

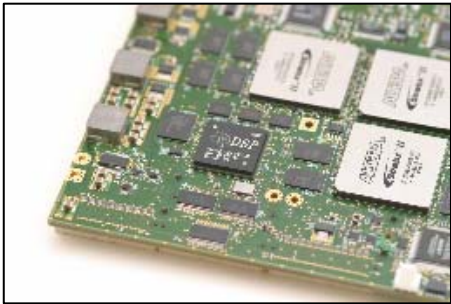
# Contribution Solution Update

4:2:0 & 4:2:2 10-bit H.264 Codec Update

# Company

- Pronounced “Ah-Tim ‘ or AT’M depending on location
- Privately held, 150 employees:
  - 100+ engineers with 20 MPEG-4 / H.264 algorithm experts
  - Patents both granted and pending
  - Renown internal R&D group leading in developing innovative technology for high quality video solutions (Consulting)

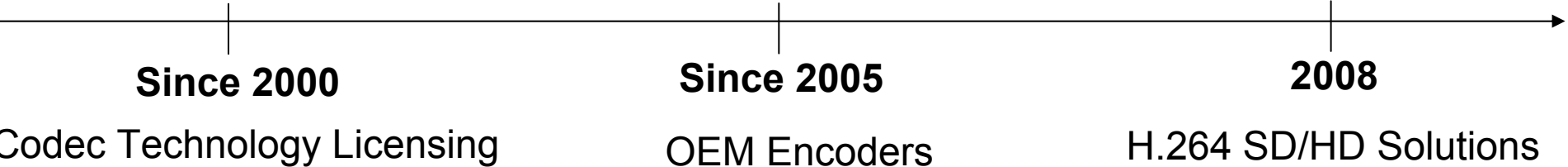
# ATEME: Adding value through solutions



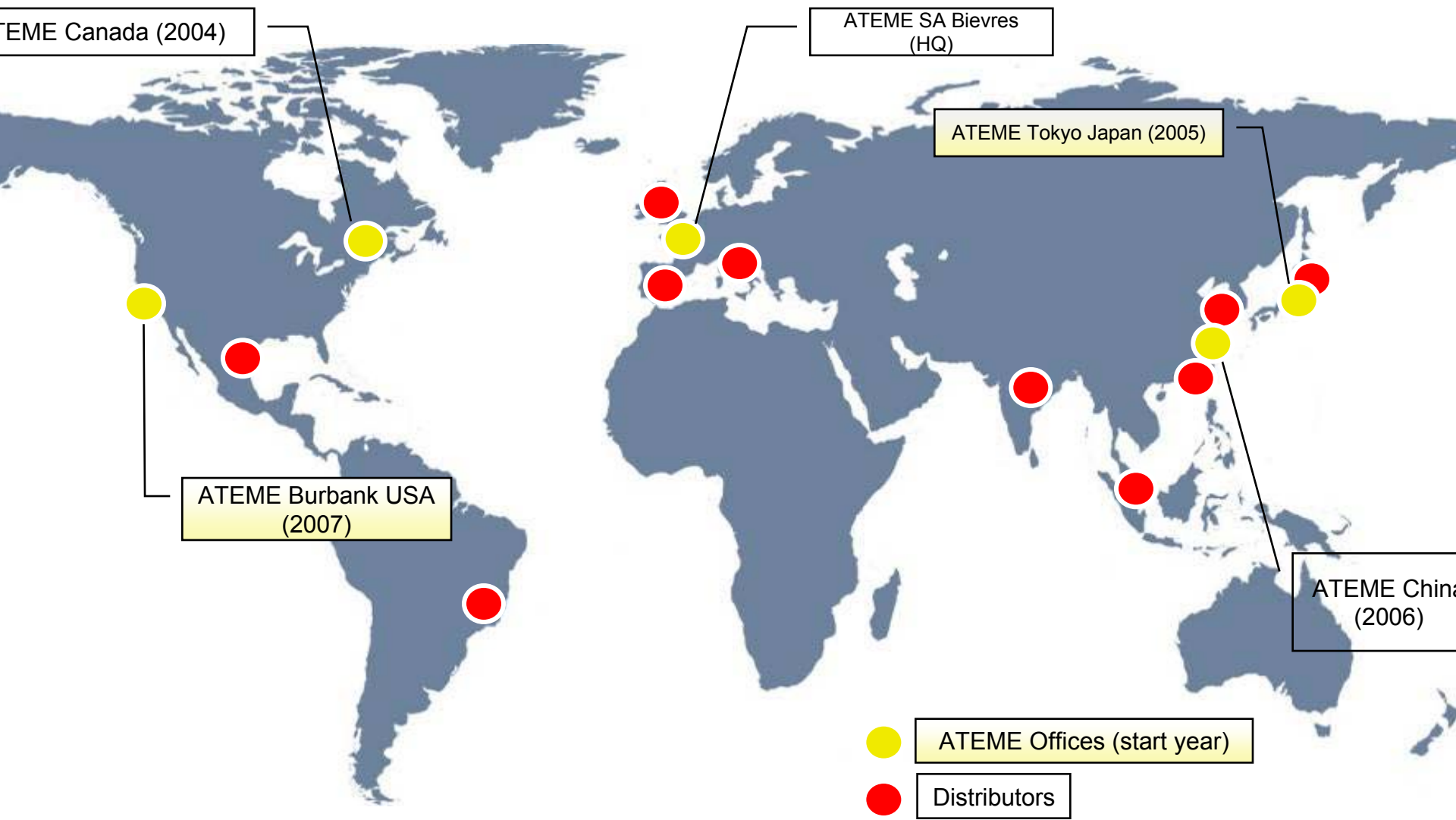
Technology Pioneer in high quality and bandwidth efficient video services

