XAVC

Advanced Video Coding Technology for HD & Beyond Content Production & Distribution

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Agenda

- Why a new Codec
- What is XAVC
  - Format Profile
  - 2 phase approach: Intra, Long GOP
- H.264/AVC : Background
- XAVC Spec. and XAVC MXF
- Codec Strategy and Positioning
Need for a “Beyond HD” Codec …..
XAVC: Need for a “Beyond” HD Codec.....

• 4K Initiative in Consumer electronics, Broadcast, D-Cinema
• High-Frame Rate HD for sports, scripted content
• OPEN format, licensing scheme to rapidly establish end-to-end workflow
• Consumer & Professional joint effort to reduce development cost, & faster time-to-market

4K XAVC
- 4K home displays shown at CES Jan/’13
- 4K content delivery being discussed / tested
  - 4K Terrestrial TX in Korea
  - 3840x2160 60Fps @35Mbps (HEVEC)

HDTV XAVC
- High Frame Rate Image capturing
- High interest in 1080/50P TV broadcasting
Super 35mm Cameras

- F65
  - 8K Imaging, 16 Bit RAW
  - Class Leading Camera
  - High Frame Rate
  - RAW or HD

- NEX-FS700
  - Unheard of features
  - In huge demand
  - High Frame Rate
  - Path to 4K

- PMW-F3
  - Best in class
  - Very successful in the marketplace

Super 35mm Cameras
- Super 35mm Cameras
- 8K Imaging, 16 Bit RAW
- Class Leading Camera
- High Frame Rate
- RAW or HD
- Unheard of features
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Closing the gap
New Super 35mm Cameras ....

- Completely new camera system
- New CineAlta 4K imager technology
- Multi codec
- Modular design
- Future proofed – upgradable features
Closing the gap

2013 : Large sensor line-up
Multi FORMAT Design

CineAlta

HD
1920 x 1080
1280 x 720

2K
2048 x 1080

QFHD
3840 x 2160

4K
4096 x 2160
Multi CODEC Design

XDCAM 50Mbps 4:2:2 + SR Codec 220Mbps 4:2:2 RGB444 440Mbps + XAVC 4:2:2 up to 16 bit Linear 2K / 4K RAW

CineAlta
Multi Codec design

**Mastering Quality**
- Prime-time program exchange
- TV Movies, Dramas

**HD High Frame Rate & 4K**
- Sports, TV Commercial Production

**1080/60i**
- News gathering
- Mainstream HDTV production

**MXF OP-1a Common Wrapper**
- Modest & flexible data payload
- Intra-frame structure
- 8 / 10 bit color sampling
- 1080 / 60P infrastructure

**MPEG4 SSstP**
- Visually lossless compression
- 220/440/880 Mbps
- 4:2:2 10 bit, RGB 10/12 bit
- 16Ch Audio

**XAVC**
- Modest & flexible data payload
- Intra-frame structure
- 8 / 10 bit color sampling
- 1080 / 60P infrastructure

**MPEG2 422 50Mbps**
- TV Workhorse format
- Best balance: Quality vs. Efficiency
- Professional Disc & SxS Memory
- Complete product lineup

**MPEG2 420 35Mbps**
Format Name for Sony H.264/AVC Professional Codec

- Name after “MPEG-4 Family”

- Simple Profile (SP)
- Simple Studio Profile (SStP)
- Advanced Simple Profile (ASP)

- High 10 Profile (Hi10P)
- High 4:2:2 Profile (Hi422P)

MPEG-4

- Part2
  - ISO/IEC 14496-2

- Part10
  - ISO/IEC 14496-10
  - H.264/MPEG-4 AVC

SRMASTER

XAVC
Standards compliance

• XAVC standards compliant
  – ISO/IES 14496-10 (MPEG-4) Level 5.2 Hi444IP.
  – Compliant to ITU-T H.264 @ Level 5.2.
    • Maximum Performance of All Coding Tools
    • 4096 x 2160 pixel resolution (4K example).
    • 1920 x 1080 pixel resolution (HD example).
    • 9.44M max. Luma samples per frame.
    • 4:4:4 & 4:2:2 sample structure capable.
    • High Bit-depth for Professional Applications
Sony H.264 Codec Chip Set

