

Review of HDTV (production) standards

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Overview

- HDTV basics
- Interfaces
- Compression
- HD-Ready, HDTV-Ready,
- EBU Demos @ IBC2005
- 1080p/50
- Summary

Uncompromised quality of Sound and Video



Details (for advertisements)

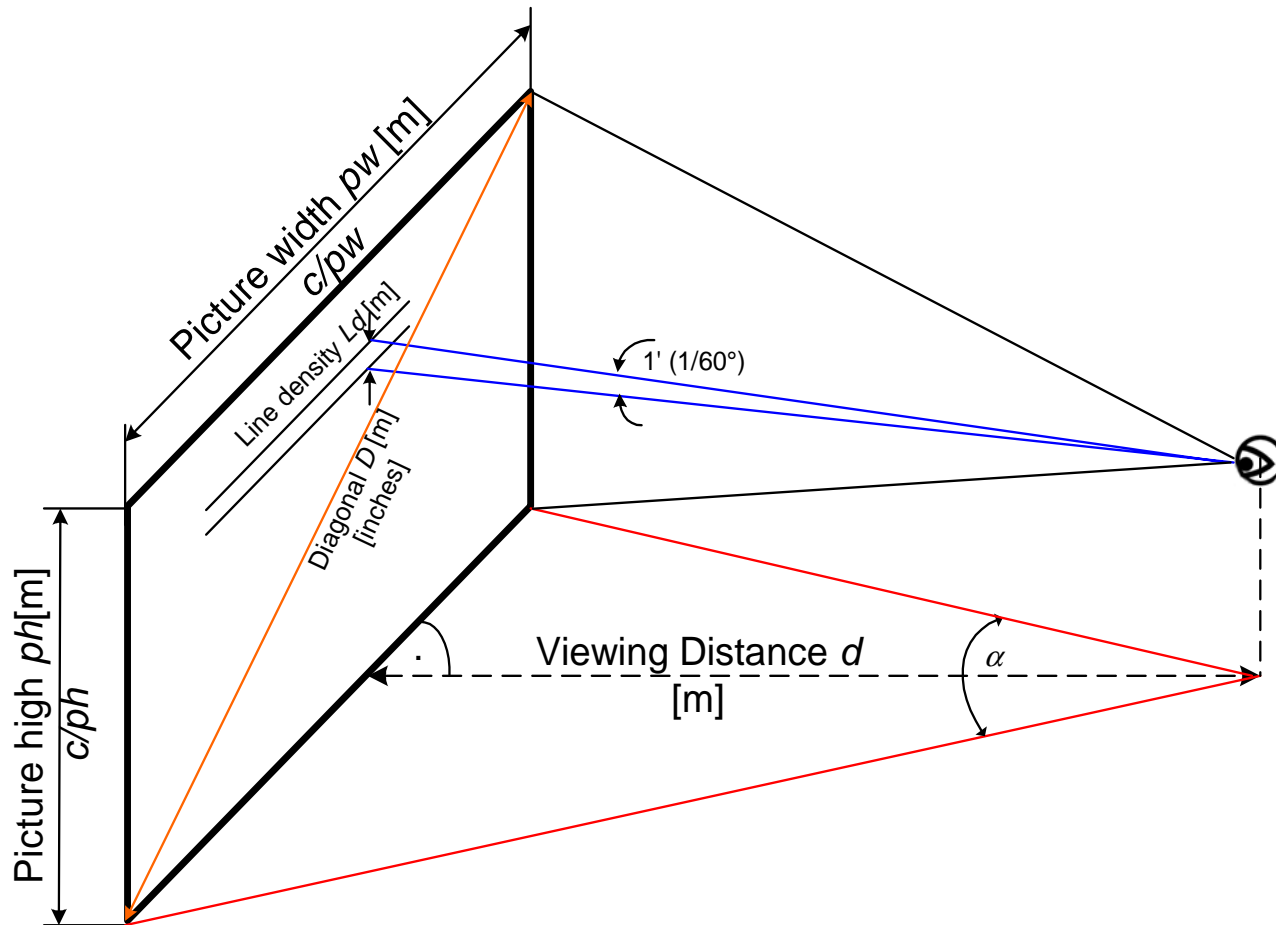


“Bad” HDTV more annoying than “bad” SDTV



High-Definition Television

- Design Viewing Distance: max. 3h on a 50inch display
- Preferred Viewing Distance: Line or pixel structure not visible



Definitions

- SDTV:
 - 625-line TV = active 576 lines, "576i/25"
 - 525-line TV = active 480 lines, "480i/29.94"
- HDTV:
 - 1080i/25
 - 1080p/25 or 1080p/24
 - 720p/50
 - 1080p/50
- Interlaced or **p**rogressive scan

HDTV – Options in the Signal Chain



What did we learn from the SDTV debate on interfaces and compression?

- The whole signal chain determines the final quality at the consumer

HDTV is much more sensitive to technical and artistic errors.

- We need to be more careful and have to provide sufficient *quality headroom* in the studio.

Studio
HD-S
HD-S
10 Gb
HD-S

try
60

HDTV – Storage

System Abb.	Compressed Bitrate	Frame Rates [Hz]	Sampling Lines	Active Lines	Aspect Ratio	Standard Based	Standard
HDCAM	112-140 Mb/s (4:2:2)	24	1080	1080	16:9	Yes	SMPTE 367 SMPTE 368
DVCPRO HD	100Mb/s	24	1080	1080	16:9	Yes	SMPTE 371
HD-D5	ca. 260 Mb/s (4:2:2)	24	1080	1080	16:9	Yes	SMPTE 342M
AVID DNxHD	ca. 260 Mb/s (4:2:2)	24	1080	1080	16:9	Yes	SMPTE activity in plan
HDCAM-SR	ca. 400 Mb/s (4:2:2)	24	1080	1080	16:9	No	SMPTE 409 (800 Mbit/s not in standard)
HDV-1	19Mb/s (4:2:0)	24	1080	1280	16:9	No	Consortium
HDV-2	25Mb/s (4:2:0)	24	1080	1920 subs. to 1440	16:9	No	Consortium

JPEG-2000??;
H.264 SP constraints
announced as a work
Item to SMPTE.
ANOTHER FORMAT
WAR?