Best in class FPGA Hardware Designs meet real time video processing demands

Meet market demand through our solutions



# Global Presence





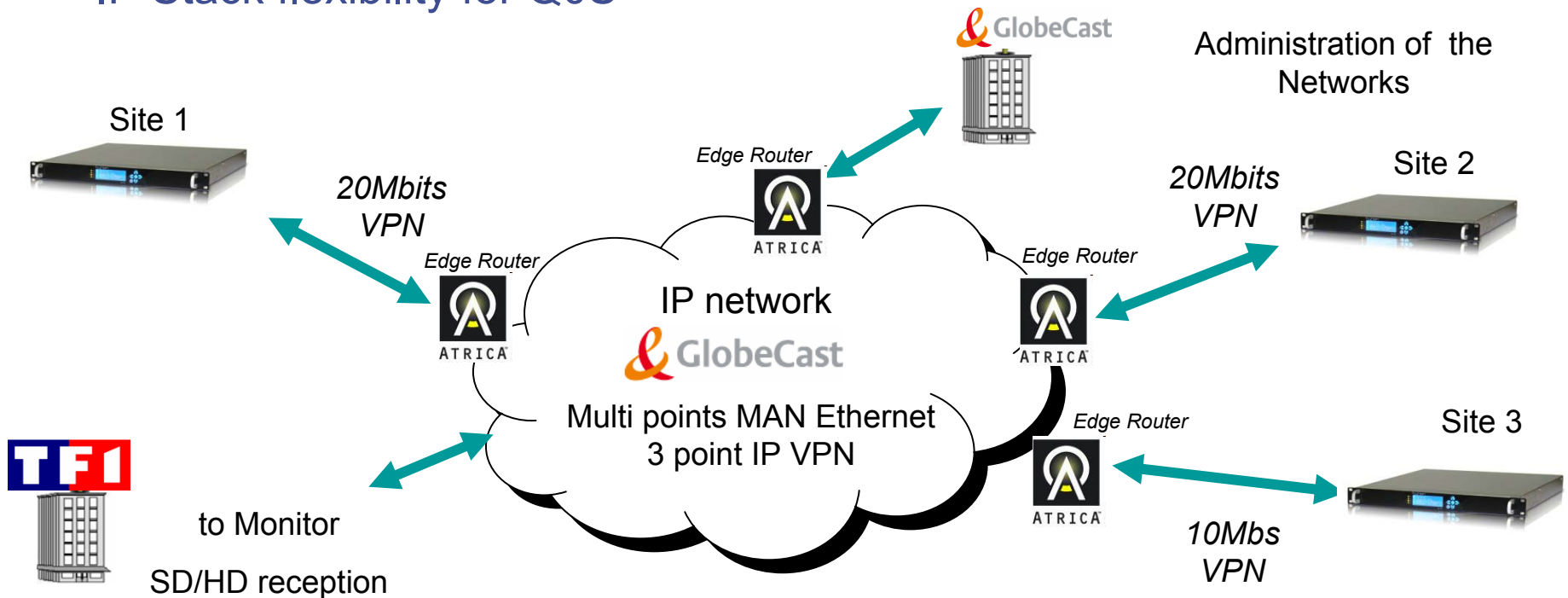
# Solution focus

- Turn Key H.264 Video Head End
  - IPTV / Distribution / Terrestrial
- Multi Screen Transcode
  - High Quality VOD / Archiving
- 10-bit Contribution
  - Fixed and Mobile

- MPEG-4 HDTV Contribution Codec Update :
  - 4:2:0 H.264 existing deployment addresses bandwidth and network concerns - eg: Globecast project in France
  - 4:2:2 H.264 brings 10-bit over legacy Codec increasing video quality while maintaining lower bandwidth
- Suggested technical parameters for different uses of the codecs:
  - Contribution Pipe vs Bit rate vs Video quality

# Example of H.264 delivery over IP Contribution

- Critical benefit is bandwidth efficiency
  - <10Mbits for HD possible on news, else 20Mbits
  - Adapt to content source SD or HD
- IP Stack flexibility for QoS



# 4:2:2 Contribution today

- Contribution feeds require the highest possible quality to support multiple generations. Bitrates are ranging from about 240Mbps down to 15Mbps (HD content)
- MPEG-2 *4:2:2 Profile* is still widely used, and other codecs exist:
  - JPEG-2000 (above 100Mbps)
  - AVC/H.264 in 4:2:2 8-bit (up to 60Mbps)
