grass valley

Compression for DTV… Beyond Master Control

CCBE 2009

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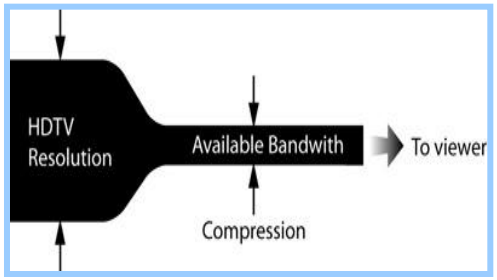
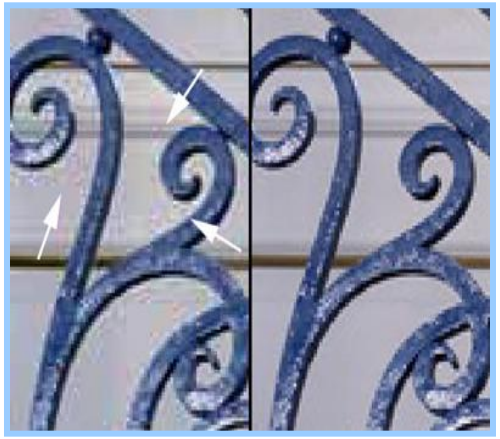
Grass Valley

A Changing Media Landscape

Why Compression Matters

- Benefit – The Business Model
  - Every Transponder cost ~$2M per year
  - HD MPEG-4 has gone from 15Mbps to 6Mbps in the last 3 years
- The Pain – Picture Quality
  - Squeezing bitrate cause picture degradation
- ViBE Premium Encoder
  - Reduce bitrate whilst maintain quality
  - More processing power leads to better use of compression toolsets
  - Mustang Compression Chip

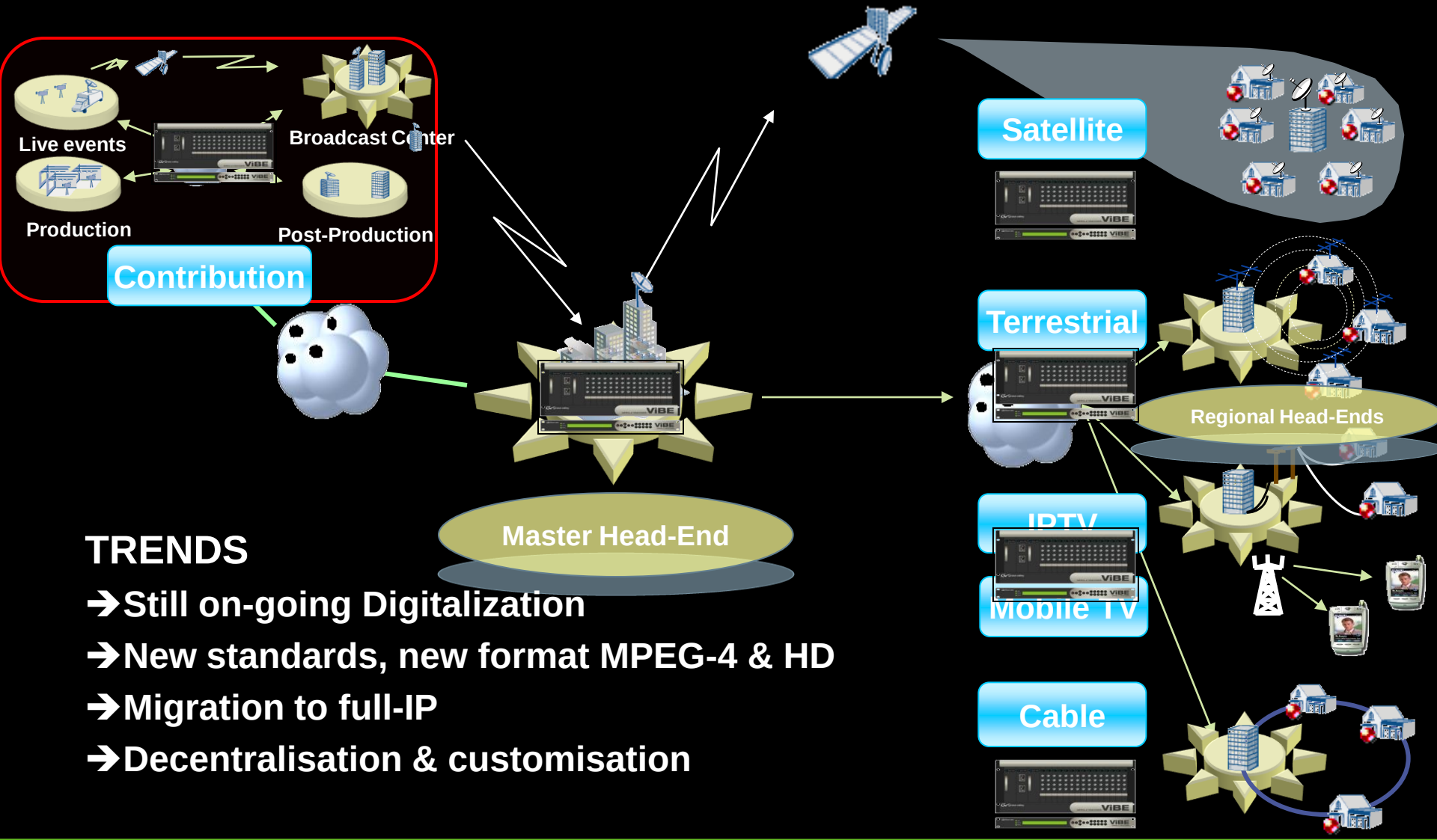




Compression Applications

- Contribution
  - 4:2:2
  - Lightly Compressed
  - Studio Feeds
  - Backhauls
  - Anything that needs more post production
- Distribution
  - 4:2:0
  - Satellite DTH
  - Broadcast
  - Cable
  - IP Networks

Codecs : Everywhere



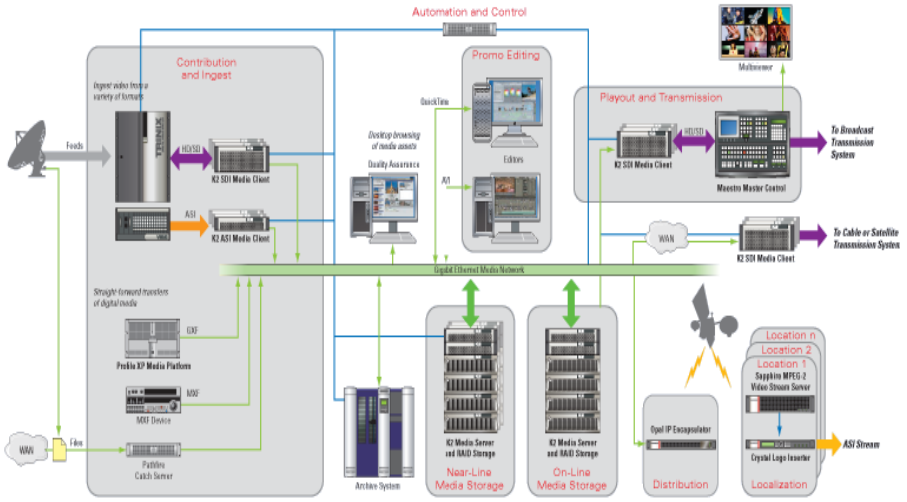
TRENDS

- ➔Still on-going Digitalization
- ➔New standards, new format MPEG-4 & HD
- ➔Migration to full-IP
- ➔Decentralisation & customisation