Interface: HD-SDI - SMPTE 292M

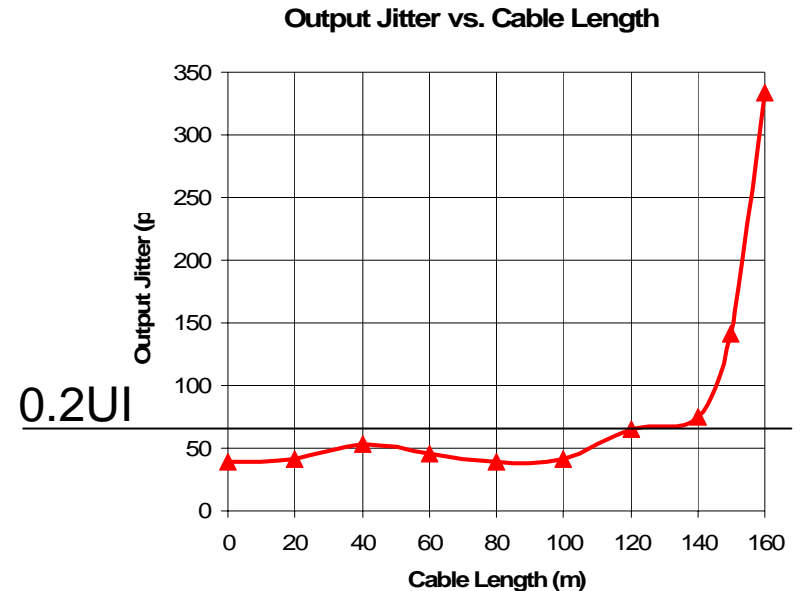
- 1.485 Gbit/s bit-serial Interface,
- coax. cable ~ 140m.
- 10 Bit
- 4:2:2 HDTV Signals divided in two bit streams as Luminance (Y) and Chrominance (Cr,Cb).

Extensions:

- *SMPTE 372M defines a Dual Link Version of HD-SDI Interfaces (e.g. for 4:2:2 1080p/50).*
- *SMPTE 348 defines packetized Data a la SDTI.*
- *SMPTE 392M defines HD-SDI as Container SDTV Signals*

HD-SDI 3Gbit/s: Studio-Interfaces

- Gennum Chips sets
- Application: 1080p/50-60 (4:2:2, 10Bit).
- 2.21Gbit/s (nett)
- HD-SDI with 3 Gbit/s
 - ITU-R Draft
 - SMPTE Draft



Source: SMPTE/Gennum

10 Gbit/s

- Proposal from Sony in SMPTE
- Point-to-point single mode fibre interface
- Up 2km distance
- Discussion in Dec.2005

Baseband Spec: SMPTE 274M or ITU-R Rec.709



System No	System Nomenclature	Luma or R'G'B' Samples per active line (S/AL)	Active lines per frame (AL/F)	Frame rate (Hz)	Interface sampling frequency fs (MHz)	Luma Sample periods per total line (S/TL)	Total lines per frame
1	1920 x 1080/60/P	1920	1080	60	148.5	2200	1125
2	1920 x 1080/59.94/P	1920	1080	$\frac{60}{1.001}$	$\frac{148.5}{1.001}$	2200	1125
3	1920 x 1080/50/P	1920	1080	50	<u>148.5</u>	2640	1125
4	1920 x 1080/60/i	1920	1080	30	74.25	2200	1125
5	1920 x 1080/59.94/i	1920	1080	$\frac{30}{1.001}$	$\frac{74.25}{1.001}$	2200	1125
6	1920 x 1080/50/i	1920	1080	50	74.25	2640	1125
7	1920 x 1080/30/P	1920	1080	30	74.25	2200	1125
8	1920 x 1080/29.97/P	1920	1080	$\frac{30}{1.001}$	$\frac{74.25}{1.001}$	2200	1125
9	1920 x 1080/25/P	1920	1080	25	74.25	2640	1125
10	1920 x 1080/24/P	1920	1080	24	74.25	2750	1125
11	1920 x 1080/23.98/P	1920	1080	$\frac{24}{1.001}$	$\frac{74.25}{1.001}$	2750	1125

Baseband Spec.

SMPTE 296M-2001;