  - AVC-I 100 (112Mbps)
- H.264 encoders and decoders supporting all *High 4:2:2 Profile* tools are about to be released

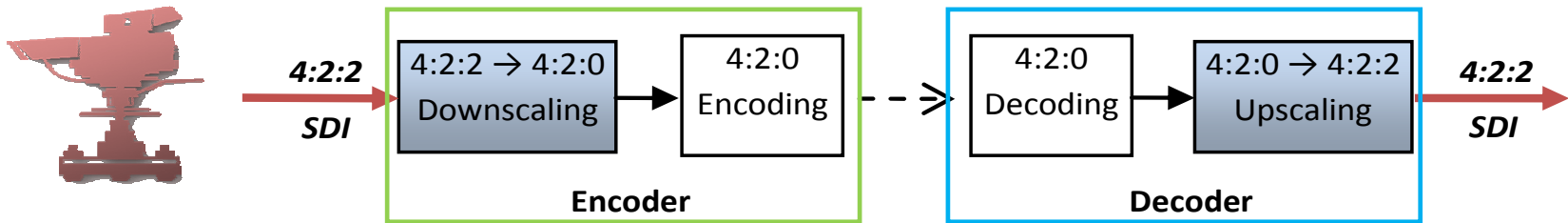


# AVC/H.264 Broadcast Profiles

Coding Tools	Main Profile	High Profile	High 4:2:2 Profile
I,P,B slices	X	X	X
Multiple Reference Pictures	X	X	X
CAVLC, CABAC Entropy Coding	X	X	X
Interlaced Coding	X	X	X
Weighted Prediction	X	X	X
In-loop Filtering	X	X	X
4:2:0 Chroma Format	X	X	X
8-bit Sample Depth	X	X	X
8x8 Transform		X	X
8x8 Intra Prediction		X	X
Quantization Scaling Matrices		X	X
Separate Chroma Quantizers		X	X
Monochrome Video Format		X	X
9 and 10-bit Sample Depth			X
4:2:2 Chroma Format			X

# 4:2:0 Compression

- Professional video sources are 4:2:2
- 4:2:0 compression requires resampling filters



- Progressive and Interlace chroma location schemes are different
- Challenges for existing chroma resampling architecture:
  - Possible mismatch between the 2 resampling filters
  - Resampling filters quality not guaranteed
  - Choosing between Progressive and Interlace filters is not obvious

# 4:2:2 10-bit Benefits: NO Downscale

- pair process 4:2:2 10-bit without any downscale.
- Completing Video Quality chain End-to-End.
- From Primary Contribution point to Distribution point.