The Big Picture

Contribution

Playout



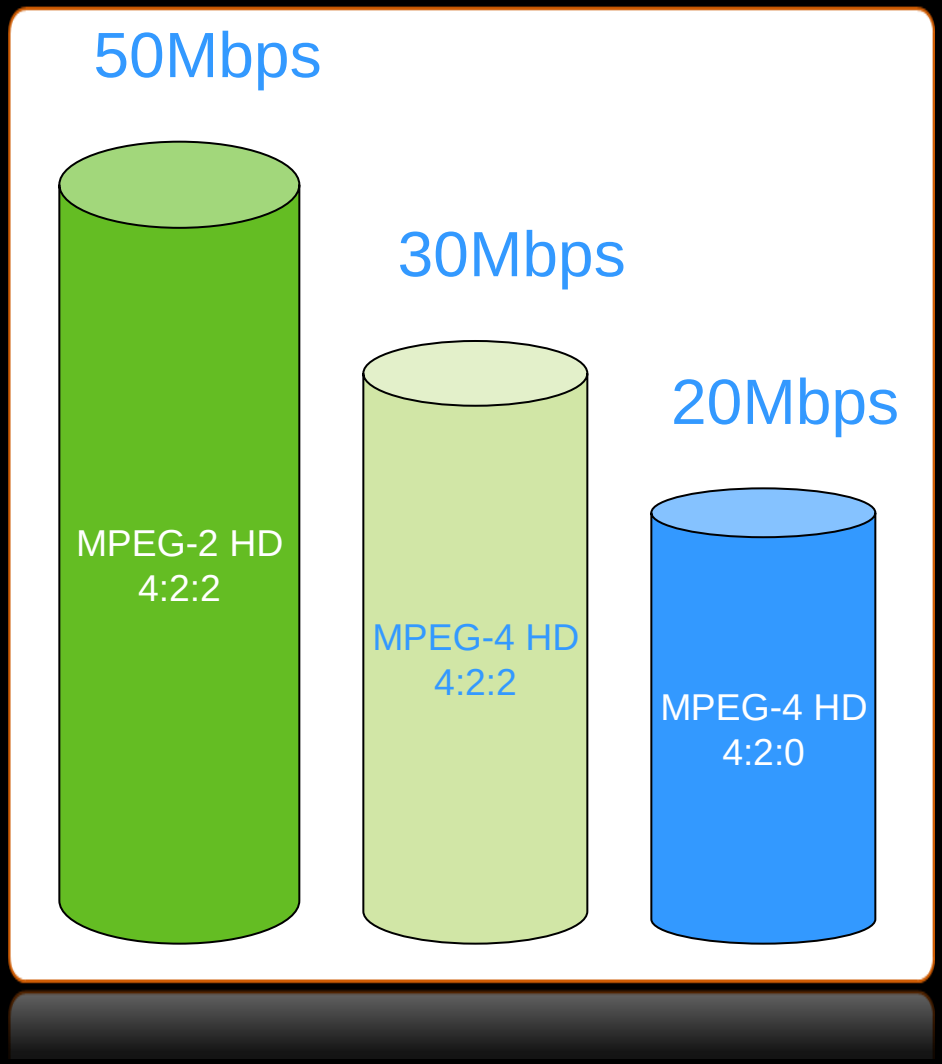
DTH Headend

Pick a CODEC

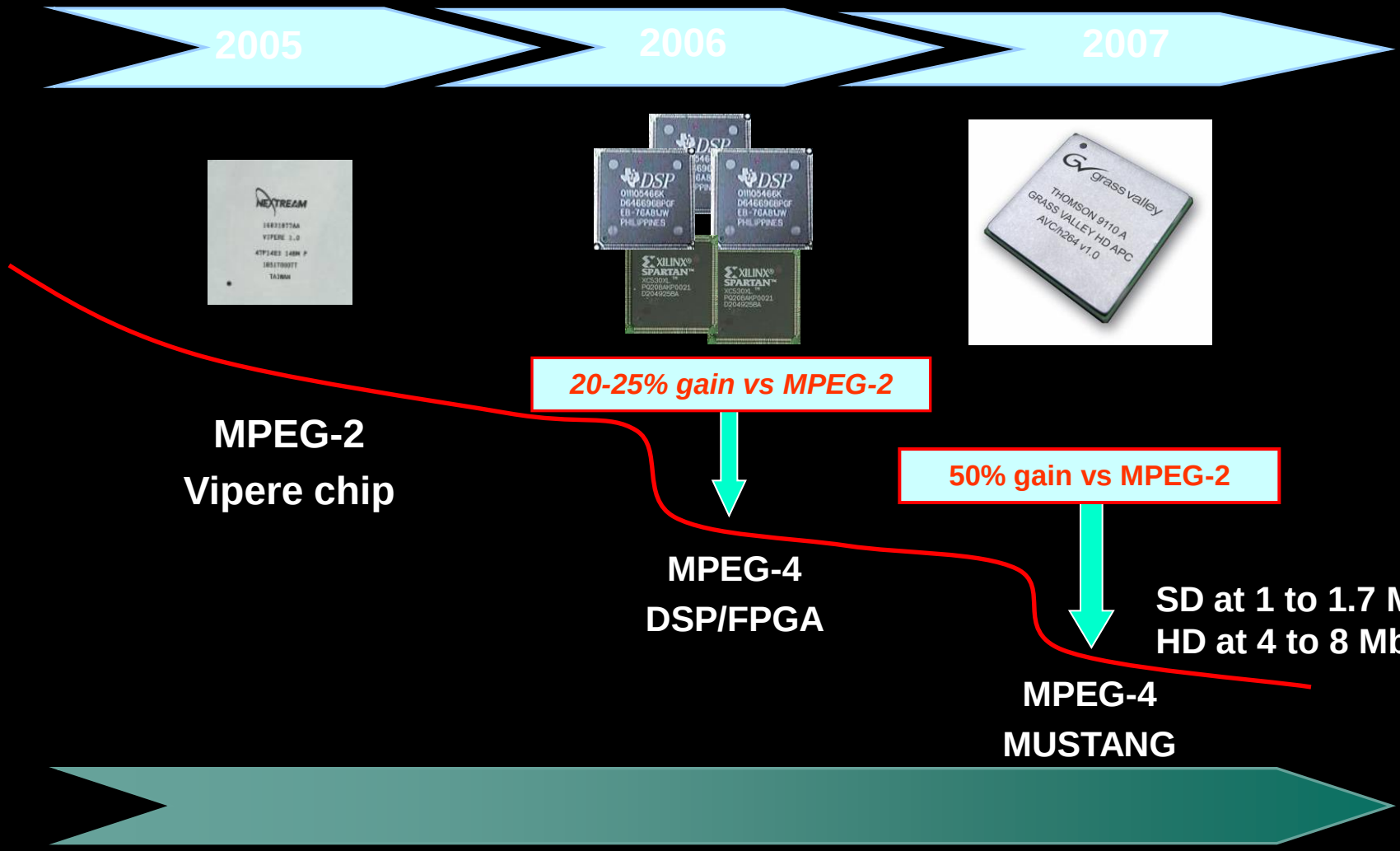
- MPEG 2
  - Legacy Compression
- MPEG 4
  - Very Efficient
- JPEG 2000
  - Contribution
  - Archival

Contribution Compression Comparison

- Sweet Spot Comparison
- MPEG-4 for bandwidth constrained network
- 4:2:2 when editing and archiving is needed
- 4:2:2 needs min. 25Mbps
- SD will still use MPEG-2 for some time (8Mbps)