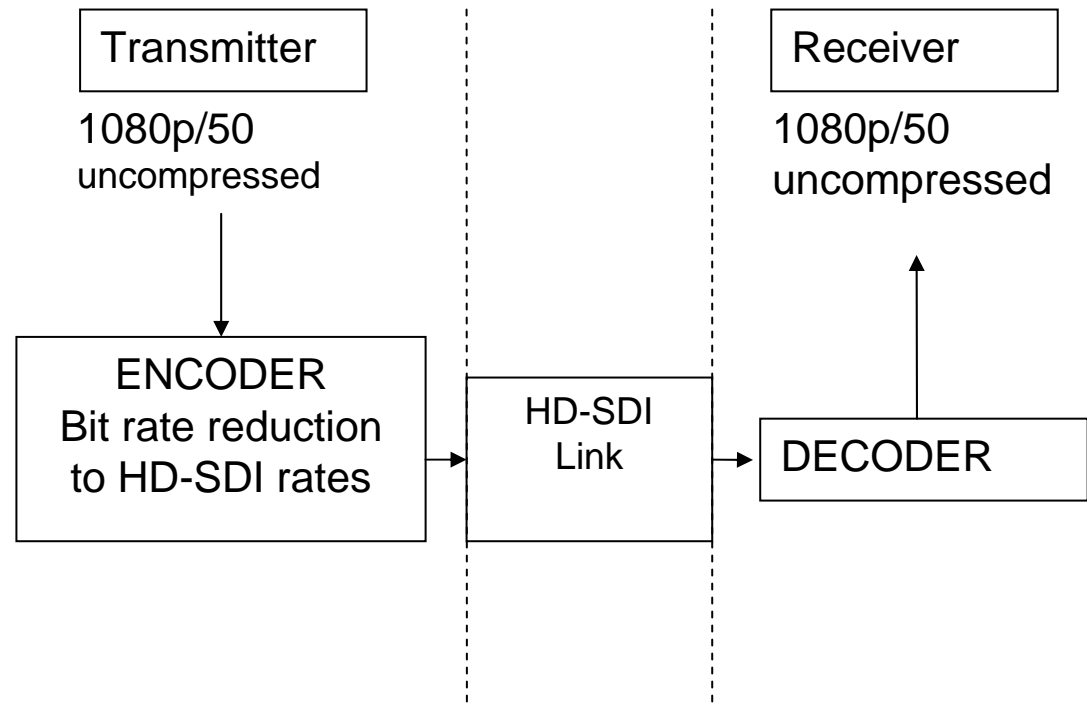
System No	System nomenclature Horizontalxvertical / frame rate	Luma or R'G'B' Samples per active line(S/AL)	Active lines per frame (AL/F)	Frame rate, Hz	Luma or R'G'B' sampling frequency (fs), MHz	Luma sample periods per total line (S/TL)	Total lines per frame
1	1280x720/60	1280	720	60	74.25	1650	750
2	1280x720/59.94	1280	720	60/1.001	74.25/1.001	1650	750
3	1280x720/50	1280	720	50	74.25	1980	750
4	1280x720/30	1280	720	30	74.25	3300	750
5	1280x720/29.97	1280	720	30/1.001	74.25/1.001	3300	750
6	1280x720/25	1280	720	25	74.25	3960	750
7	1280x720/24	1280	720	24	74.25	4125	750
8	1280x720/23.98	1280	720	24/1.001	74.25/1.001	4125	750

Approach of 13 European administrations for 720p/50 in ITU failed

Near Lossless Compression via HD-SDI Studio-Interfaces

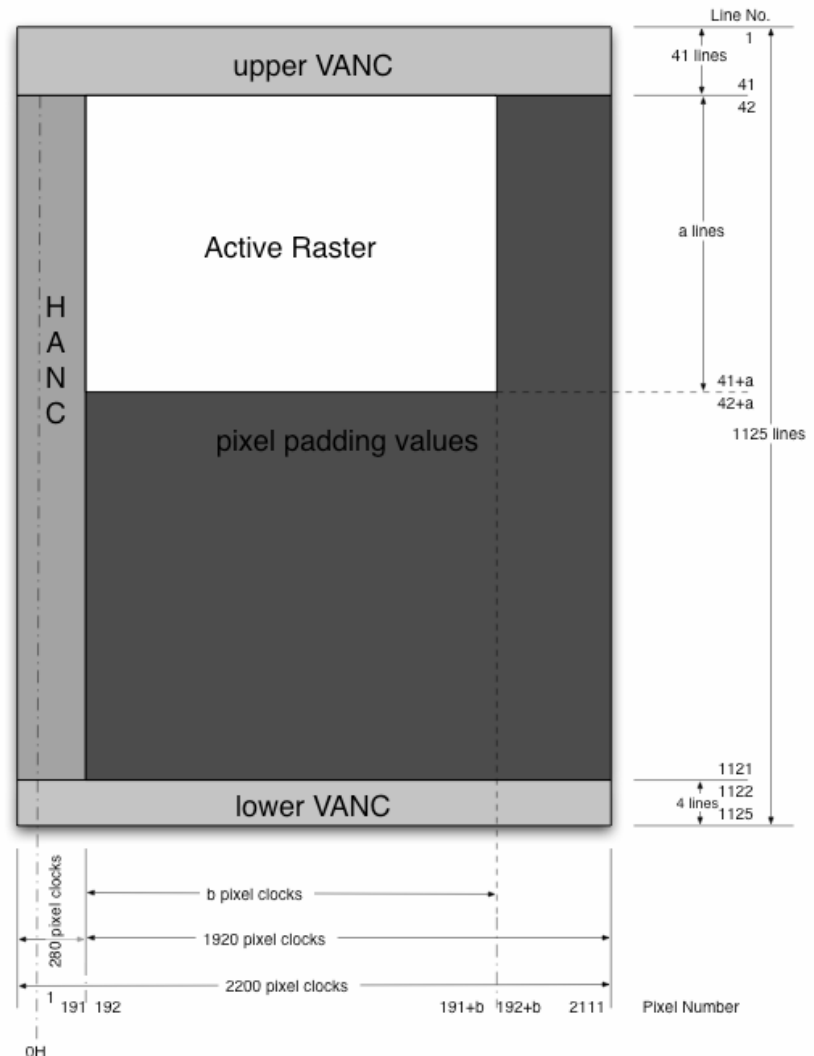


- BBC/EBU/SMPTE
 - Use of HD-SDI infrastructure with “Perceptual Lossless” compression
 - Delay: 4 lines
- Under standardisation in SMPTE



Container/Wrapper

- ITU-R discussion (input from US)
- 1080p/50, 1080p/60 wrapper
- Requires 3Gb/s HD-SDI
- Still under discussion...



