

# iHD1500: Low Latency Multipoint Telepresence

PRAGMA 13

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THINK FORWARD. THINK RESEARCHCHANNEL.

# ResearchChannel Advanced on-line Services



## ■ ResearchChannel-HD

- Currently VC-1 SMPTE 421M
- AVC (h.264, MPEG-4 Part-10) coming soon
- Unicast:
  - [http://media-wm-  
hd.cac.washington.edu/ResearchChannel-HDVideo](http://media-wm-hd.cac.washington.edu/ResearchChannel-HDVideo)
- Multicast:
  - [http://researchchannel.org/multicast/ResearchChannel-  
HDVideo.nsc](http://researchchannel.org/multicast/ResearchChannel-HDVideo.nsc)

# ResearchChannel Advanced on-line Services



- ResearchChannel satellite feed on the network
  - 233.0.73.29 MPEG2@ 3.2mbps
- Live 1080i HD video of Mt Rainier
  - 233.0.73.26 MPEG2 MP@HL @ 20mbps
- Live 720p HD video of Mt Rainier

<http://www.researchchannel.org/tech/desktopclients.asp>
- HD VOD 720p WMV-HD

<http://www.researchchannel.org/visions05/hdpresentation.asp>
- HD VOD 1080i MPEG2 ML@HL

<http://www.researchchannel.org/tech/desktophdsamples.asp>
- KEXP-FM Audio-on-demand; uncompressed audio webcasting

<http://www.kexp.org>

# ResearchChannel Advanced on-line Services



- Seattle Science Foundation Project – testbed for new Medical technology with HD video archiving –  
[seattlesciencefoundation.org](http://seattlesciencefoundation.org)
- WWAMI: collaborative medical education via Advanced video technology
- RC HD Lab on-line
- Advanced venue on UW campus commissioned
- Successful launch of Experimental Internet ResearchChannel-HD



iHDTV Open Source Project



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# iHDTV™ Software Suite

- iHDTV Explained
  - iHD1500
  - iHD270
  - HD to the Desktop
- WindowsXP-based application suite
- Released as Open Source
- Account created on SourceForge
- iHD\_Trusted\_Partners\_Group formed to direct software development





# iHDTV™ Development / Deployment

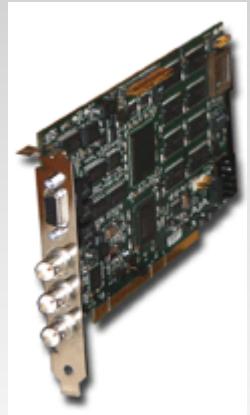
- SourceForge load
  - SVN Tree transferred
  - iHDTV\_trusted\_partners formed – 47 members
  - 4 Core developers @ (UW / U-Mich / U-Wisconsin)
  - Executive team to guide development will meet monthly
- Deploy globally
  - N-way implementation this summer with 6 nodes





# iHDTV™ iHD270

- iHD270 (first introduced aug 99)
  - Sony HDCam™ compression
  - SDTI data format 270mbps
  - AJA Xena I/O
  - Requires:
    - AJA Xena-HD capture cards
    - Dual Processor P4
    - Windows XP
    - Sony HDCam Hardware encoder/decoder
    - Gige network connection





# iHDTV™ iHD270

- 1920x1080 60i 8bit 4:2:2
  - Sony HDCam source material
  - 995mbps active lines, 1188mbps total





# iHDTV™ iHD1500

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## ■ iHD1500

- Uncompressed SMPTE 292M 4:2:2
- Data rate total approx 1.5 gbps
- Requires:
  - Uncompressed HD capture cards
  - PCI Express platforms
  - Windows XP
  - 2 x gige or 1x10gige network connection
  - Jumbo frame transport and routing
  - Specs:  
[http://zzz.cac.washington.edu/ihdtv\\_wiki/index.php/Main\\_Page](http://zzz.cac.washington.edu/ihdtv_wiki/index.php/Main_Page)
  - Software:
    - <https://sourceforge.net/projects/ihdtv>





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# iHDTV™ iHD1500

Latency about 4 frames end to end plus network delay

- 4 frames=133ms or ~ 1/7 sec





# iHDTV™ iHD1500

- iHD1500 Enhancements:
  - New i/o board options
  - GUI front end
  - Self-installing package
  - Uncompressed HD Server:
    - Single link
    - Dual link
    - Quad link
  - HD Screen rendering for OptIPortal integration
  - NTT i-VISTO interoperability