Custom ASIC:
MPEG-4 AVC/H.264 level 5.2, MXF

- XAVC & MPEG2 Compatible
- Bi-directional Encode or Decode
- Long GOP or INTRA Frame
- Bit depth: 10 bit sampling
- 4096 x 2160 / 3840 x 2160 up to 60P
- HD / 2K up to 180P
- Color sampling: 4:2:2
- Unique, ‘Two-Pass’ Sony encoding architecture
Unique feature of the SONY XAVC Encoder

- **Multi Pass Encoding**
  - Select appropriate encoding parameters by Pre-encoding
  - Accurate rate control achieves stable high picture quality constantly

- **Bit Allocation based on human visual characteristics**
  - Improve subjective picture quality
    - by checking picture statistics, and
    - by allocating more bits to image areas whose degradations can be easily noticed
Unique feature of the SONY XAVC Encoder

- **Multi-generation Guaranteed logic**
  - Maintains multi-generation picture quality
  - by detecting pictures that were once encoded, and
  - by selecting appropriate encoding parameters that don’t increase encoding degradation

![Multi-generation Quality Graph](chart.png)
## XAVC Format Overview

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Frame Rate</th>
<th>Color</th>
<th>Max Bit Rate</th>
<th>Intra / Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>4K</td>
<td>4096x2160 3840x2160</td>
<td>23.98p to 59.94p</td>
<td>4:2:0/8bit to 4:4:4/12bit</td>
<td>960Mbps</td>
<td>Intra Long</td>
</tr>
<tr>
<td>HD</td>
<td>2048x1080 1920x1080 1440x1080 1280x720</td>
<td>23.98p to 59.94p 50i/59.94i</td>
<td>4:2:0/8bit to 4:4:4/12bit</td>
<td>300Mbps</td>
<td>Intra Long</td>
</tr>
<tr>
<td>Proxy</td>
<td>1280x720 640x360 480x270</td>
<td>23.98p to 59.94p</td>
<td>4:2:0/8bit</td>
<td>15Mbps</td>
<td>Long</td>
</tr>
</tbody>
</table>
Image File Size Comparison (Mega bytes per Frame)

- HD 220Mbps
- 4K XAVC
- F55 RAW
- F65 RAW Lite
- F65 RAW
Expanding XAVC operating points

① ENG / HDTV

② 4K Production

③ Consumer

Enhanced Image Quality

4K/QFHD INTRA
240Mbps@24P~600Mbps@60P
2K/1080P INTRA
90Mbps@24P~600Mbps@180P

Consumer Friendly Efficiency

Enhanced Efficiency

XAVC
Expanding XAVC operating points: ENG / HDTV

- INTRA operating points will be supported by initial product release
- Low-rez. Proxy files for wireless applications
- Strong demand for long GOP: magic numbers: 25 / 50Mbps
  - 1080/60P 4:2:2 10bit @ 50Mbps
  - 1080/60i 4:2:2 10bit @ 25Mbps
- Support of 720P users
Expanding XAVC operating points: 4K Production

- Recording data rate on F55 capped at 600Mbps due to internal bandwidth
- Must achieve 600 Mbps with 4K/60P in-camera recording, thus 240Mbps @ 4K/24P
- DMC applications shoot 24P/25P/30P most of the time
- **240-300Mbps** @ 4K 24P/25P/30P under evaluation
Expanding XAVC operating points

② 4K Production

INTRA HQ Mode
240-300 Mbps@ 4K/24P

③ Consumer

4K/QFHD INTRA
240Mbps@24P~600Mbps@60P
2K/1080P INTRA
90Mbps@24P~600Mbps@180P

① ENG / HDTV

MP4 WRAP
QFHD LONG GOP
HD LONG GOP

1080i/P LONG
50Mbps@60P~25Mbps@60i
720P LONG/INTRA
Proxy
XAVC &
H.264/AVC, MPEG4 Part 10
Evolution of Codecs

Natural moving video

1990

ITU-T

H.261

ISO / IEC

MPEG-1

MPEG-2

Same

DVC

CE Industry Consortium

Proprietary

SMPTE

Real Video, WMV, On2, Divix, ...