SID Data – size of displays

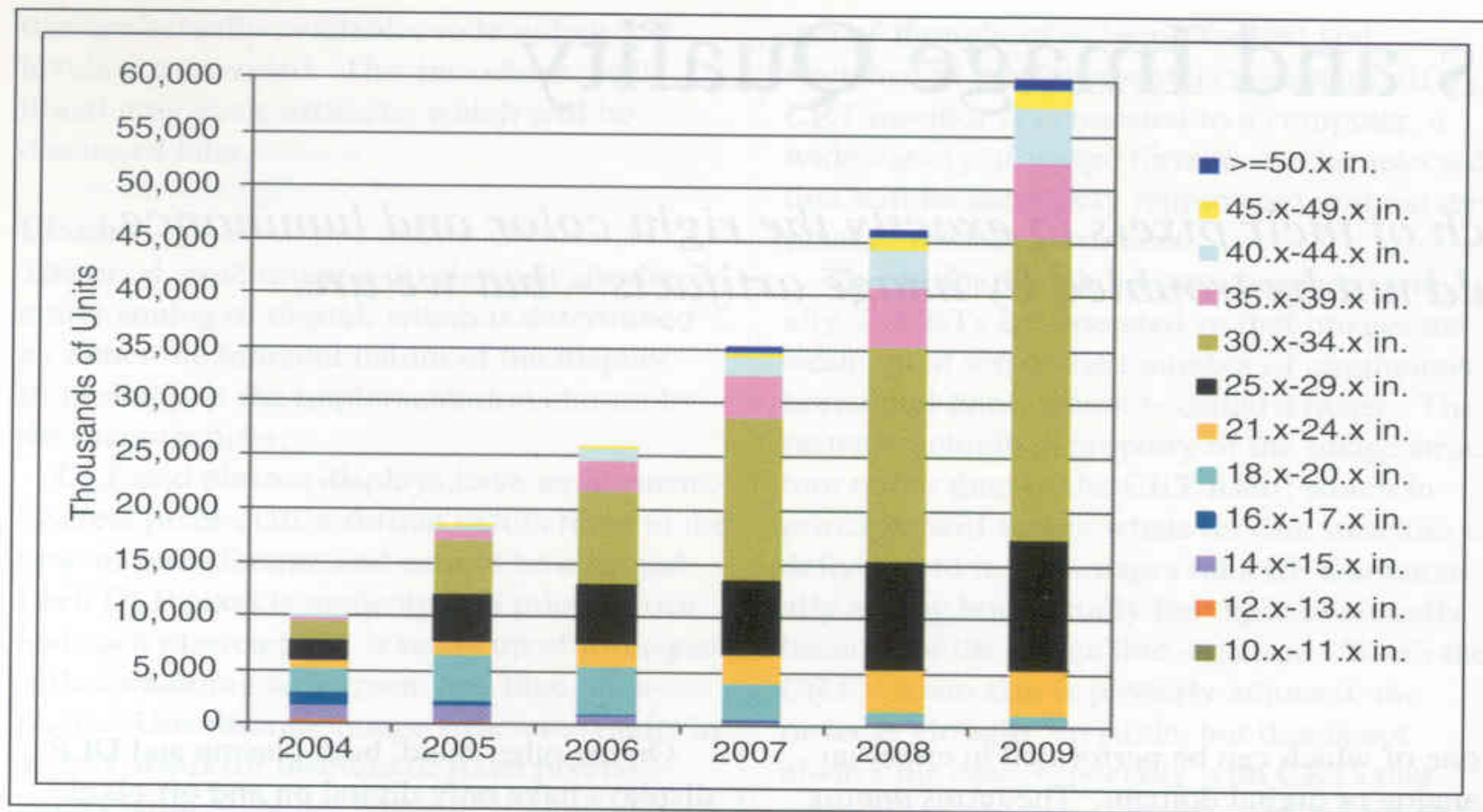


Fig. 3: Total LCD-TV market shipments are expected to increase at a CAGR of 5% from 2005 to 2009, but the 30–40-in. segment and the greater-than-40-in. segment are expected to have 27 and 36% CAGRs, respectively. (Source: iSuppli Corp., LCD Tracker Report.)

Displays (EICTA Min. Spec.)

HD-Ready



Abbreviation	Spatial Resolution
VGA	640x480
SXGA	1024x768
WXGA	1366x768 (1280x720)
UXGA	1600x1200
WUXGA	1920x1080
QXSGA	2560x2048
More to come	European? Research needed