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# HD – a Background

1920 x 1080P - HDTV

1024 x 768 - XGA

1280 x 720P  
HDTV

768 x 576 - PAL

720 x 480 - DV NTSC/VGA



# Sample Rates

- NTSC 4:2:2
  - Y, Pb, Pr color matrix
    - $4 \times 3.38$  (compromise rate from 3.58MHz) = 15.5MHz
    - Color difference channels @ 6.75MHz
- HD 4:2:2 (really 22:11:11)
  - Y, Pb, Pr color matrix
    - $22 \times 3.38 = 74.25$ MHz
    - Color difference channels @ 37.125MHz
- 10 bit – 1024 gradations
- 8 bit – 256 gradations



# Sample Rates

- 4:2:2
  - Chroma sampled at  $\frac{1}{2}$  rate of Luma
- 4:1:1
  - Chroma sampled at  $\frac{1}{4}$  rate of Luma
- 4:2:0
  - Chroma sampled at  $\frac{1}{2}$  rate of Luma on every other line of each field

# Sample / Bit Rates

- Broadcast
  - 4:2:0 MPEG-2 TS 19.2mbps
- DVD
  - 4:2:0 MPEG-2 PS VBR
- HD DVD/Blu-Ray
  - 4:2:0 VC-1 @ 8mbps
  - 4:2:0 AVC @ 8mbps





# HD Resolutions

- 720p 60Hz – SMPTE 274M
  - 1280x720 24p
  - 1280x720 30p
  - 1280x720 60p
- 1080i/p 60Hz – SMPTE 296M
  - 1920x1080 24p
  - 1920x1080 30p
  - 1920x1080 60i
  - 1920x1080 60p

# HD Bitrates – Uncompressed

## 720p 10-bit 4:2:2



- 720p 60Hz - SMPTE 296M
  - 1280x720 30p
    - 742mbps
    - 30MHz Y, 15MHz Chroma
  - 1280x720 60p
    - 1485mbps
    - 30MHz Y, 15MHz Chroma



# Progressive / Interlaced

- 1080/60i and 1080/30p occupy the same datarate – 1.485gbps
- Interlaced pictures produce spacial errors associated with the time difference in motion between fields
- This can create a smoothing effect which is easier on the eye during fast motion
- High Framerate progressive (60 frame or greater) is best

# HD Bitrates – Uncompressed

## 1080i/p 10-bit 4:2:2



- 1080i/p 60Hz – SMPTE 274M
  - 1920x1080 30p
    - 1485mbps
    - 30MHz Y, 15MHz Chroma
  - 1920x1080 60i
    - 1485mbps
    - 30MHz Y, 15MHz Chroma
  - 1920x1080 60p
    - 2970mbps
    - 60MHz Y, 30MHz Chroma



# Color Processing

- 3 chip
  - RGB output from image processing
  - Digital sampling and CODECS operate on component video – Y, Pb, Pr (Y',Cb',Cr')
  - Y = Luma channel
  - Pb= subsampled blue matrix
  - Pr= Subsampled red matrix

# Codec comparison Project

- SMPTE StEM HD Mini-Movie
  - Designed for critical evaluation of HD equipment as well as encoders and decoders
  - Delivered as tga files, uncompressed
  - Imported into Final Cut Pro