2000

H.262

H.263

++

JVT

H.26L

AVC

2003

H.264

Part 10

Part 2

High level of commonality

VC-1
AVC Long GOP Compression Tools

Input Video

AVC (H.264)

Coder Control

Transform/Quantizer

Decompression

Motion Estimator

De-quantizer / Inv.Transform

4x4, 8x8 Integer Transform

Quant. Transf. coeffs
Intra, predictive and bi-predictive coding using multiple reference pictures

Motion Data:

Entropy Coding

UVLC, CAVLC, CABAC

16x16, 16x8, 8x16
8x8, 8x4, 4x8, 4x4

MC precision:

1, 1/2, 1/4, 1/8 pel

Input Video

Split into Macroblocks 16x16 pixels

Control Data
H.264 “Technical Tool Box”

- Structure
  - Sequence -> GOP -> Picture -> Slice -> MB -> Block
- Slice type: I, P, B, SI, SP
- Frame structure: interlaced, progressive
- Adaptive frame/field: per picture, per MB
- Deblocking filter – in loop
- MV resolution – \( \frac{1}{4} \) pixel
- Tree-like motion segmentation – 16x16 to 4x4
- Entropy coding – CAVLC / CABAC
- Data partition – NAL unit, priority
- ASO (arbitrary slice order) – independently decodable
- FMO (flexible macroblock order) – map
- ABP (adaptive bi-prediction) – adaptive weighting
High Profile

- **Main Profile**
  - 8x8 Transform and Quantisation matrices

- **High Profile**
  - 4:4:4 12 bit profile
  - 4:4:4 12 bit profile

- **High 10 Profile**
  - 10 bit video

- **High 4:2:2 Profile**
  - 4:2:2

- **Residual Color Transform**
- **Transform Bypass**
  - 4:4:4 12 bit profile
  - 4:4:4 12 bit
H.264/AVC: HIGH PROFILES

**High Profile (HiP)**
The primary profile for broadcast and disc storage applications, particularly for High-Definition Television applications (e.g., Blu-Ray storage format and the DVB HDTV broadcast service).

**Progressive High Profile (PHiP)**
Similar to the High Profile, but without support of field coding features.

**Constrained High Profile (PHiP)**
Similar to Progressive High Profile, but without support of B (Bi-predicted) Slices.

**High 10 Profile (Hi10P)**
This profile goes beyond mainstream consumer applications by adding support for up to 10 bits per color sample of coded picture precision.
High 4:2:2 Profile (Hi422P)

Primarily targeting professional applications that use interlaced video, this profile builds on top of the High 10 Profile adding support for the 4:2:2 Chroma format with 10 bits per color sample of coded precision.

High 4:4:4 Predictive Profile (Hi444PP)

This profile builds on top of the High 4:2:2 Profile supporting 4:4:4 chroma sampling, and up to 14 bits per color sample. It also adds support for efficient lossless region coding and the coding of each picture as three separate color planes.
For camcorders, editing and professional applications, the H.264/AVC standard contains four additional Intra-Frame only profiles which are defined as simple subsets of other corresponding Profiles.

These are mostly for professional applications.