Compression Efficiency

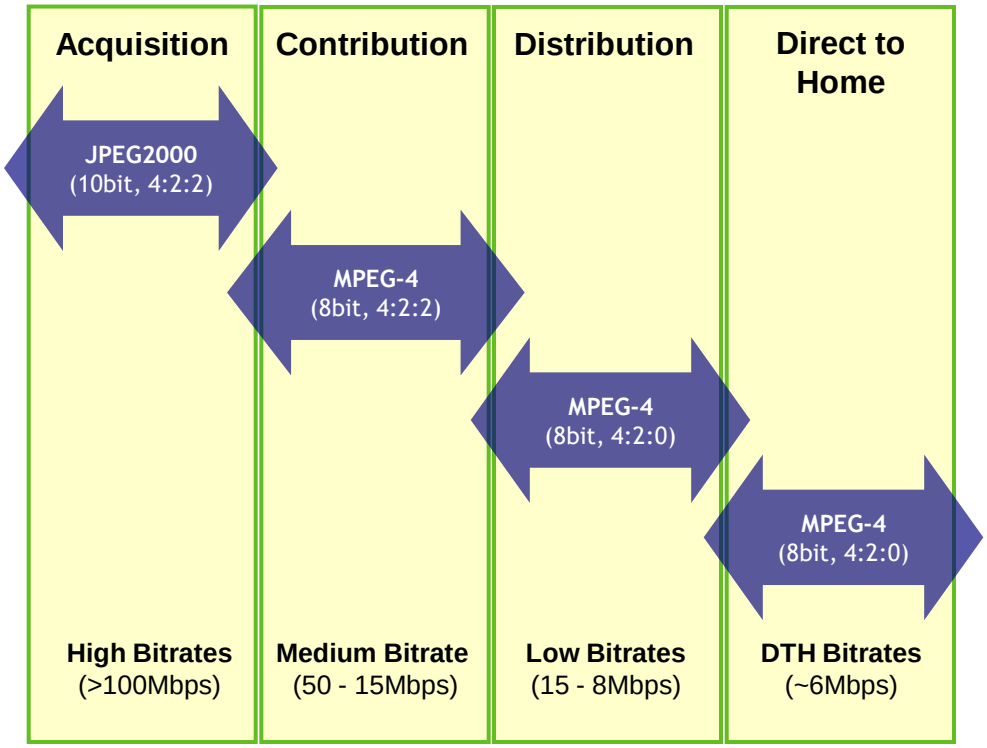


Video Format and Bitrate Segmentation

Bitrate Comparison & Compression Formats

- Acquisition
- Contribution
- Distribution
- DTH

All bitrates for HD video



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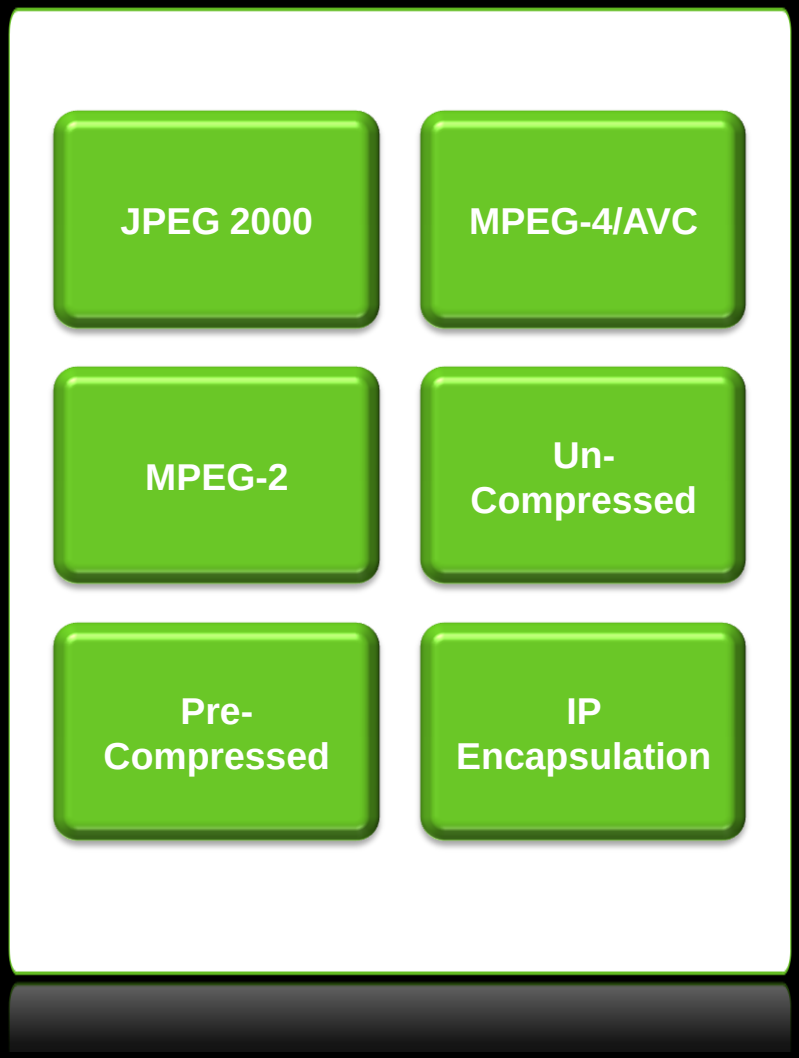
Grass Valley Video Adaptors

- Compression
  - JP2k (10bit, 4:2:2, 1080p 50/60)
  - MPEG-4 (8bit, 4:2:2, 1080i/720p)
  - MPEG-2 (8bit, 4:2:2, 1080i/720p)
  - SD-SDI (270Mbps, 4 streams)
  - ASI (213Mbps, 22 streams)
- IP Encapsulation
  - GigE Encapsulation
  - MPEG-2 TS or MXF encapsulation
  - FEC for improved IP resilience

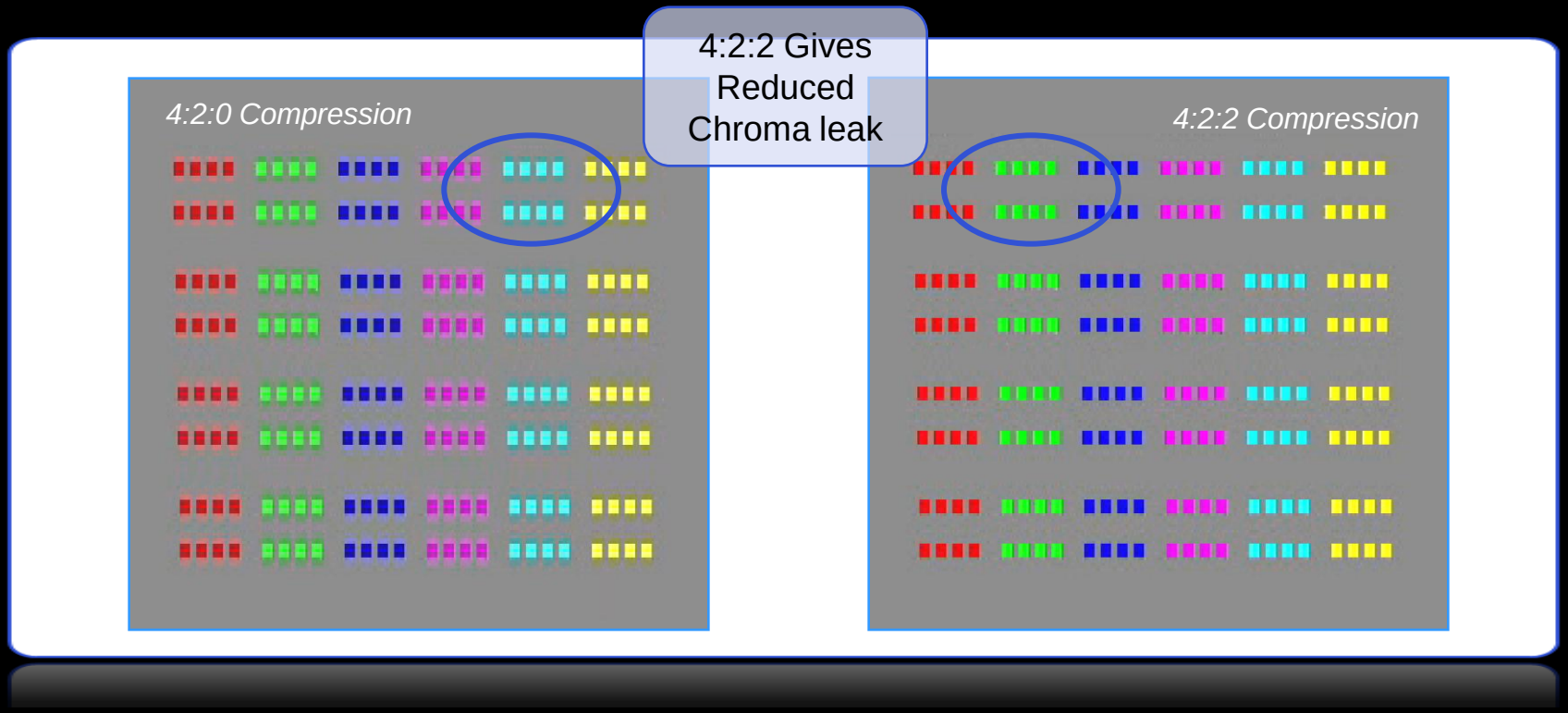


MPEG Compression

- MPEG is a LOSSY COMPRESSION
  - Bits are “thrown away” never to be recovered.
- MPEG is ASYMMETRIC
  - The encoder is more complex than the decoder
- MPEG Standard is contained in the DECODER
  - Every set top box has a MPEG compliant decoder
- ENCODERS can do anything…so long as it is compliant.
  - Speed, Quality, Tricks and Cost are up to encoder manufacturer.

4:2:2 Compression

- Increased chroma sampling gives better color re-production
- Avoid 4:2:0 Up-Sampling used for HD-SDI and SD-SDI



High Definition Trends

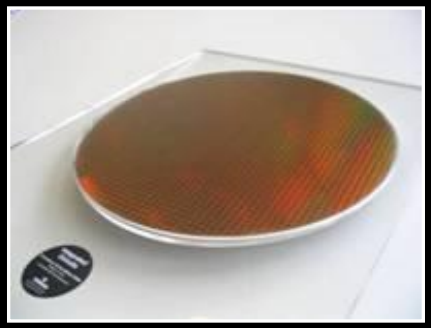
- Production
  - About 90-95% of all cameras sold are now HD Capable
  - The majority of studio workflows are now HD
  - Most content are archived in HD
  - 1080p 50/60 is expected to become the dominant production format
- Consumers
  - Consumers are expecting better Picture Quality
  - Average Screen-size is continuously increasing revealing compression artifacts
  - About 50 channels are launched annually in Europe

High Definition Trends

- Networks
  - HD needs about 6x Bandwidth of SD (25-50Mbps in MPEG-2)
  - Satellite bandwidth expected to be saturated by 2012
  - Fiber is expected to be the dominant Contribution medium
  - IP will become the dominant transport layer
- Compression
  - MPEG-2 not suited for next generation Contribution links
    - Due to lack of 10bit and 1080p 50/60 support
  - JPEG2000 and AVC will be the main compression formats
  - Both File based and Live transmission need to be supported