Not Optimum:

Downscale 8-bit = Video Quality Breaking point

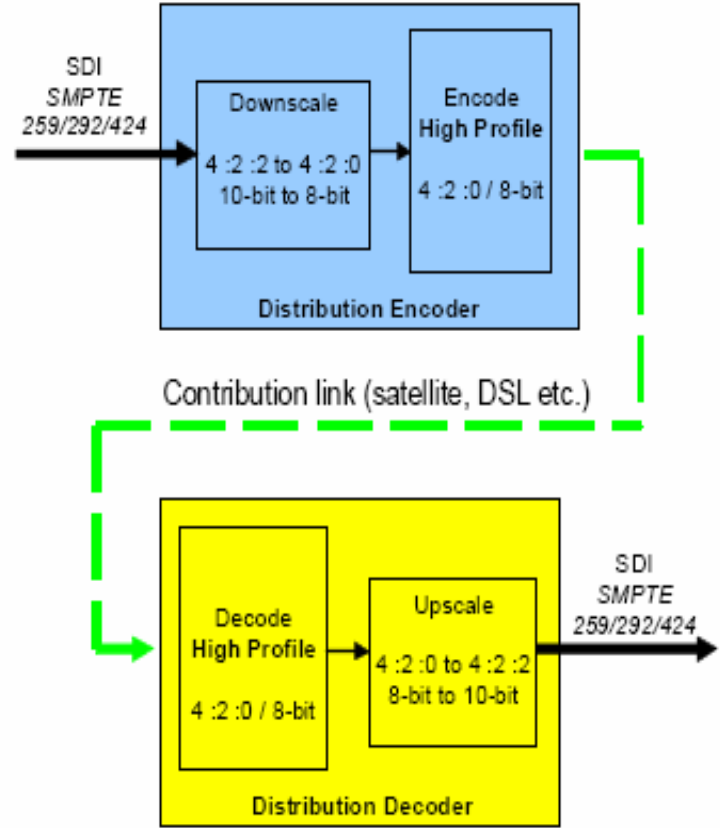
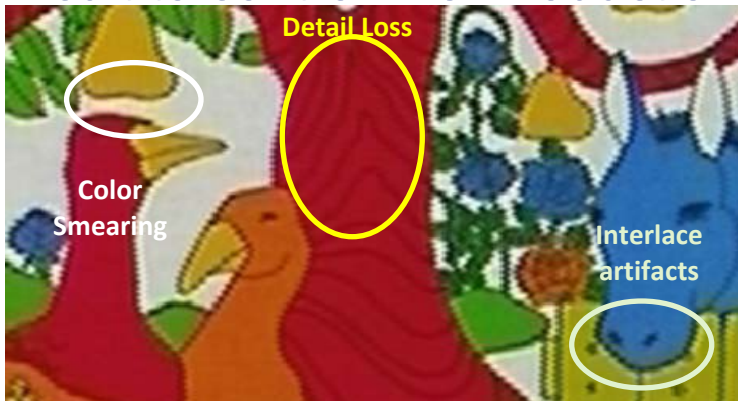


Figure 1 - Architecture with Distribution encoder/decoder

# 4:2:0 Chroma Artifacts

- Mainly caused by a mismatch between downscale/upscale filters
  - Color bleeding
  - Chroma detail loss
  - Interlace/Progressive artifacts
- Worsen with each generation
- Difficult to control in a Production chain



After 5 4:2:2 ↔ 4:2:0 conversions



Source picture

# 10-bit compression: banding removal

- Processing video with 8-bit sample depth may create banding artifacts in shallow changing light scenes:
  - Blue skies
  - Underwater scenes
  - Sunsets
- These defects are not visible at 10-bit or more