**High 10 Intra Profile**

The High 10 Profile constrained to all Intra-Frame use

**High 4:2:2 Intra Profile**

The High 4:2:2 Profile constrained to all Intra-Frame use

**High 4:4:4 Intra Profile**

The High 4:4:4 Profile constrained to all Intra-Frame use

**CAVLC 4:4:4 Intra Profile**

The High 4:4:4 Profile constrained to all Intra-Frame use and to CAVLC entropy Coding (i.e., no supporting CABAC)
<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Extended</th>
<th>Main</th>
<th>High</th>
<th>High 10</th>
<th>High 4:2:2</th>
<th>High 4:4:4 Predictive</th>
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<tbody>
<tr>
<td>I and P Slices</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>B Slices</td>
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<td>Yes</td>
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<tr>
<td>SI and SP Slices</td>
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<td>No</td>
<td>No</td>
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<td>Multiple Reference Frames</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>In-Loop Deblocking Filter</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>CAVLC Entropy Coding</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>CABAC Entropy Coding</td>
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<td>Flexible Macroblock Ordering (FMO)</td>
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<td>Arbitrary Slice Ordering (ASO)</td>
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<td>Redundant Slices (RS)</td>
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<td>Data Partitioning</td>
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<td>Interlaced Coding (PlcAFF, MBAFF)</td>
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<td>4:2:0 Chroma Format</td>
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<td>Monochrome Video Format (4:0:0)</td>
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<td>4:2:2 Chroma Format</td>
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<td>4:4:4 Chroma Format</td>
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<td>8 Bit Sample Depth</td>
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<td>Yes</td>
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<td>9 and 10 Bit Sample Depth</td>
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<td>11 to 14 Bit Sample Depth</td>
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<td>8x8 vs. 4x4 Transform Adaptivity</td>
<td>No</td>
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<td>No</td>
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<td>Quantization Scaling Matrices</td>
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<td>Separate Cb and Cr QP control</td>
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<td>Separate Color Plane Coding</td>
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<td>Predictive Lossless Coding</td>
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<td>No</td>
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</table>

H.264/MPEG-4 AVC

Compression Tools
<table>
<thead>
<tr>
<th>Level</th>
<th>Max decoding speed</th>
<th>Max frame size</th>
<th>Max video bit rate for video coding layer (VCL) kbit/s</th>
<th>Examples for high resolution @ highest frame rate (max stored frames)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Luma samples</td>
<td>Macroblocks</td>
<td>Luma samples/s</td>
<td>Macroblocks/s</td>
</tr>
<tr>
<td>4</td>
<td>62,914,560</td>
<td>245,760</td>
<td>2,097,152</td>
<td>8,192</td>
</tr>
<tr>
<td>4.1</td>
<td>62,914,560</td>
<td>245,760</td>
<td>2,097,152</td>
<td>8,192</td>
</tr>
<tr>
<td>4.2</td>
<td>133,693,440</td>
<td>522,240</td>
<td>2,228,224</td>
<td>8,704</td>
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<tr>
<td>Level</td>
<td>Max decoding speed</td>
<td>Max frame size</td>
<td>Max video bit rate for video coding layer (VCL) kbit/s</td>
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<td>Luma samples</td>
<td>Macroblocks</td>
<td>Luma samples/s</td>
<td>Macroblocks/s</td>
</tr>
<tr>
<td>5</td>
<td>150,994,944</td>
<td>589,824</td>
<td>5,652,480</td>
<td>22,080</td>
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<td>5.1</td>
<td>251,668,240</td>
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<td>9,437,184</td>
<td>36,864</td>
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<tr>
<td>5.2</td>
<td>530,841,600</td>
<td>2,073,600</td>
<td>9,437,184</td>
<td>36,864</td>
</tr>
</tbody>
</table>
What's XAVC-Intra?

XAVC-Intra does not use Inter-Frame coding techniques.
Compression Tools in Intra coding

- **Intra Prediction**
  - Predict image by neighboring pixels

- **Adaptive Block Size**
  - Intra Prediction (16x16, 8x8, 4x4)
  - DCT block size (8x8, 4x4)

- **Entropy Coding**
  - CAVLC or CABAC, selectable
    - CABAC is more efficient than CAVLC,
    - the CABAC’s computational complexity is higher than the CAVLC’s,
  - therefore using CABAC in high bit rate is somewhat difficult.
### Prediction in Intra Picture

<table>
<thead>
<tr>
<th>Mode 0 - Vertical</th>
<th>Mode 1 - Horizontal</th>
<th>Mode 2 - DC</th>
<th>Mode 3 – Diag Down/Left</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Mode 0 - Vertical Diagram" /></td>
<td><img src="image" alt="Mode 1 - Horizontal Diagram" /></td>
<td><img src="image" alt="Mode 2 - DC Diagram" /></td>
<td><img src="image" alt="Mode 3 – Diag Down/Left Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode 4 – Diag Down/Right</th>
<th>Mode 5 – Vertical-Right</th>
<th>Mode 6 – Horizontal-Down</th>
<th>Mode 7 – Vertical-Left</th>
<th>Mode 8 – Horizontal-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Mode 4 – Diag Down/Right Diagram" /></td>
<td><img src="image" alt="Mode 5 – Vertical-Right Diagram" /></td>
<td><img src="image" alt="Mode 6 – Horizontal-Down Diagram" /></td>
<td><img src="image" alt="Mode 7 – Vertical-Left Diagram" /></td>
<td><img src="image" alt="Mode 8 – Horizontal-Up Diagram" /></td>
</tr>
</tbody>
</table>