# CODEC Comparison

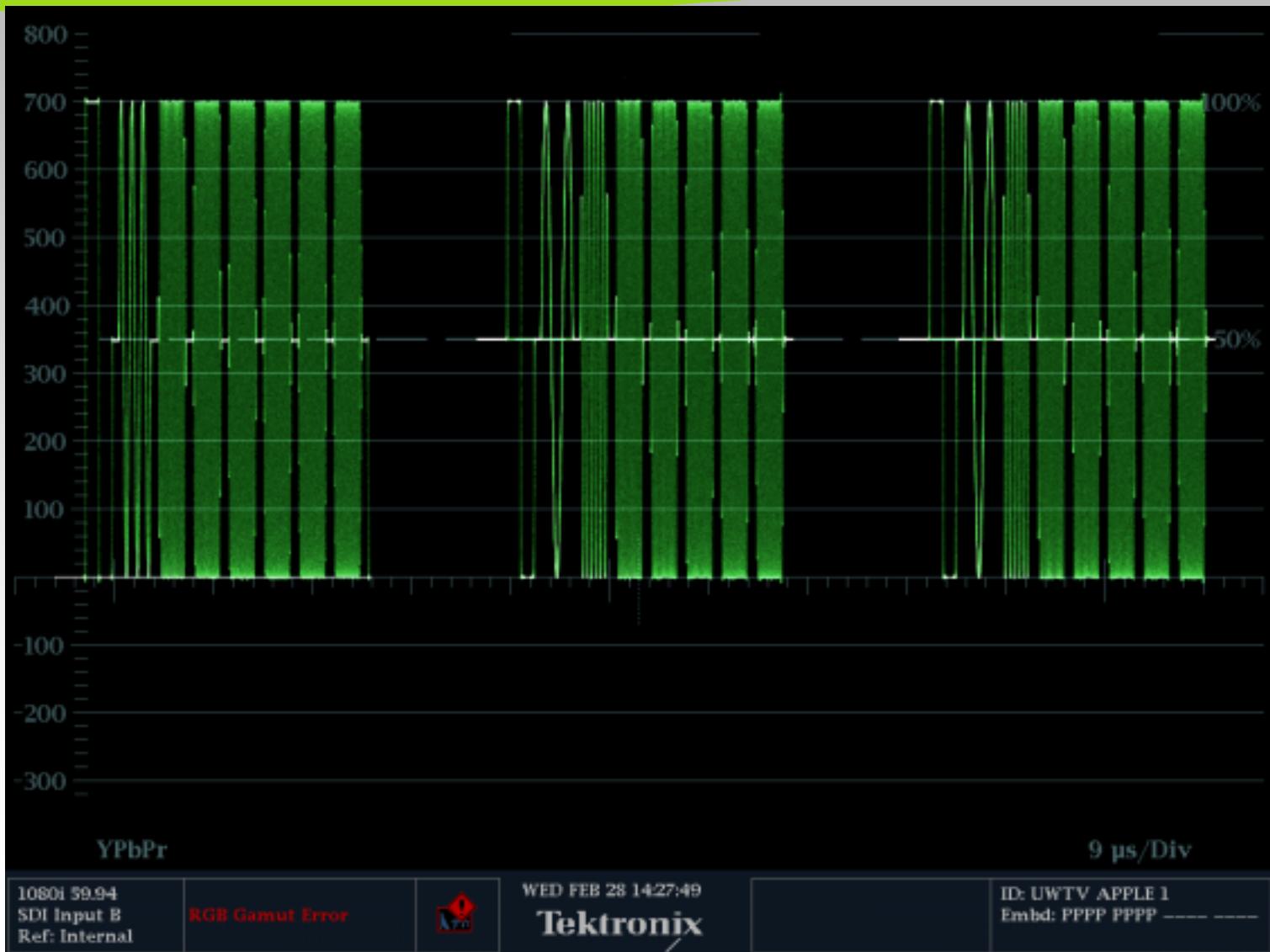
CODEC	Bit Rate (Mbps)	File Size (MB)	Compression Ratio	Type	Size	Color Space	Encode Time
HDCam	144	n/a	10.4:1	Hardware	1440X1080	3:1:1	6:30 min
HDCam SR	440		=1500/B3	Hardware	1920X1080	4:4:4	6:30 min
DVCPROHD	115.24	5100	13:1	Software	1280x1080	4:2:2	17 min
XDCam HD	35			Hardware			6:30 min
MPEG-2 4:2:2@HL	30	n/a	56:1	Hardware	1920X1080	4:2:2	6:30 min
MPEG-2 MP@HL 4:2:0	18	n/a	93:1	Hardware	1920X1080	4:2:0	6:30 min
HDV MPEG-2 MP@H14	24.96	1110	60:1	Software	1440X1080	3:1:1	33 min
MPEG-4 H.264	7.572	344	198:1	Software	1920X1080	4:2:0	1 hr 5 min
MPEG-4 Basic	5.937	270	253:1	Software	1920X1080	4:2:0	24 min
VC-1	8	320	188:1	Hardware	1920X1080	4:2:0	28 min
JPEG2000	46/25*			Hardware			
JPEG2000	100/75*			Hardware			
JPEG2000	220/190*			Hardware			