Mustang Technology

- World first professional grade MPEG4 compression ASIC
  - Optimised for Video/AVC Encoding
  - Unrivalled compression performance
- Designed by Thomson Research
  - 3 Years Research Program
  - 60 Dedicated Engineers
  - Manufactured by Texas Instrument using cutting edge 90nm technology
- First applications powered by Mustang
  - HD MPEG4 compression
  - SD MPEG4 compression
- Unique GrassValley “breakthrough” Technology
  - All competition using “consumer grade” ASIC’s or DSP’s

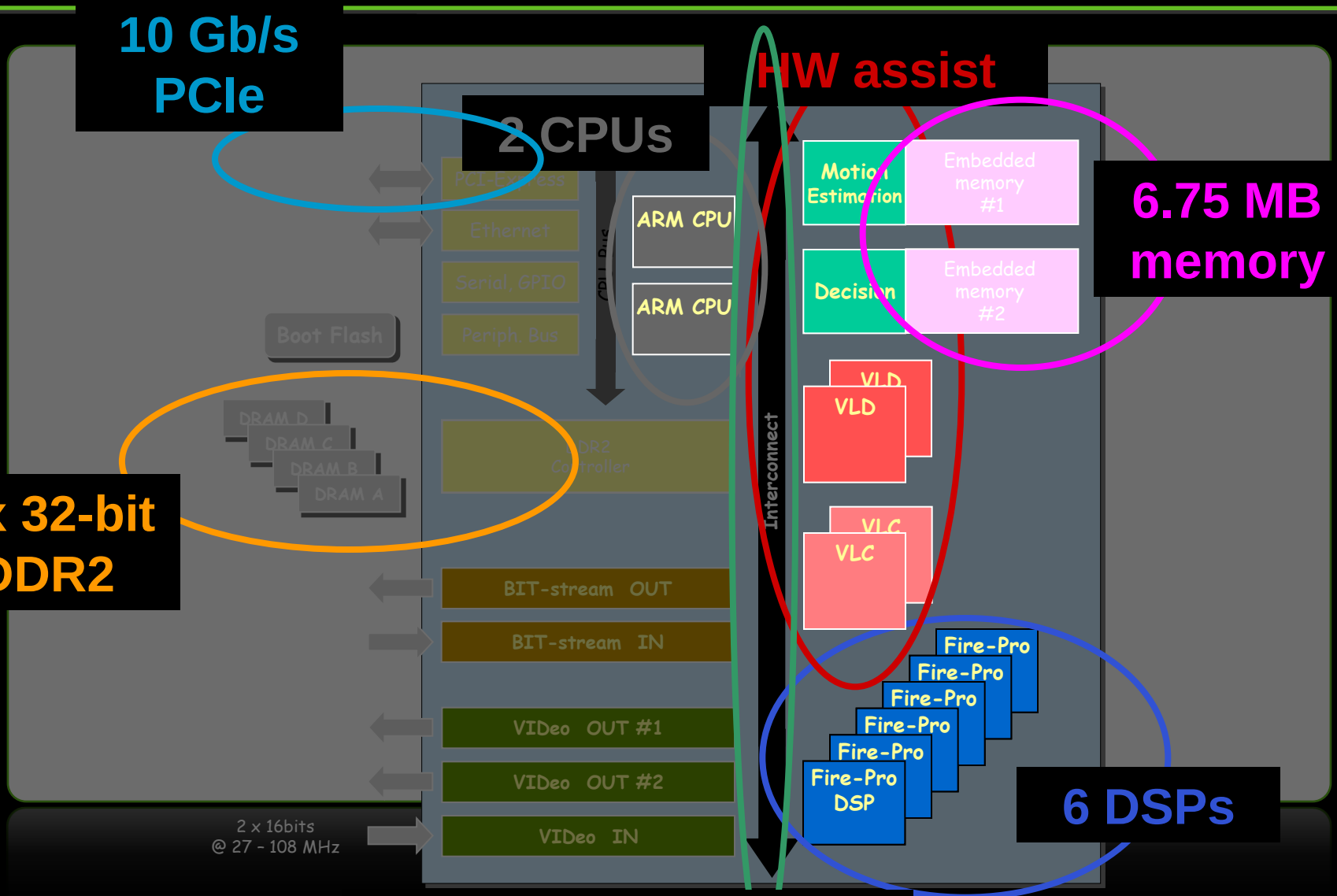


Mustang – Video Compression Engine

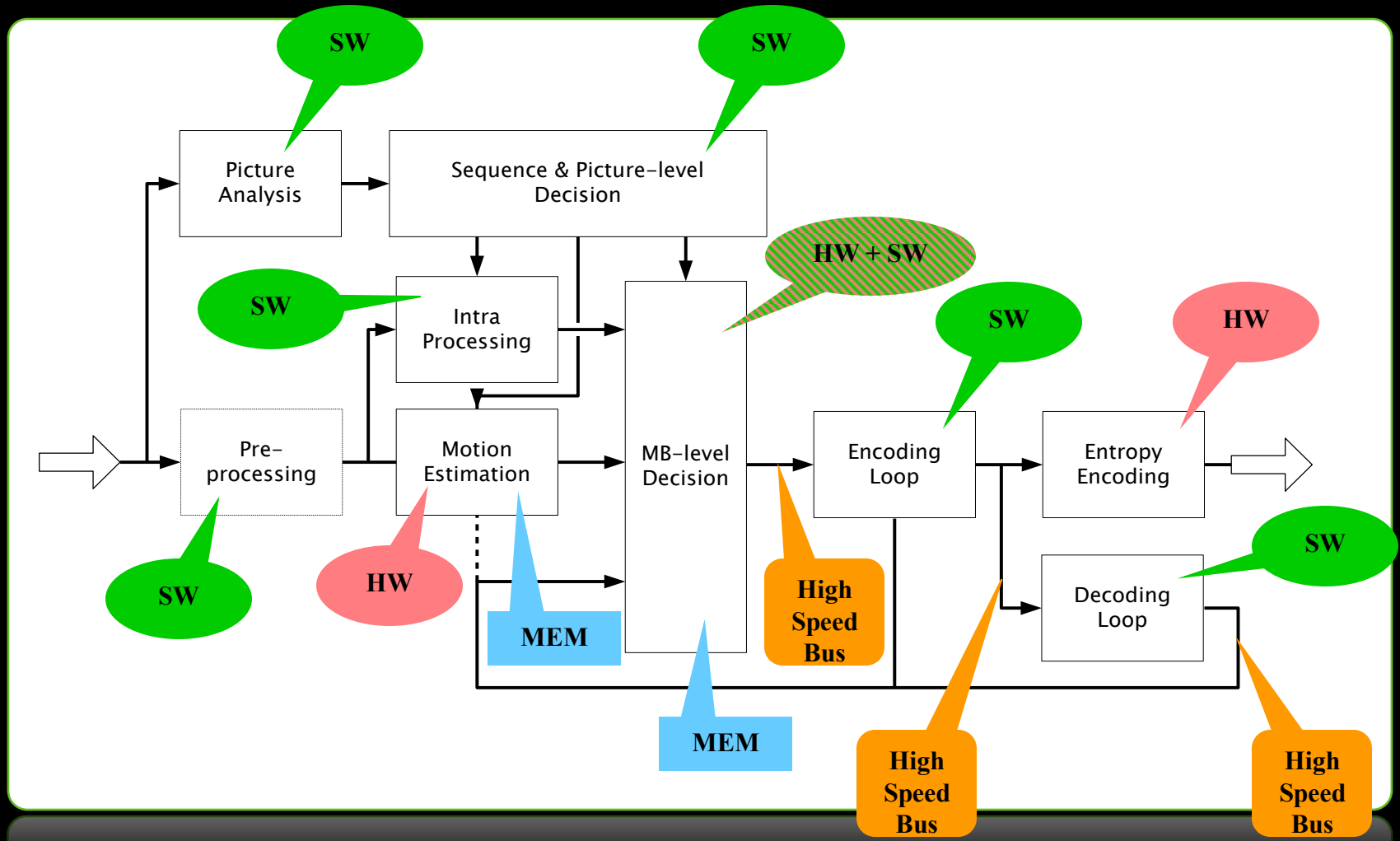
- Mustang Update
  - New MPEG-2 and MPEG-4 SD Capable
  - New High Profile Compression
  - New Reduced Compression Delay
  - New PAFF Field/Frame Compression
  - New Soft / Medium / Sharp Video Setting

Content	HD MPEG-4 1080i/1920	SD-MPEG-4 576i/720	SD-MPEG-2 576i/720
Sport	6.9 Mbit/s	1.4 Mbit/s	3.4 Mbit/s
Movie	3.8 Mbit/s	1.2 Mbit/s	2.4 Mbit/s

