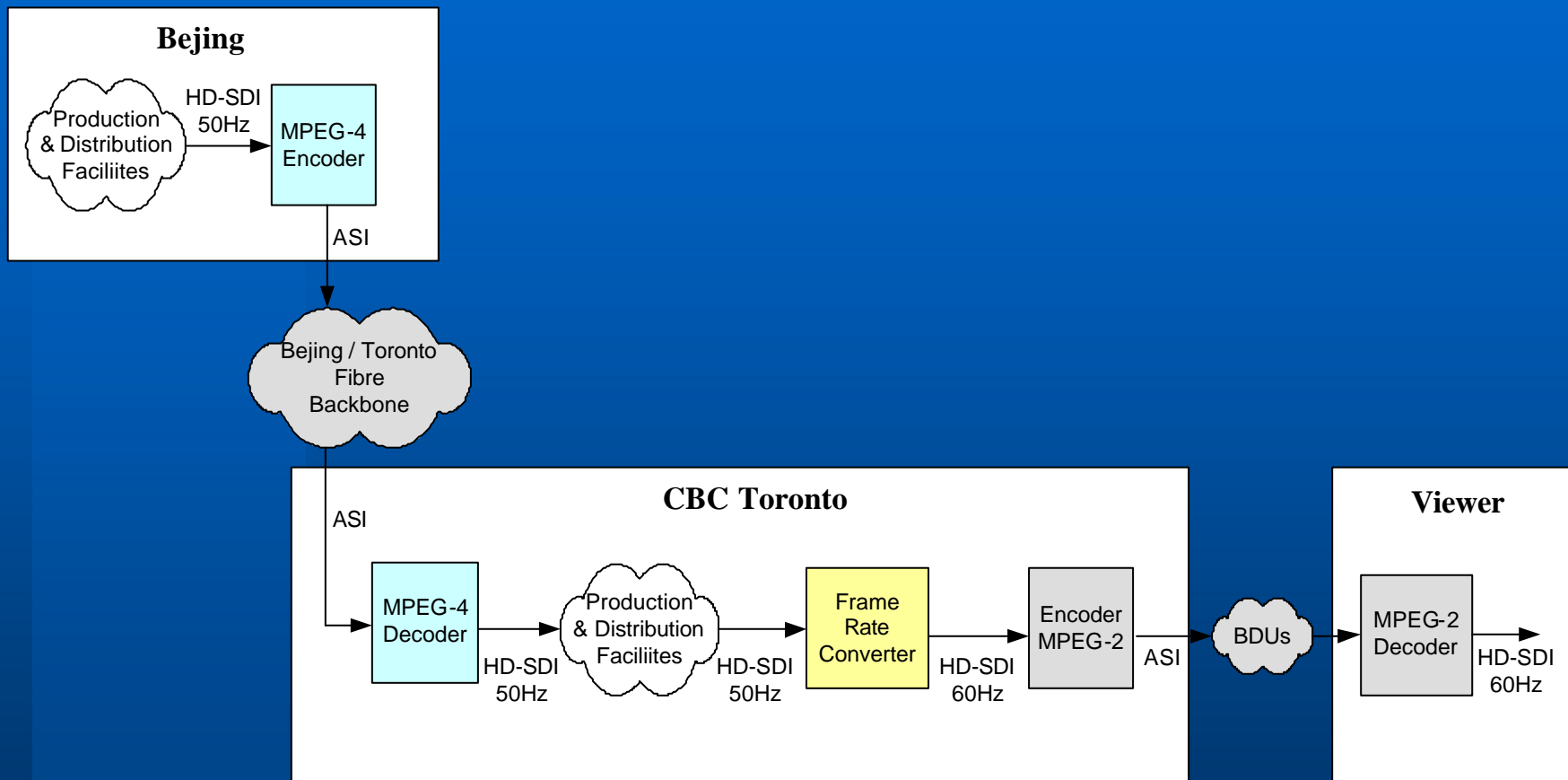
Optimizing Network' Bandwidth

- We started looking at new compression schemes including MPEG-4 with the goal to reduce further the bandwidth demands for transporting sports content in High Def.
- Several month of testing was performed in Montreal comparing bit rates, compression schemes, coding structure/length, profiles and latencies.