Plus-Points: interface specifications

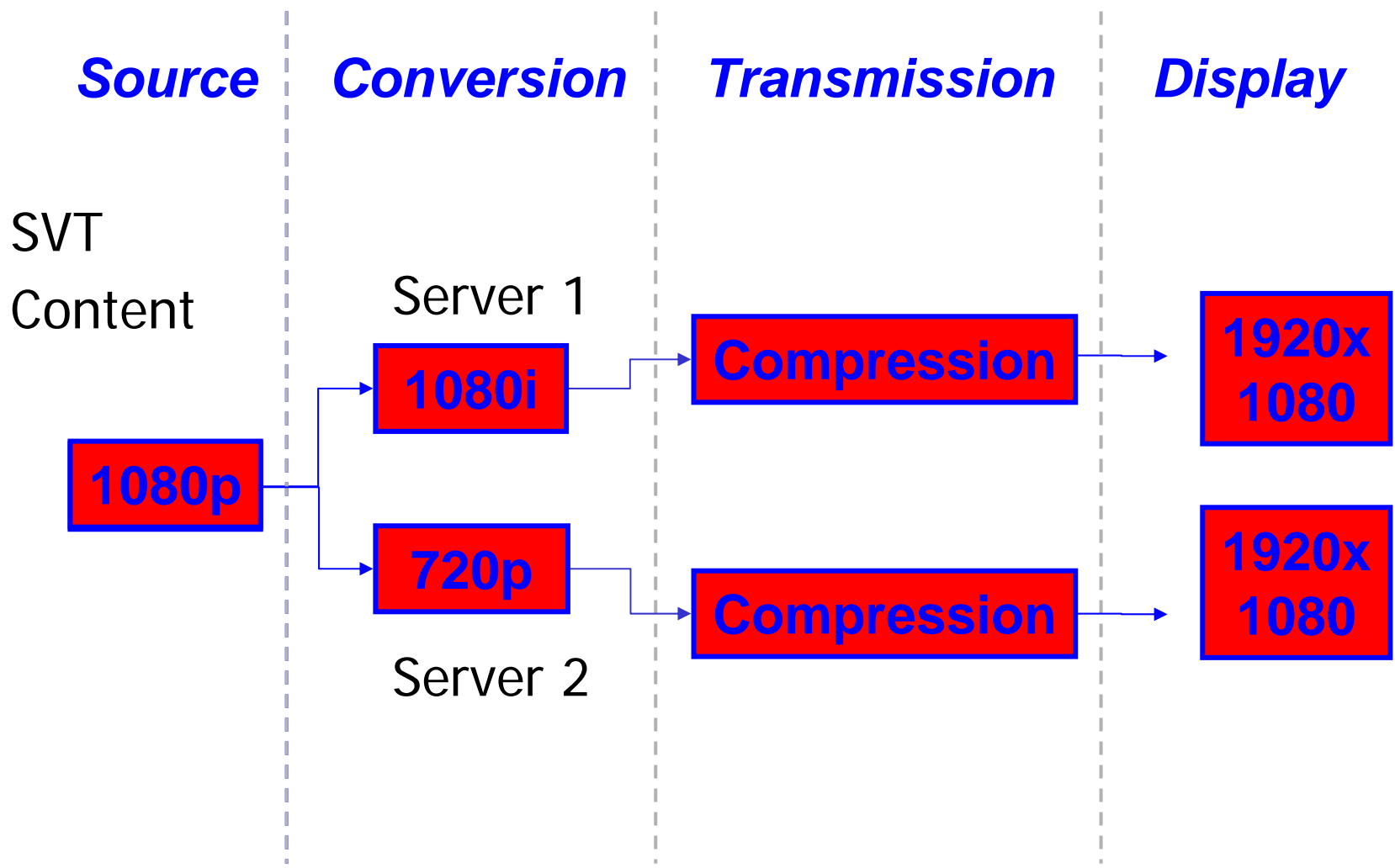
Drawback: no real spec. on the image quality

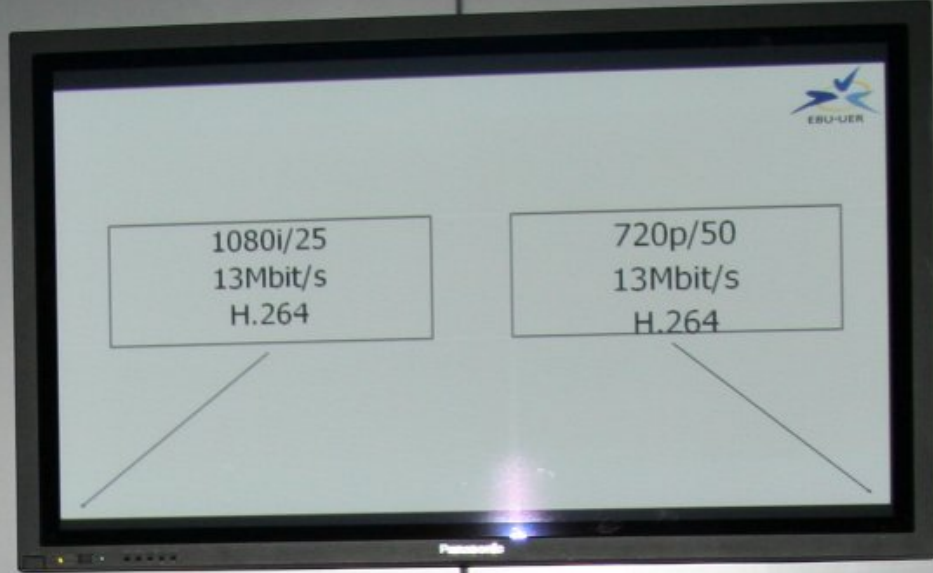
Receiver (EICTA Min. Spec.)



- HDTV Ready
 - H.264 und MPEG-2
 - only 50 Hz
 - HDCP (default on/off discussion)
 - no Scart
 - EBU Input to EICTA was only partly considered