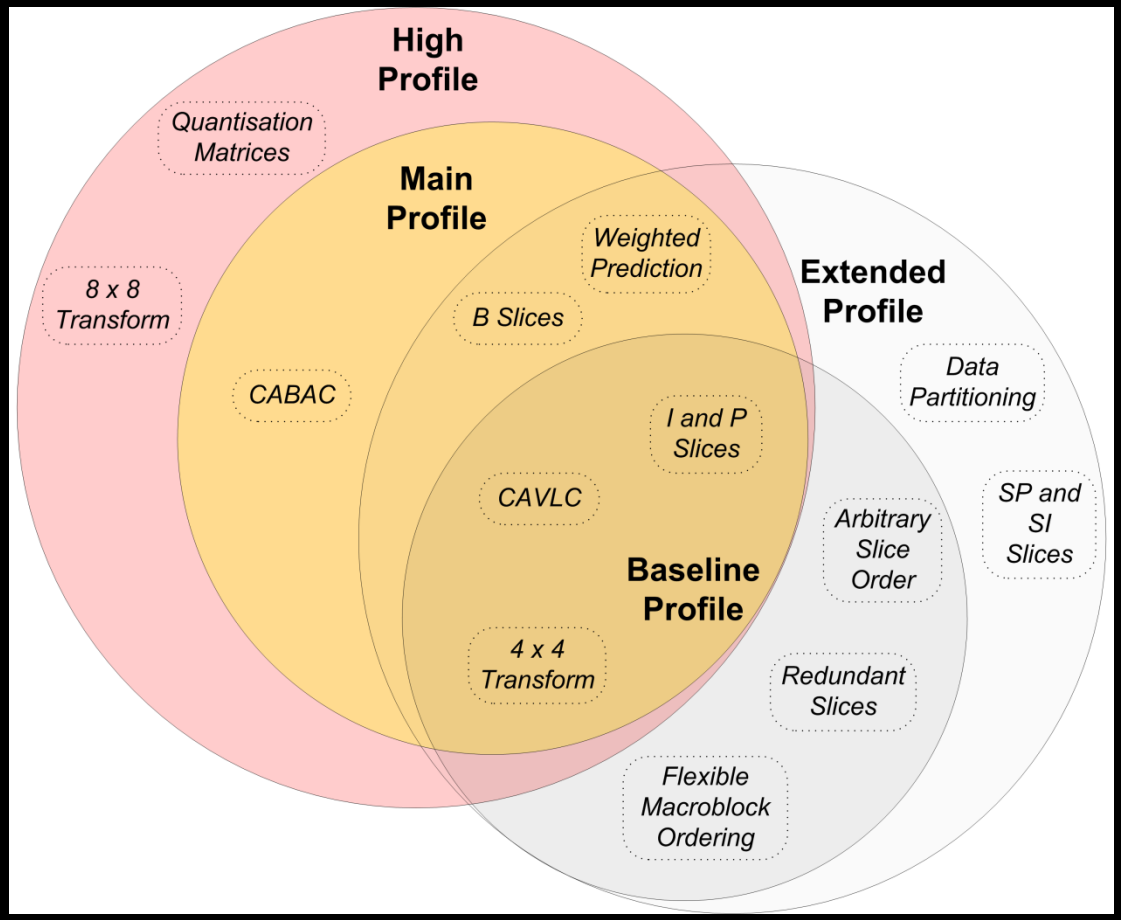
Mustang High Level Architecture



Algorithm vs Architecture Tradeoffs



How can MPEG-4 delivers >50% reduction over MPEG-2?



- This rate advantage can only be achieved from the combination of **all MPEG-4 AVC tools.**

ViBE MultiPass Compression

Stage 1

- Scene Cut
- Flash Detection
- 3:2 Pull Down
- Noise Filtering

Stage 2

- Full 1st Compression
- Estimate Bitrate
- Adjust Settings
- Adjust Toolset Use

Stage 3

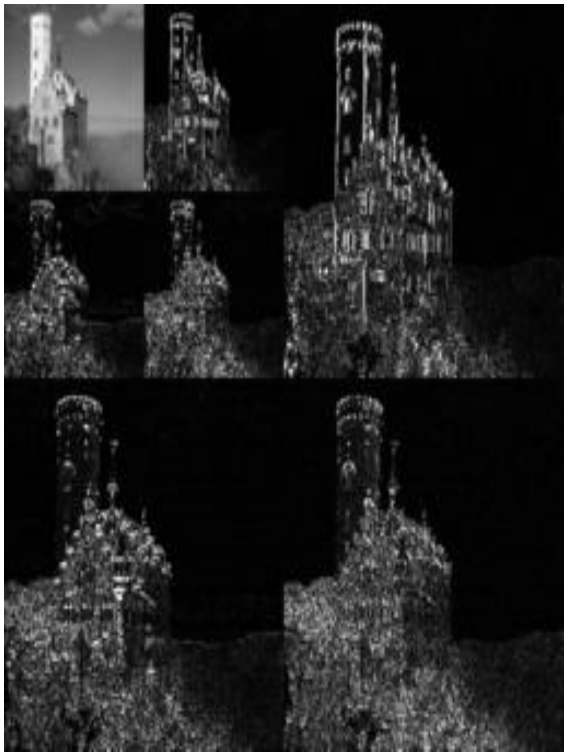
- 2nd Compression
- Stable Picture
- All MPEG4 Tools
- Ideal for Flextream

MPEG-2↔MPEG-4 SD Transcoding

- ViBE Transcoder Enhancements
  - 6 channels per unit
  - Improved Compression Performance
  - MPEG-4 to MPEG-2 & MPEG-2 to MPEG-4
  - Audio Only Transcode
  - PIP Generator

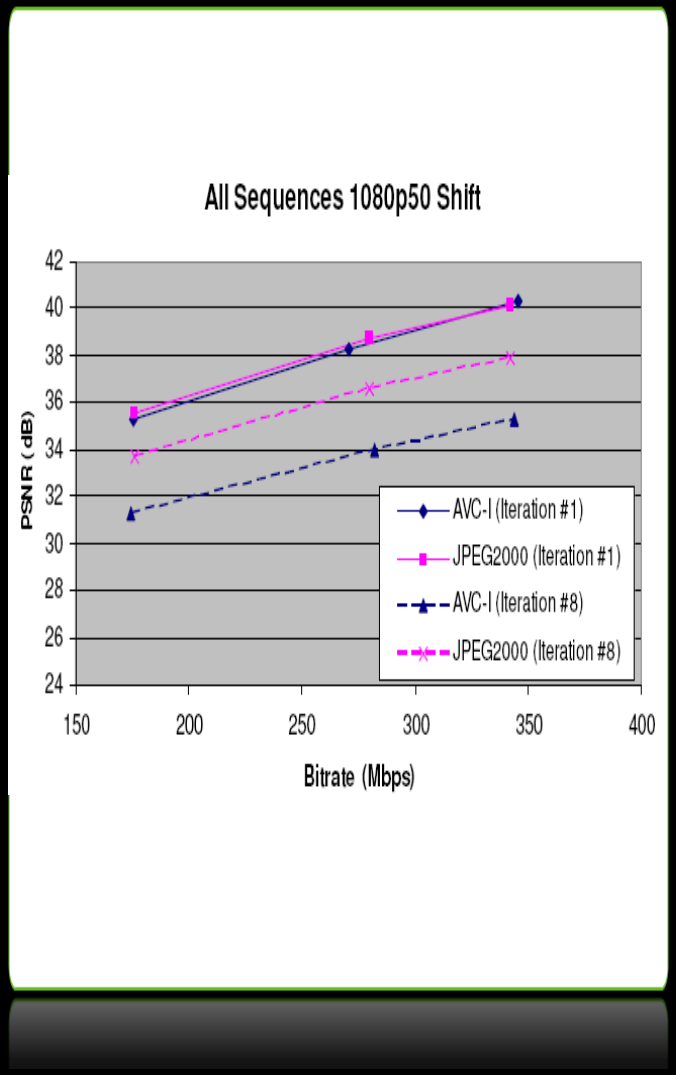
JPEG2000 for Contribution Applications

- JP2K is a real alternative to MPEG-4 for next generation video networks
- JP2K is offering low complexity Codecs supporting 1080p, 10bit and 4:2:2
- JP2K is a intra-frame wavelet based compression format offering high quality image capturing
- JP2K is offering excellent latency and concatenation capabilities



JPEG2000 Performance

- JP2K has equal I-Frame compression rate as H.264
- JP2K performs well across a range of bitrates and formats including 1080p
- JP2K shows superior performance over multiple iterations and outperform MPEG compressions formats
- JP2K is considerably outperformed by MPEG-4 in the low bitrate area