Optimizing Network' Bandwidth

- The last phase of the project was to emulate the entire path from Beijing to Toronto.
- The end-to-end path included a MPEG4 codec concatenated with a HD standards Converters and further concatenated with an ATSC MPEG-2 codec.
- The goal was to evaluate picture quality at 3 stages of the process.

Olympic Games - End-to-End Broadcast Chain

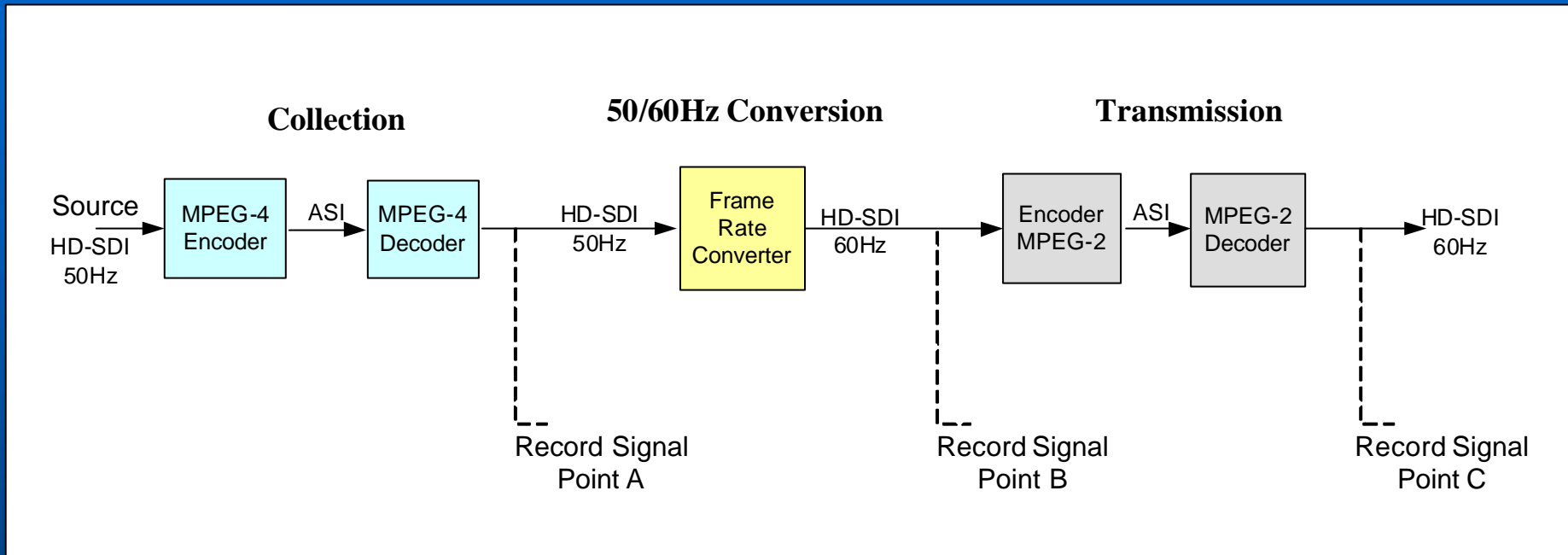


HD Signal Path - Overall Schematic

Picture Quality Assessment

- The assessment of Picture quality was performed at 3 major points of the end-to-end system.
 - Point A: at the output of the MPEG-4 decoder.
 - Point B: at the output of the HD Standards Converter.
 - Point C: at the of the ATSC MPEG-2 consumer grade decoder.