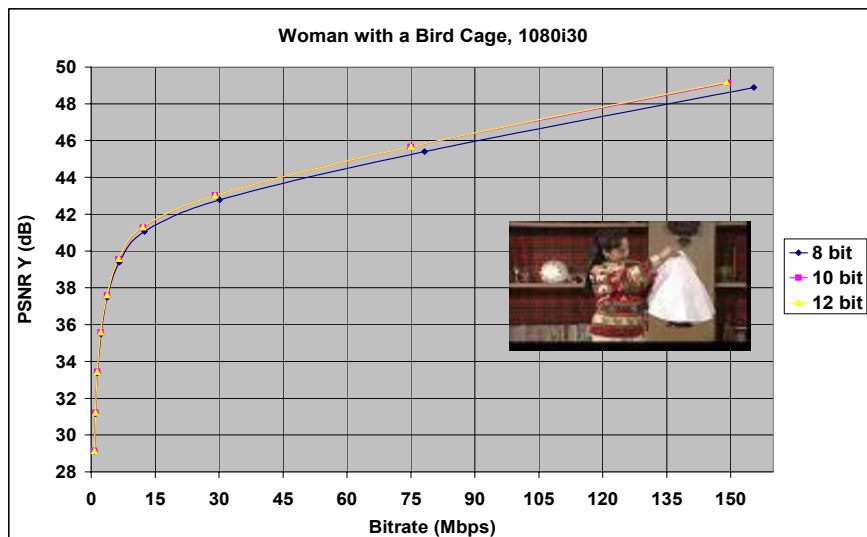
8-bit compression



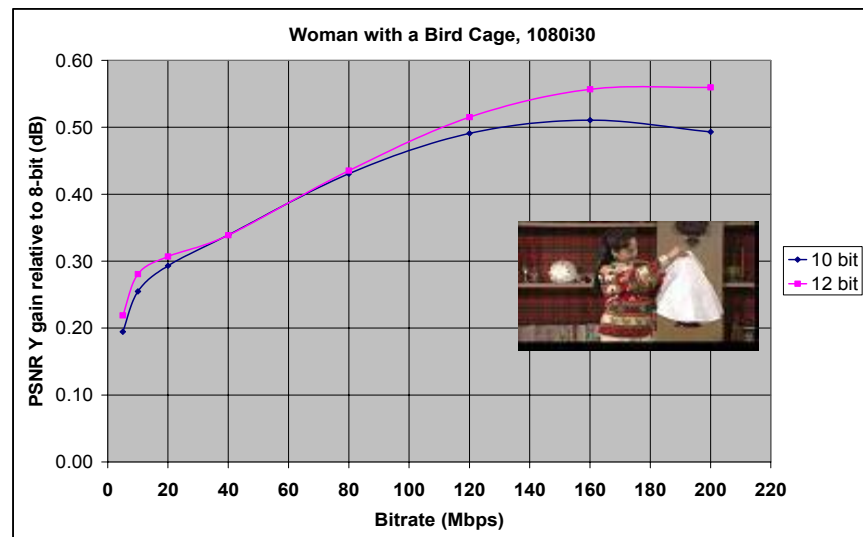
10-bit compression

# 10-bit compression: increased coding efficiency

- Coding efficiency is increased: less bit-rate for the same quality
- Rate saving between 5% and 20% on most sources
- Most of the gain is provided with 10-bit coding. 12-bit and 14-bit coding efficiency gain is much smaller