Compression Summary

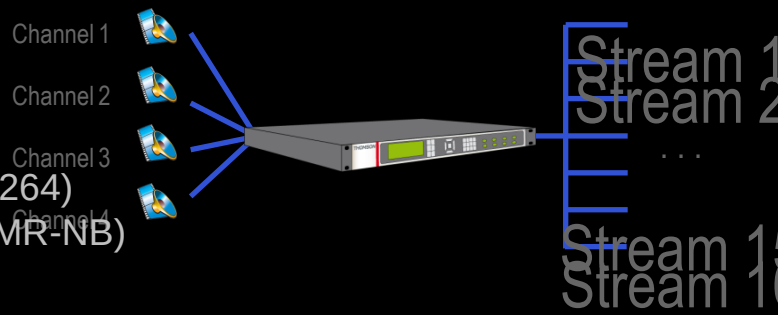
- MPEG-2
  - Still the dominant Contribution format (in particular for SD)
  - Grass Valley expect HD MPEG-2 to disappear rapidly
- MPEG-4
  - Increasingly used for HD Contribution (30Mbps sweet spot)
  - High Profile toolset is important for improved quality
  - 4:2:2 Compression (20-25Mbps being knee-point compared to 4:2:0)
- JPEG2000
  - Establishing itself in the High End Contribution / Acquisition
  - 10bit, 4:2:2 Compression and 1080p/50 is main driver

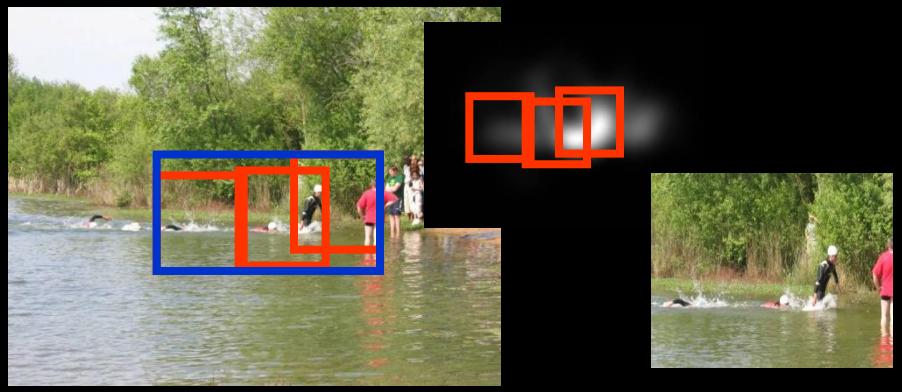
ATSC-M/H Solutions

- ATSC-M/H
  - Free TV I can take with me
  - The BIG Screen is now on a portable !

ViBE Mobile TV Encoder

- Multi-channel encoder – more than 900 channels in the field.
- Various input formats
  - Analog or digital un-compressed
  - Compressed (MPEG-2, H.264) over IP or ASI
- Versatile output formats
  - Multi-resolution (from 8x8 to SD)
  - Multi-video codec (MPEG-2, H.263, MPEG-4 SP/ASP, H.264)
  - Multi-audio codec (MPEG-1, AAC-LC, HE-AAC V1/V2, AMR-NB)
- Local/remote statistical encoding available
- Unique advanced pre-processing
  - Dynamic reframing based on region-of-interest detection





Mobile Encoder

- Advanced pre-processing filters
  - Resizing / cropping/ Clipping
  - Sharpness
  - 3:2 pull down
  - Enhanced Motion Compensated filtering (MCTF)
  - Dynamic aspect ratio support (WSS handling / MPEG-2 aspect ratio support
  - Logo insertion
- Configurable frame rate
- Audio
  - HE-AAC V1 & v2 AAC-LC (8 –512 kbps)
  - MPEG-1 LAYER II (32-384 kbps)
  - AMR-NB (5.2-12.8 kbps)
- Outputs
  - RTP/RTSP
  - unicast & multicast
  - H.264 over MPEG-2 TS over IP Networks (UDP,unicast & multicast)

ViBE Mobile TV – Dynamic Reframing

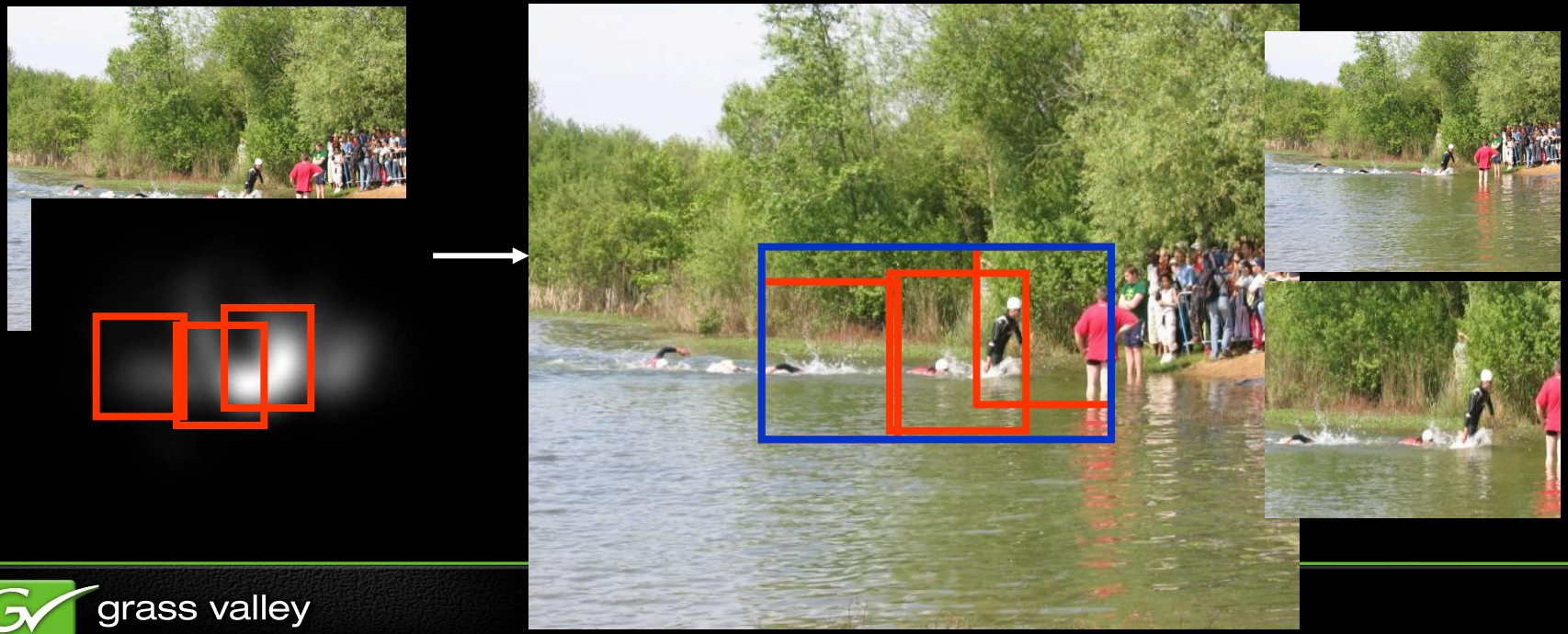
- In partnership with Thomson Corporate Research
- Problematic
  - Render an SD-sized video content
    on a device with limited display size (mobile handset)
- What is done today
  - Nothing => resizing to mobile display
  - Manual reframing on recorder content by dedicated companies
- Dynamic reframing in ViBE Mobile TV
  - Modelling for human perception of video content
  - Automatic identification of interesting zones
  - Cropping to fit best to mobile display

ViBE Mobile TV – Dynamic Reframing

- Selection of “interest zones”