Olympic Games - End-to-End Broadcast Chain



Picture Quality Degradation Results from the Combined effect of:

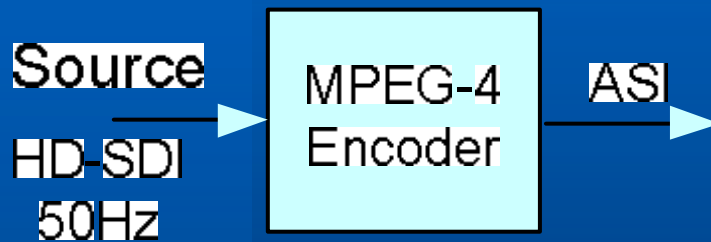
- Collection: MPEG-4 Compression (A)
- 50Hz to 60Hz Frame-Rate Conversion (B)
- Transmission: MPEG-2 Compression (C)

MPEG-4 Encoder Parameters Setup

- The parameters of the encoder were setup to optimize picture quality with minimum bit rates.
 - Variable parameters during the testing were:
 - Bitrate,
 - Profile,
 - GoP structure & length.

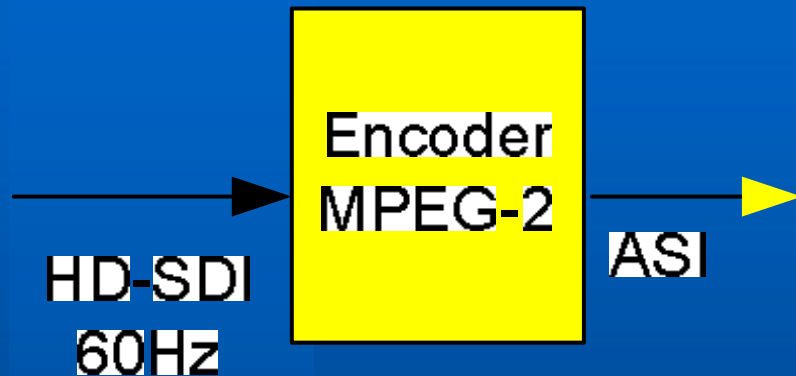
MPEG-4 Encoder Parameters Setup

Configuration



- **TS Rate (A/V): 20 Mbps**
- **Sampling: MPEG-4 Profile 4:2:2**
- **GOP Length: 15**
- **GOP Structure: IBBP**
- **Video Resolution: 1080i**
- **Audio channels: 4**
- **Audio Compression: 2 x 256kps**
- **Compression: MPEG Layer II**

MPEG-2 Encoder Setup Parameters



Configuration:

- **TS Rate(A/V): 19.3 Mbps**
- **Sampling: MPEG-2 4:2:0**
- **GOP Length: 15**
- **GOP Structure: IBBP**
- **Video Resolution: 1080i**
- **Audio channels: 4**
- **Audio Compression: 384kbps**
- **Compression: AC-3**

Subjective Viewing

- We produced 4 tapes with recorded material at the various points of the chain.
 - Tape 1 contains source material
 - Tape 2 recorded at the output of the MPEG-4 decoder.
 - Tape 3 recorded at the output of the HD Standards Converter.
 - Tape 4 recorded at the output of the MPEG-2 decoder.

Subjective Viewing

- We used a 50" LCD HD display plus a CRT based HD professional studio monitor for the subjective viewing.
- The reference for the subjective viewing was the source material.
- We found that the threshold of video quality for sports content with MPE-4 compression was at 18 Mbps.

Subjective Viewing

- **The HD Standards Converter tends to convolute artifacts coming out of the MPEG-4 coding and increase its perceptibility.**
- **There was a noticeable difference in subjective quality of content coded with MPEG-4 using 4:2:2 profile in reference to 4:2:0 at 18 Mbps.**

Audio

- The regular feeds we will use 2 pairs of stereo audio, one for English and one for French.
- The Opening Ceremony we will use surround sound with the video bit rate increased to a maximum possible.

Conclusions

- We will use MPEG-4 compression at the Olympics for transporting HD at 18 Mbps for video plus audio at 256kbps per channel.
- The acquisition for the HD feeds will be performed in HD with the image format of 1080i x 1920.
- We will not apply any means content protection in the form of watermarking or Fingerprinting to CBC feeds.

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- Questions?