# equipment

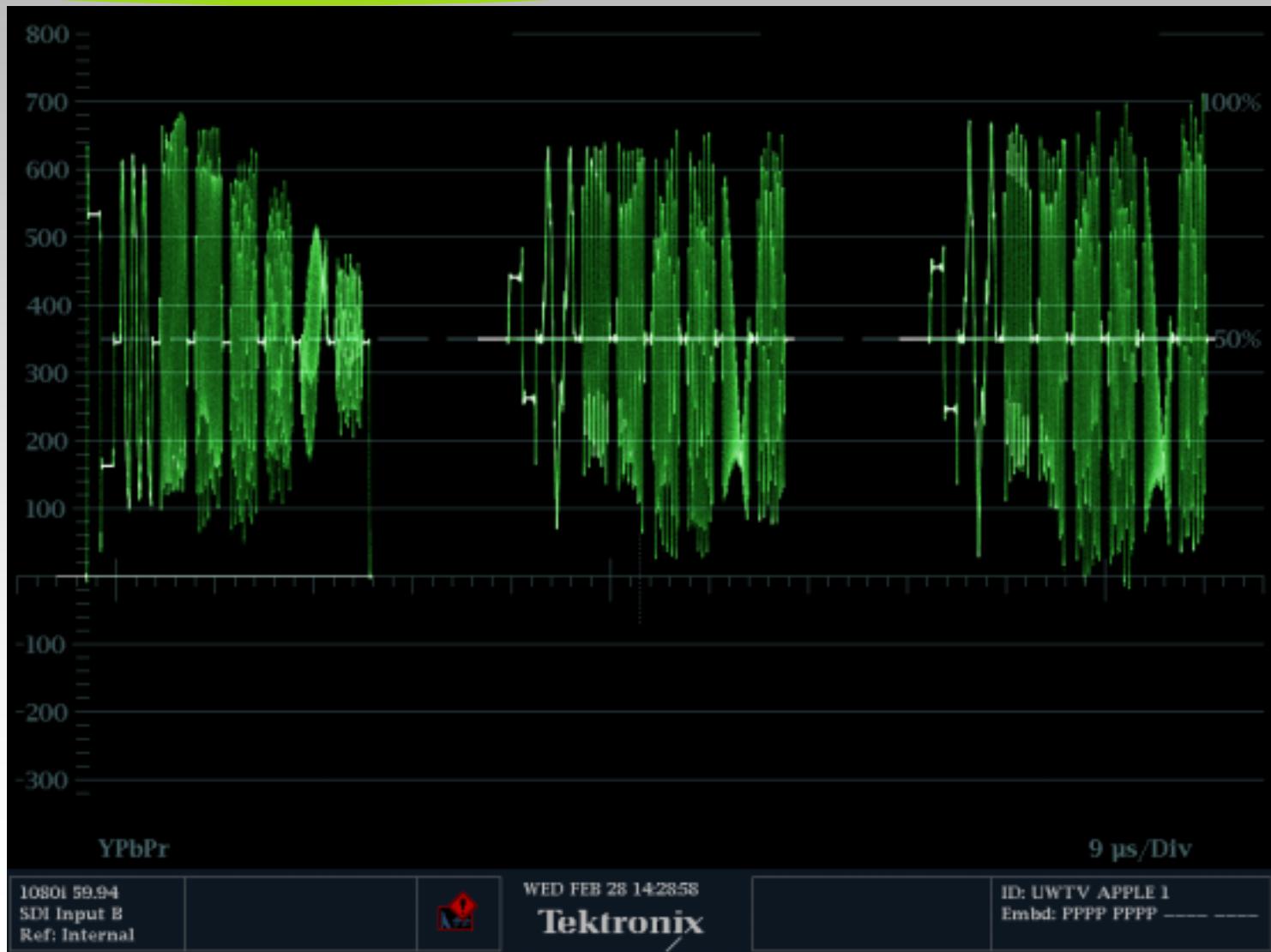
- SONY HDW-500 VTR
- SONY HDCAM-SR VTR
- SONY XDCAM –HD VTR
- Panasonic DVCPRO-100
- Apple Dual 2.7GHz G5
  - 4GB RAM
  - Mac OS-X 10.4.7
  - Final Cut Pro 5.1.1
  - AJA Kona 2 I/O
- NTT HD 1000 MPEG Encoder
- NTT HD 1000 MPEG Decoder