**MPEG-2**
- DCT DC Coefficients are predicted.

**MPEG-4**
- DC + Low AC Coeff. are predicted.

**XAVC**
- Pixels are predicted, i.e. Spatial prediction

---

**MPEG-2**
- DCT DC Coefficients are predicted.

**MPEG-4**
- DC + Low AC Coeff. are predicted.

**XAVC**
- Pixels are predicted, i.e. Spatial prediction
Intra Prediction

- Exploits Spatial redundancy between adjacent macroblocks in a frame
- 4 x 4 luma block
  - 9 prediction modes: 8 Directional predictions and 1 DC prediction
    (vertical: 0, horizontal: 1, DC: 2, diagonal down left: 3, diagonal down right: 4, vertical right: 5, horizontal down: 6, vertical left: 7, horizontal up: 8)

Samples a, b, ..., p: the predicted ones for the current block,
Above and left samples A, B, ..., M: previously reconstructed ones
Intra Prediction

Example of 4 x 4 luma block

- Sample a, d : predicted by \( \text{round}(I/4 + M/2 + A/4), \text{round}(B/4 + C/2 + D/4) \) for mode 4
- Sample a, d : predicted by \( \text{round}(I/2 + J/2), \text{round}(J/4 + K/2 + L/4) \) for mode 8
<p>…completing Sony’s codec range</p>

<table>
<thead>
<tr>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16</th>
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</tbody>
</table>

- **Camera RAW**
- **MPEG – 4 SStP**
- **XAVC Intra**
- **MPEG - 2**
- **AVCHD**
- **DV**

- **422:8bit 50M / 420: 8bit 35M**
- **420:8bit 60i: 24M, 60p: 28M**
- **420 & 411: 25M**
- **SD 420 & 411: 25M**
Market Segments and Application areas

- Art
- High Budget
- Low Budget
- Sports
- Drama
- Docu-
- Documentary
- Cinema, CM
- Music, PV
- Event
- Magazine, Web
- Bridal
- Indies
- News, Variety, Wide Show
- (inc. Local Station, CATV)
- Information
- Education, Training, Corporate, School, Government, Religion
- XAVC Intra
- Application Area
- XAVC Long
- Application Area
- Pro-Sumer/Entry-Level
- High Frame rate
- SSIP / F65RAW
- MPEG2 HD
Multiple CODEC for Multiple Applications

HD SSstP 444
- SRMaster Workflow
- Working with major NLE Vendors

HD XAVC-I 422
- MPEG2 Workflow

MPEG2 422

Feature Film
High Budget CM
Episodic TV

VFX
Blue/Green-Screen

TV Drama
Documentary
CM

General Use
Documentary
TV Program

4K RAW
- Following F65 RAW Workflow
- Working with major NLE Vendors

4K XAVC-I
XAVC Workflow Alliance Phase 2
Broadcast production-to-play-out workflow

CM Cinema
- RAW Acquisition
- Dailies Screening
- Transcode

4K Production
- XAVC (4K) Acquisition

BC Production
- XAVC HD&HFR Acquisition

BC News Production
- XAVC HD&HFR Acquisition

NLE Gp:
- Adobe
- VEGAS
- grass valley
- HARRIS
- Quantel

Post Production
- Editing
- Conform
- Colour Grading

DMC Gp:
- Blackmagic
- ImLight
- YoYotta

App Gp:
- AVID
- DALET

Server HW Gp:
- Omneon
- DVS
- EVS
- Harris
- MOG
**XAVC Codec cards**

- **XAVC Video card**
  - 4x 3G HD-SDI, 4K/60P/4:2:2 single stream, 1080/60P
    4:2:2 x4 streams
  - 4K/QFHD INTRA, HD INTRA/Long GOP
  - MPEG2 support (up to 1080 59i/29P)
  - Availability: November 2013