EBU DEMO @ IBC 2005



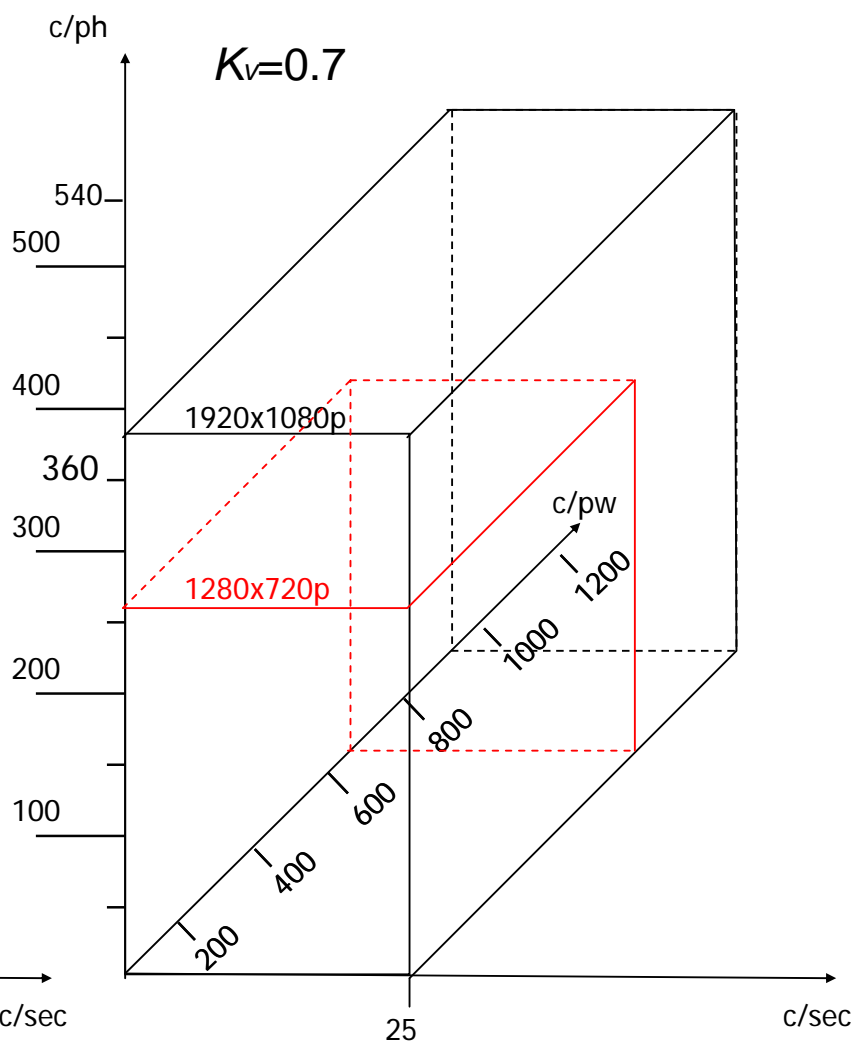
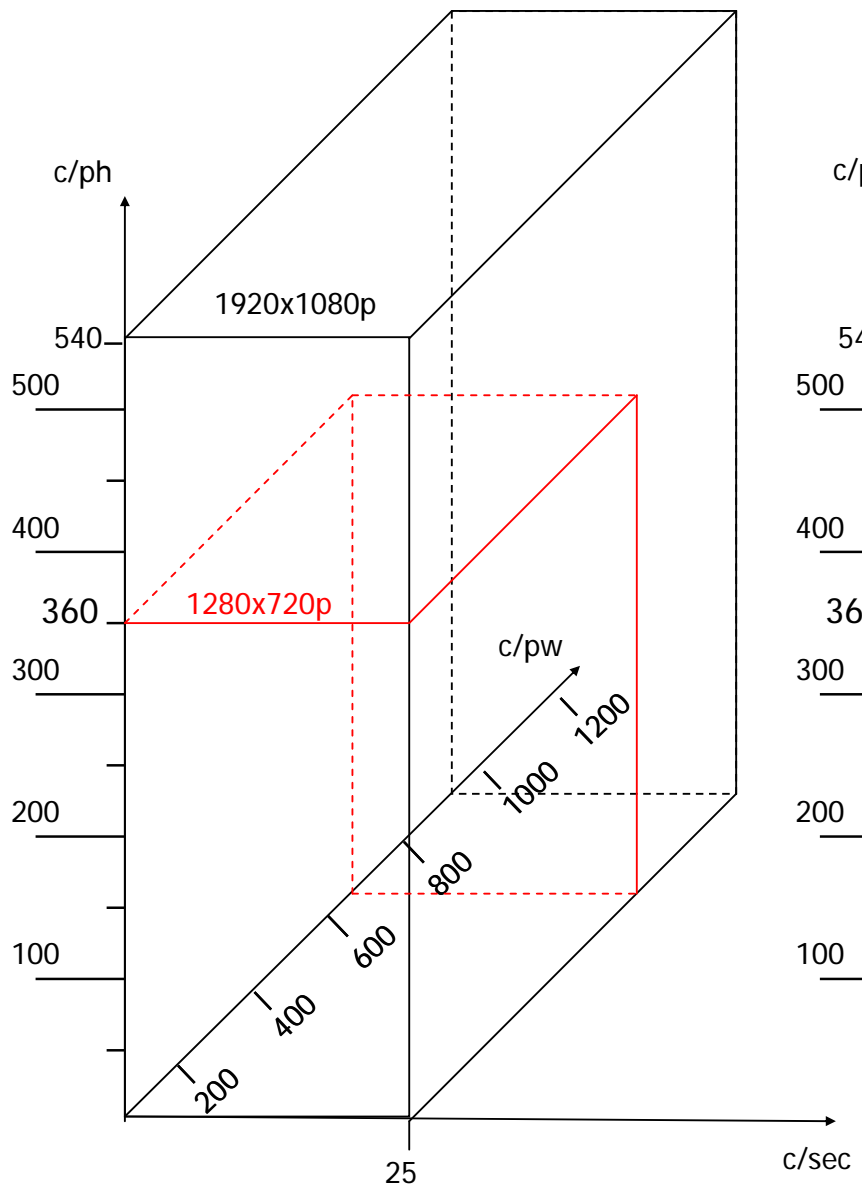