# HD Multiburst Waveform Uncompressed Reference



# HD Multiburst Waveform

## DVCPro 100



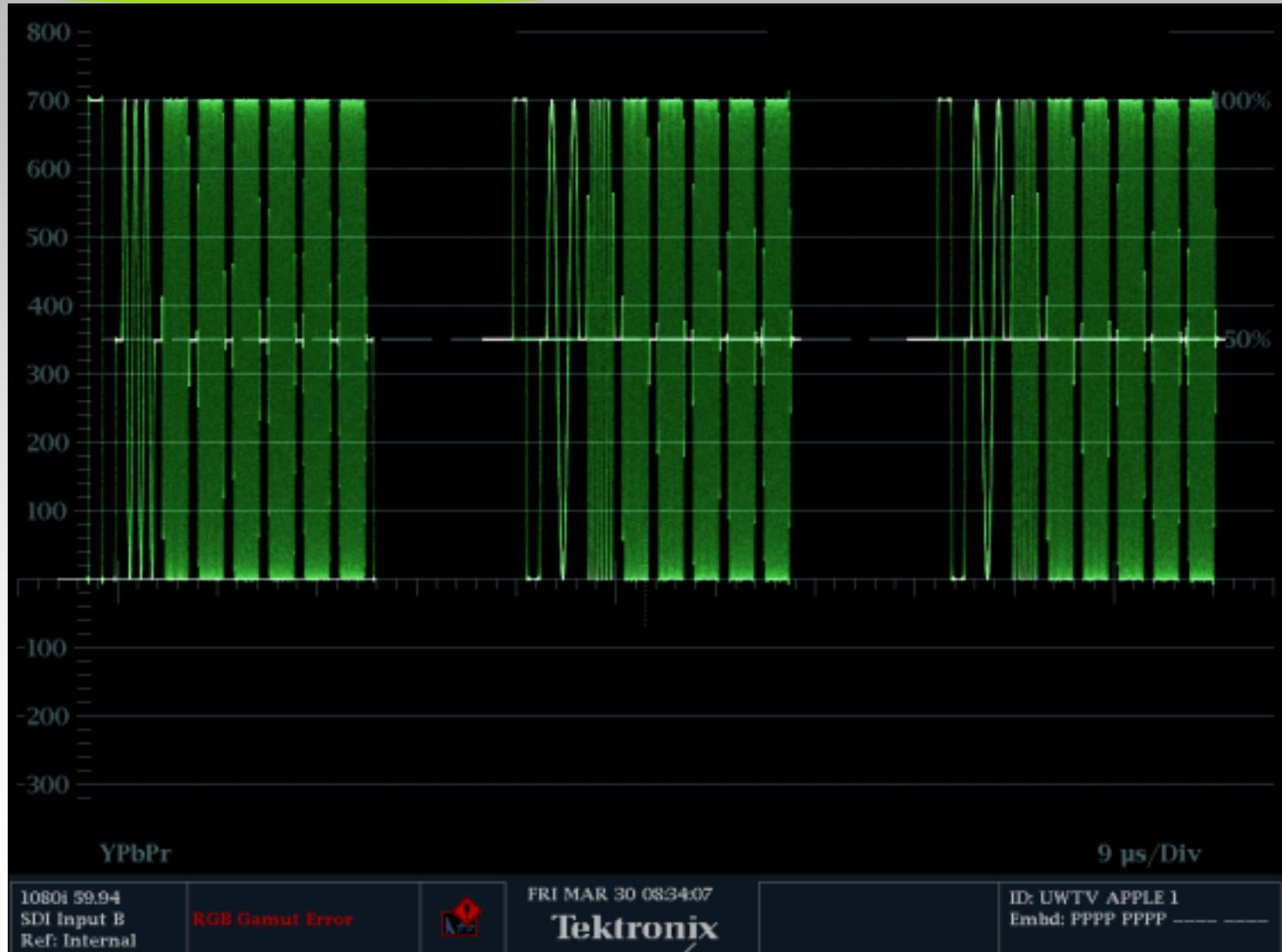
# HD Multiburst Waveform

## SONY HDCam



# HD Multiburst Waveform

## SONY HDCAM SR



# HD Multiburst Waveform

## HDV



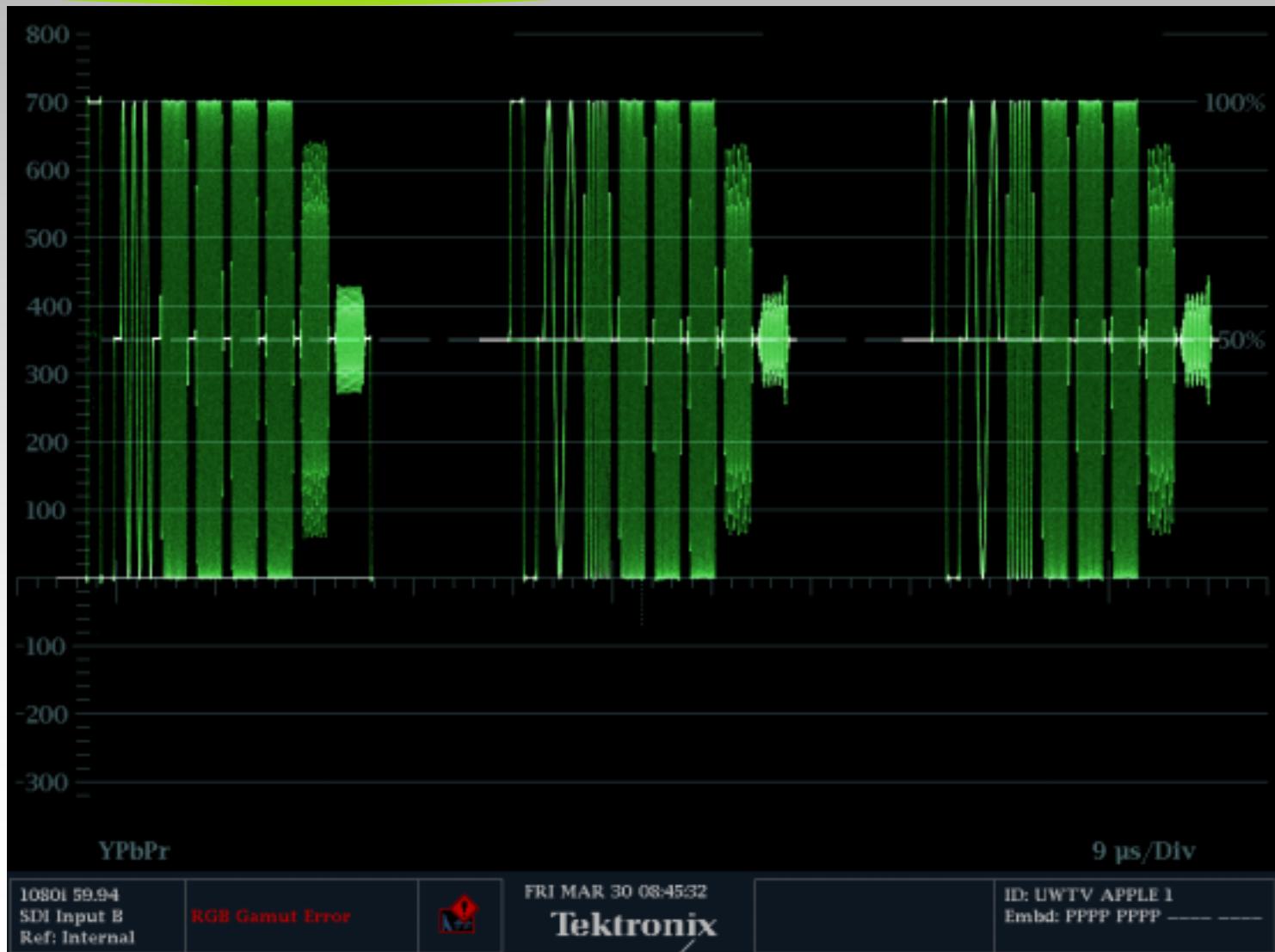