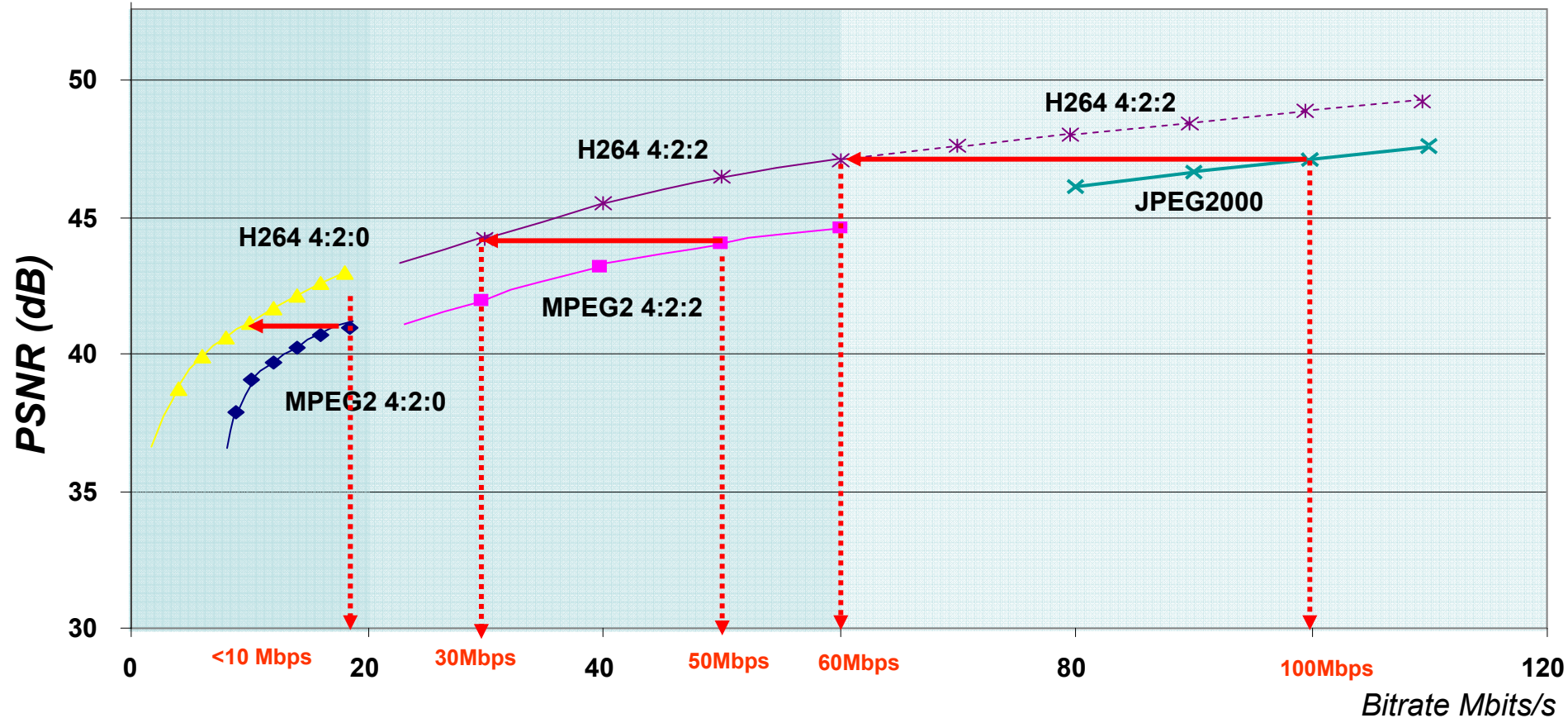
RD curve at 8, 10 and 12-bit



Distortion gain vs 8-bit compression

# HD Contribution Overview :

## Bit Rate VS Pipe VS Video Quality



**IP contribution:**  
Decrease Bandwidth

**Satellite contribution:**  
Increase Service Density

**High Video quality Contribution:**  
Increase Video Quality

# Summary

- H.264 4:2:0 enables HD contribution over never seen before transport rates
  - ⇒ Now Mature technology with deployments
  - ⇒ < 10Mbit depending on content (news) possible, even better for SD
- Supporting the native video format, H.264 *High422P* was designed for high quality professional applications and should be applied for contribution:
  - ⇒ 10-bit compression helps removing artifacts difficult to mask
  - ⇒ 10-bit compression applied to H.264 is offering greater BW efficiency
  - ⇒ 2 HD quality content over DVB-S2 possible
  - ⇒ Highest quality estimate obtained around 60Mbps with technology plan to go higher exists



Thank You

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