EBU @ IBC 2005

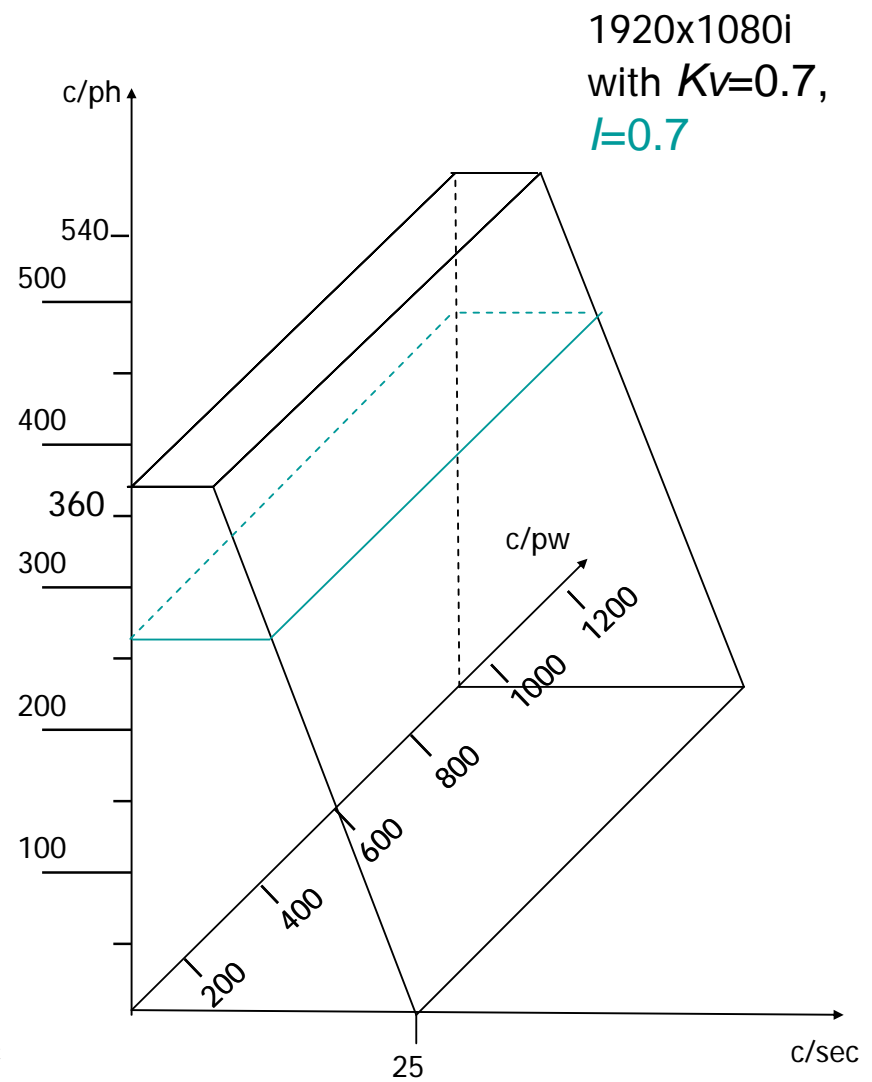
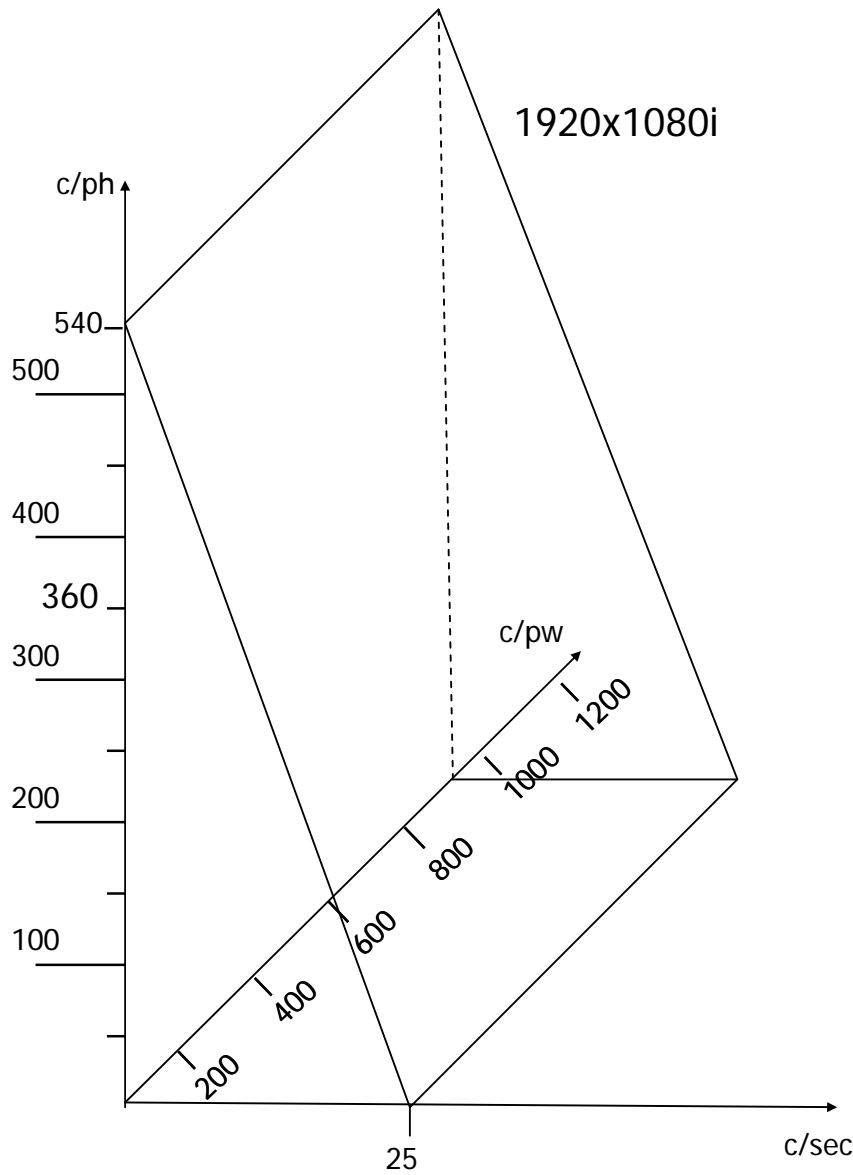