# HD Multiburst Waveform

## H.264 /AVC



# HD Multiburst Waveform

## SONY XDCAM HD 30



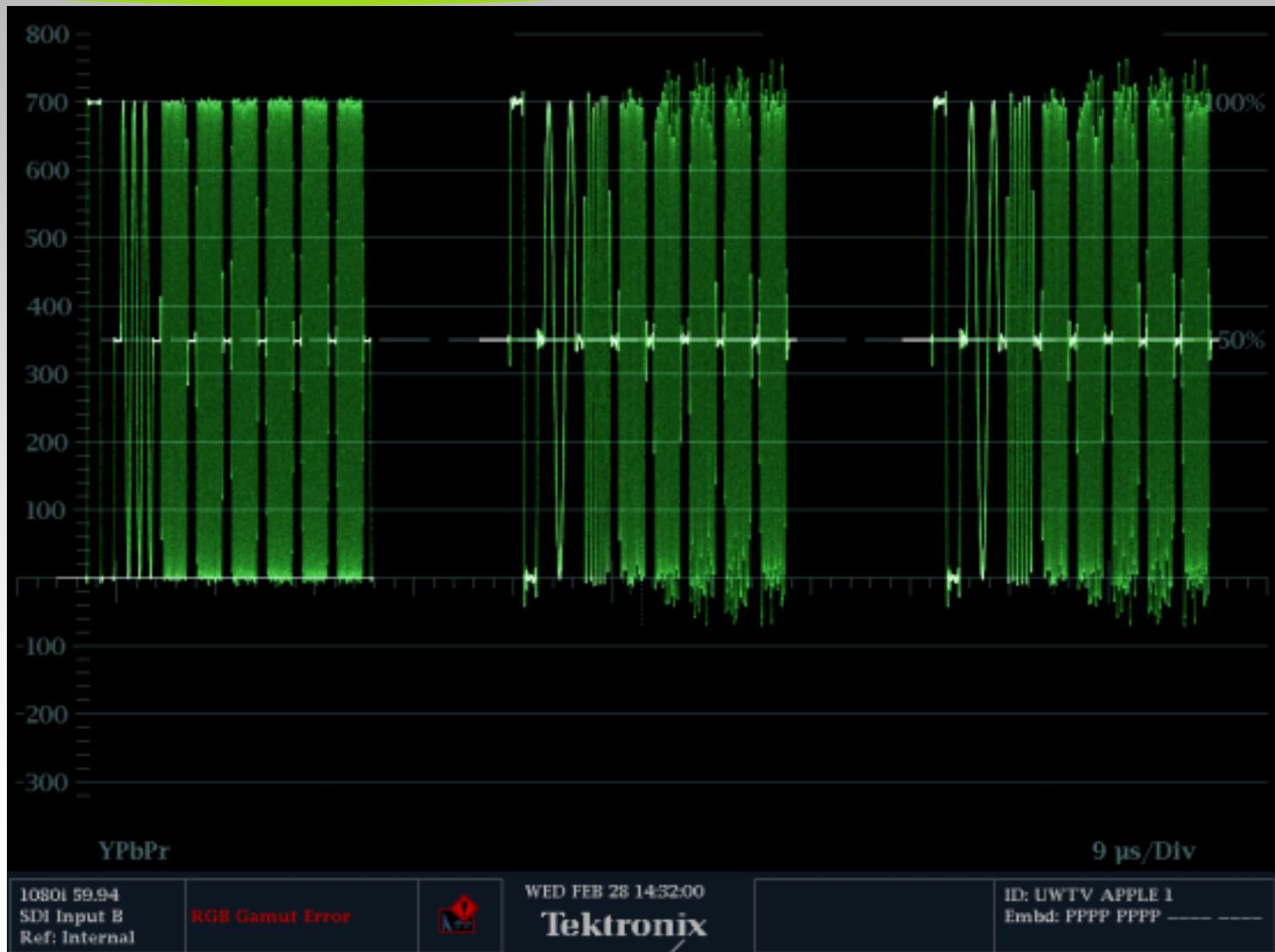
# HD Multiburst Waveform

## JPEG 2K 25mbps



# HD Multiburst Waveform

## JPEG 2K 75mbps



# HD Multiburst Waveform

## JPEG 2K 250mbps



1080I 59.94  
SDI Input B  
Ref: Internal

RGB Gamut Error



WED FEB 28 14:31:07

Tektronix

ID: UWTV APPLE 1  
Embd: PPPP PPPP -----

# For more information

- [www.researchchannel.org](http://www.researchchannel.org)
- [wellings@washington.edu](mailto:wellings@washington.edu)