⇔visual attention model

- Dynamic reframing algorithms



Vibe encoder Advanced Processing Features

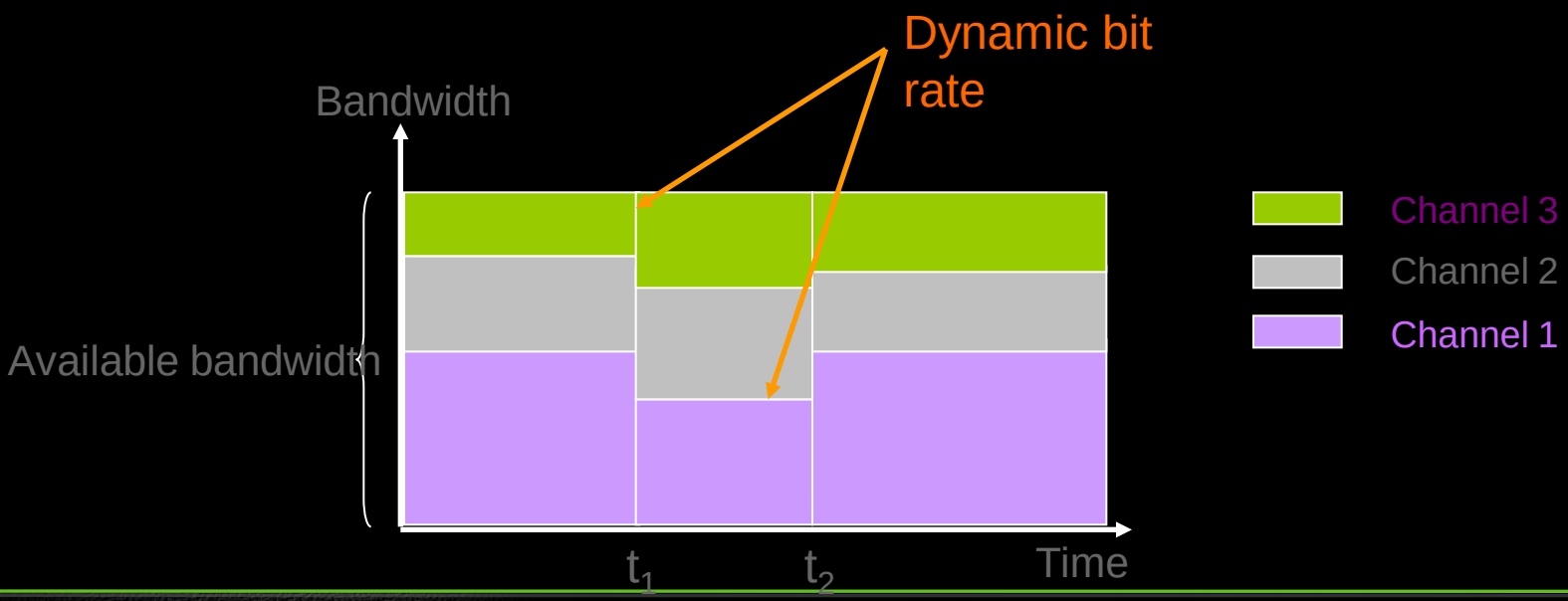
- **Pre-Processing**
  - Resizing, cropping, clipping
  - Sharpness
  - 3:2 pull down
  - Etc.

- **Configurable GOP**
  - GOP/Scene management (H.264,H.263, MPEG-4 part 2 only)
  - Open GOP / Closed GOP

- **ViBE Mobile TV dedicated Video Processing Technology**
  - Anti-flickering
  - Psycho-visual Enhancement
  - Automatic scene cut detection

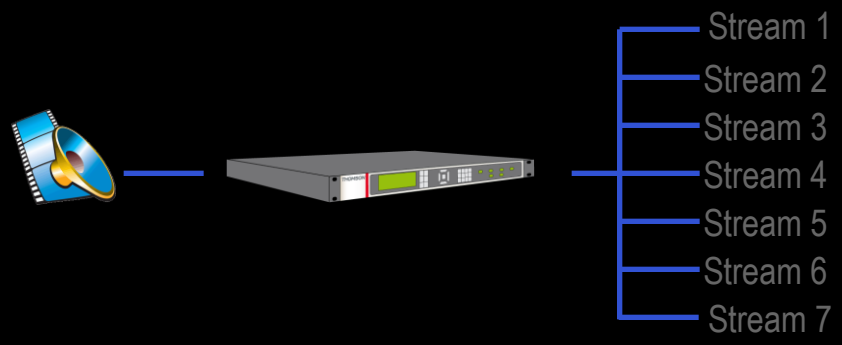
ViBE MobileTV Statistical encoding

- Statistical encoding
  - A Global bandwidth is shared between several encoders, each encoder uses a variable bit rate depending of the complexity of the image
  - Using bit rate only when it is needed
  - Bit rate changes dynamically to fulfill the encoder's quality requirements
  - H.264 only
- Statistical encoding results



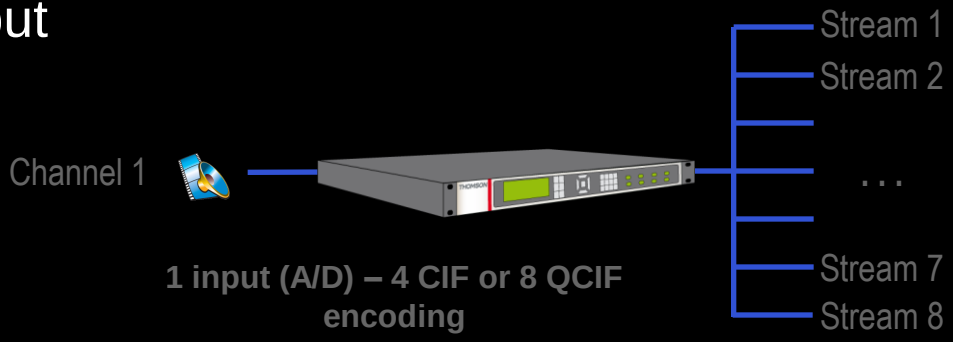
ViBE Mobile TV – Multi-stream

- One channel source (video & audio)
- ViBE Mobile TV can be used as a radio encoder (Up to 24 channels)
- Simultaneous TV streaming and radio streaming
- Multiple outputs
  - Different video resolutions (CIF, QCIF)
  - Different bit rates
  - Different codec



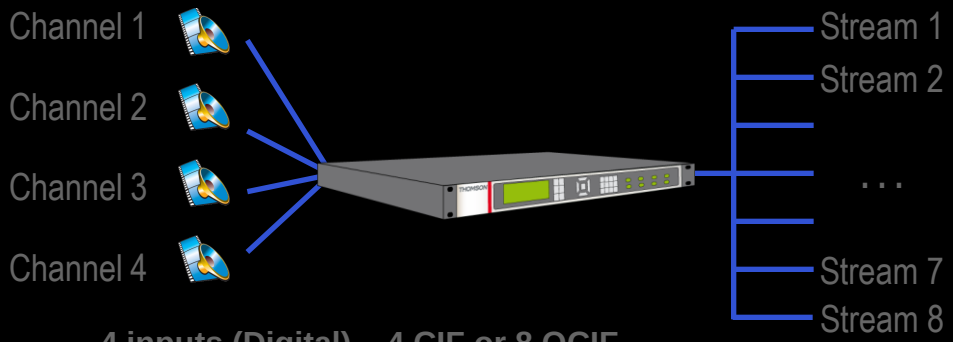
Multi-streams examples

- Single input



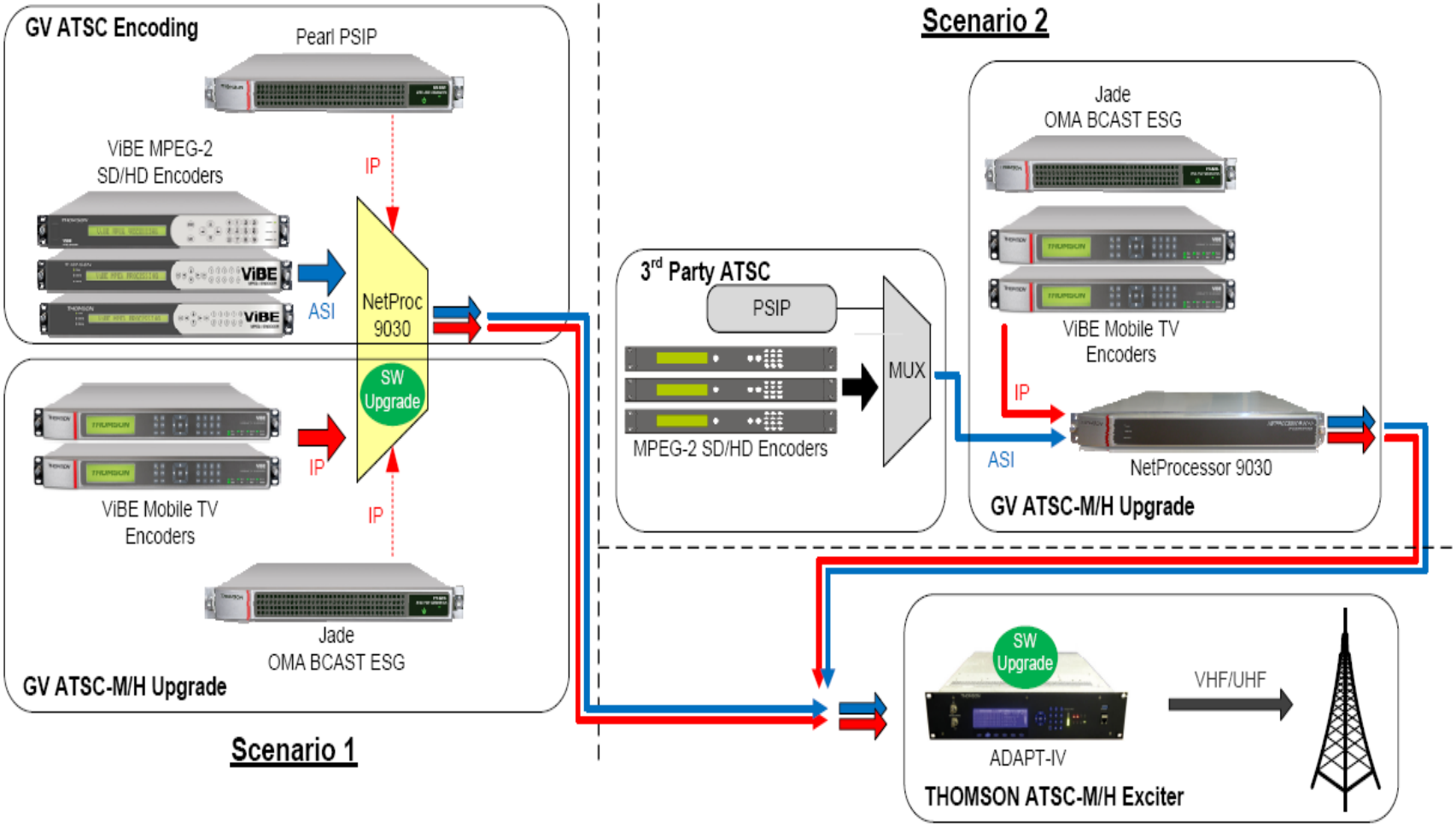
1 input (A/D) – 4 CIF or 8 QCIF encoding