- **MSQ-211 XAVC Module**
  - Designed as Sub Card for Various 3rd Parties Mother Boards
  - Real time ENCODE/ DECODER of XAVC & MPEG2, up to 1080/60P
  - Dual - stream XAVC decode
  - Inherit existing MSQ201 function for MPEG2, pin compatible
  - Availability: September 2013
XAVC Card

- HD x 4ch (1080 60p)
- 4K x 1ch (4096/3840 60p)

PC based XAVC Solution
MSQ211 design and use

Same W and H size as MSQ-201
XAVC Spec.
XAVC Profiles

- **XAVC 4K Profile**
  - 4096x2160: 420 8bit
  - 3840x2160: 420 8bit
- **XAVC HD Profile**
  - 1920x1080: 420 8bit, 422 10bit
  - 1440x1080: 420 8bit, 422 10bit
  - 1280x720: 420 8bit
- **XAVC 4K Intra Profile**
  - 422 10bit
  - 600Mbps
  - 960Mbps
- **XAVC HD Intra Profile**
  - 422 10bit
  - 420 10bit
  - 220Mbps
  - 440Mbps
- **XAVC 4K444 Intra Profile**
  - 440Mbps
- **XAVC HD444 Intra Profile**
  - 960Mbps

Supported Formats:
- MP4
- MXF
Terminology

• Resolution
  – HD  1920 x 1080, 1440 x 1080
  – 2K   2048 x 1080
  – QFHD 3840 x 2160
  – 4K   4096 x 2160

• Encoding method
  – VBR: Variable Bit Rate
  – CBG: Constrained Bytes per GOP

Intra CBG = Constant Bytes GOP
Stuffing data
Max coded frame size
frames
XAVC Stream
XAVC Intra Stream Spec.

- **High 4:2:2 Intra Profile (10bit 4:2:2), Level 4.1~5.2**
- **CAVLC (Context Adaptive Variable Length Coding)**

1440x1080

- **High 10 Intra Profile (10bit 4:2:0), Level 4**
- **CABAC (Context Adaptive Binary Arithmetic Coding)**

**Common**

- No de-blocking filter
- Multi-slice (horizontally divided 8 slices)
XAVC Long Stream Spec. (tentative)

- High Profile (4:2:0) & High 422 Profile
- Level 4.1, 4.2, 5.1, 5.2
- QFHD  8bits 4:2:0
- HD    10bits 4:2:2, 8bit 4:2:0
- Picture/GOP concept similar to BD/AVCHD
- CABAC (Context Adaptive Binary Arithmetic Coding)
XAVC MXF
XAVC MXF Structure

1. Same style for Intra (CBG/VBR) or Long GOP commonly
2. Based on existing Sony MXF format (XDCAM, SR)

File Header
- Header Metadata (complete)
- Index Table
  - Edit Unit

File Body
- Edit Unit
- Edit Unit
- Edit Unit
- Edit Unit
- ... (more edit units)

File Footer
- FP
- IP
- RP

Item Spec.
- Wrapping (Interleaving) Frame Wrapping
- Partitions Essence Container in a Partition
- Index Table Pre-index
- Random Index Pack exist
- KAG size 512
- Edit Unit System, Picture, Sound, and Data Items
- System Item CP-compatible, not incl. Camera Metadata
- Picture Item AVC Intra 4K/QFHD/2K/HD
  - CBG/VBR
- Sound Item AES3 Elements (8ch): 48kHz, 24bit
- Data Item Ancillary Data incl. Camera Metadata
XAVC Stream Structure

**File Header**
- Header Metadata
- Index Table

**File Body**
- System Item
- Picture Item
- Sound Item
- Data Item

**File Footer**
- F P P

**AVC** byte stream

**Slice data**

**SPS:** SEQUENCE Parameter Set
**PPS:** PICTURE Parameter Set

- **Intra**: SPS and PPS placed in every frame
- **Long GOP**: SPS and PPS(s) placed in the beginning of every GOP
In Summary,…

- New F5 & F55 Full System
- F65 with new v3.0
- FS700 with new 4K workflow
- XAVC
- New 4K Compression Codec
- New 4K 30” Monitor

The Sony 4K experience
Thank you