- Multiple inputs

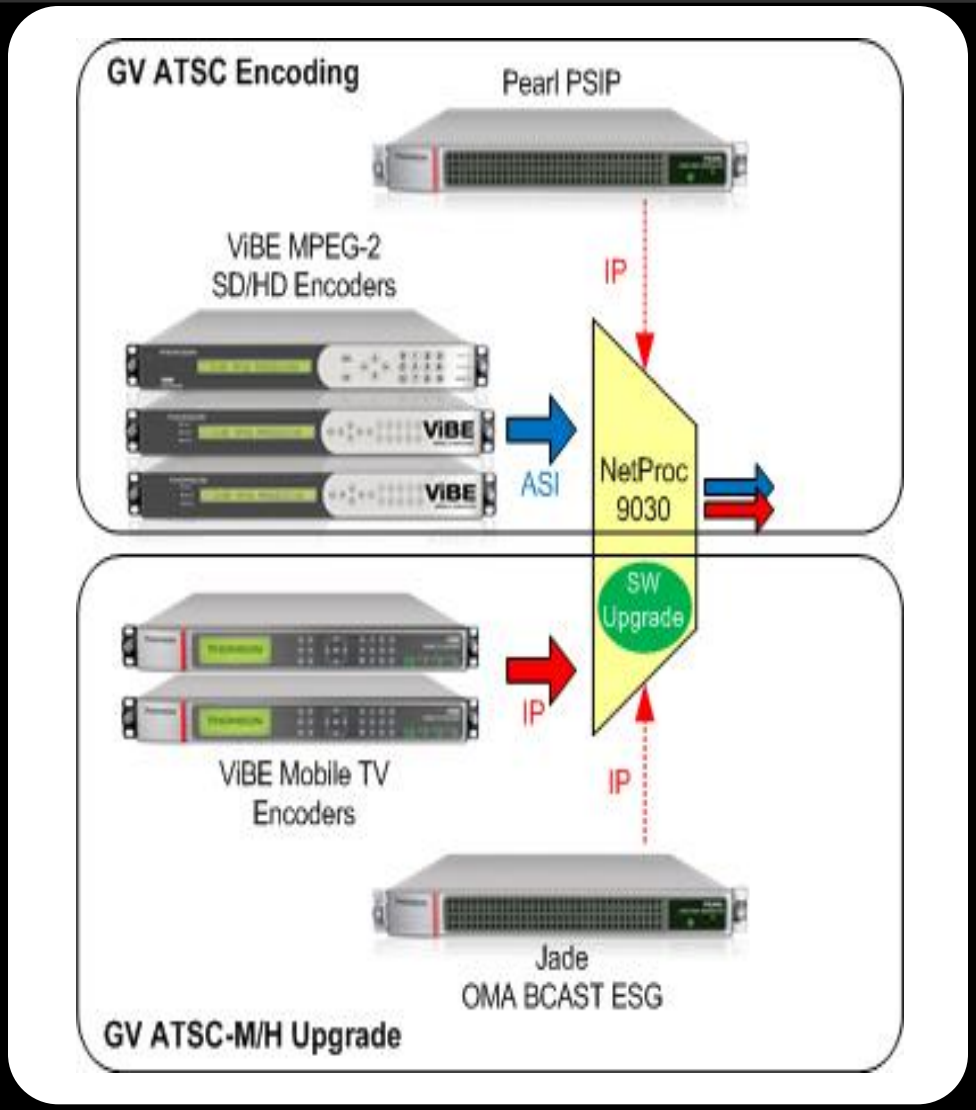


4 inputs (Digital) – 4 CIF or 8 QCIF encoding

Upgrade Path to ATSC-M/H

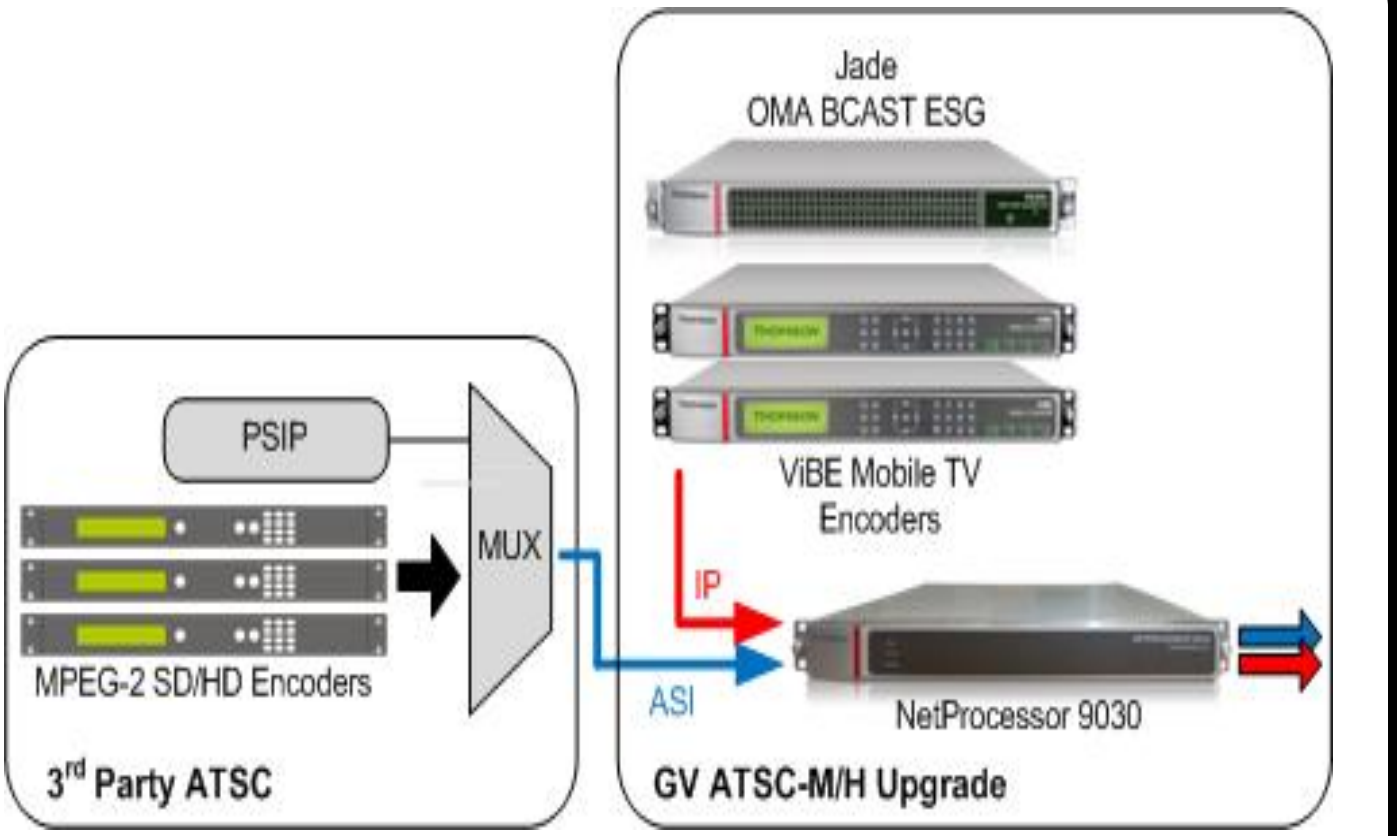


Upgrade Path to ATSC-M/H



Scenario 1

Upgrade Path to ATSC-M/H



Scenario 2

Thank you

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