- Two 1920 x 1080 LCD screens 45 inch
- Input Signal:
 - Content was uncompressed and compressed with software codec of
MPEG-4 AVC H.264 (6, 8, 10, 13 Mbit/s)
SMPTE VC1 (6, 13 Mbit/s)
- Viewing Distance: 3h..7h
- Comments from viewers at 3h:
 - minor or non visible differences for uncompressed Content. Few commented that 1080i was better
 - significant differences and clear preference for 720p/50 for compressed Content

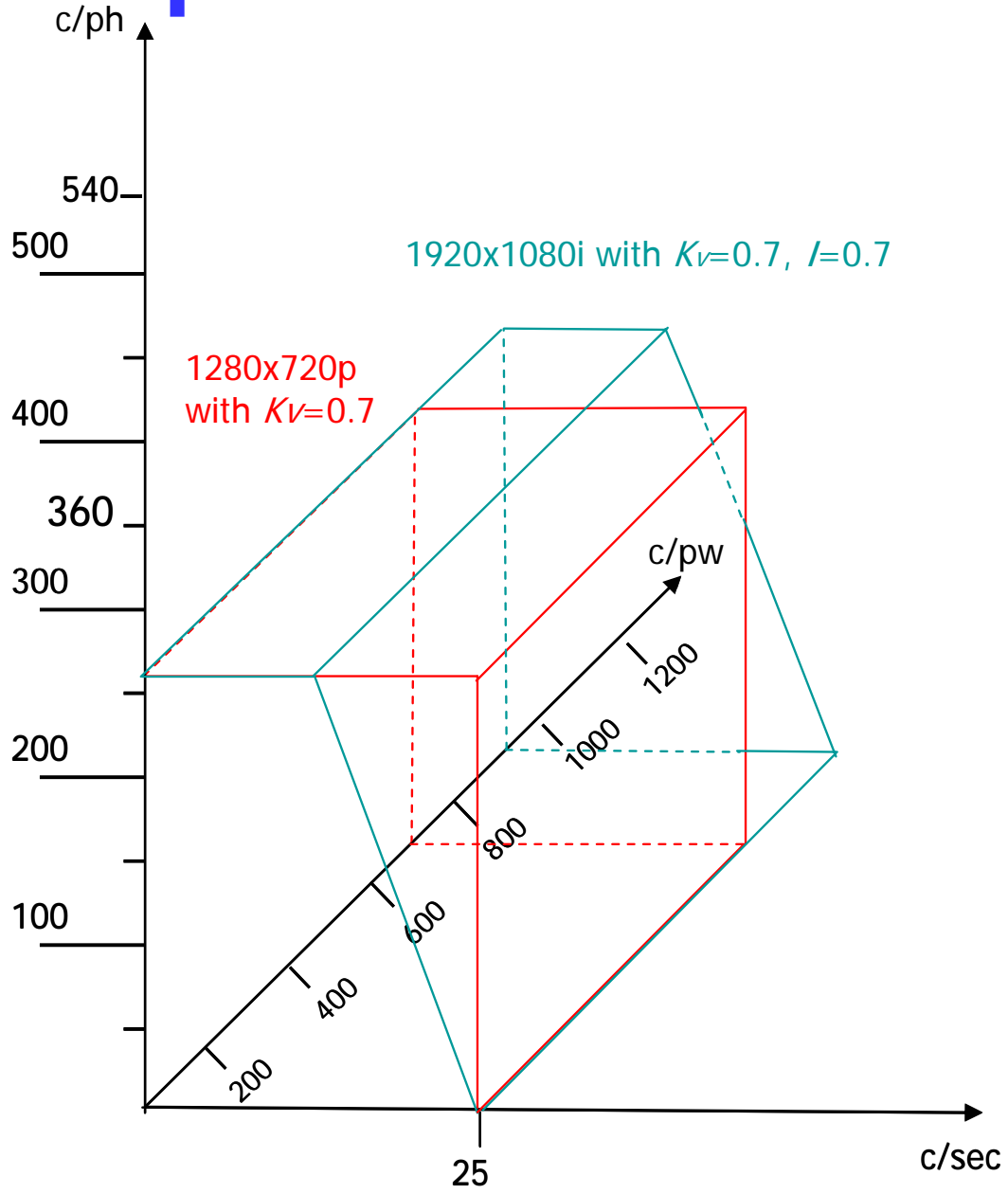
Idealised Spectrum



Idealised Spectrum



Idealised Spectrum



It's about motion artefacts

- Static resolution is probably better served by 1080i/25; Television is not static
 - HDTV will have huge impact with sport events
- Progressive scan delivers better motion portrayal
- New production systems will support both scanning standards
- The broadcaster has the freedom of choice!?

Demo for Lunch break

- Splitscreen: Sequence 720p and 1080i
- Left: H264 AVC Software Codec
- Right: uncompressed
- 1st sequence: 720p @ 6,8,13 Mbit/s
- 2nd sequence: 1080i @ 6, 8, 13 Mbit/s
- Factors:
Projector (1920x1080), Deinterlacer,
Motion Blur.....

EBU HDTV Position

- R112-2004: EMISSION standards for HDTV should be based on progressive scanning:
 - 720p/50 is currently the optimum solution, but 1080p/50 is an attractive option in the longer term
- Although there are strong technical arguments in favour of progressive scanning for emission, the EBU recognises that some broadcasters might wish to broadcast 1080i programme material

EBU HDTV Position



- HDTV Tech3299: Signal formats in production:
 - 720p/50
 - 1080i/25
 - 1080p/25
 - 1080p/50 (long term)

1080p/50

- 3rd Generation of HDTV
- ~ 3 Gbit/s uncompressed
 - Studio interfaces ?
 - Compression ?
 - Display interfaces ?
 - Emission formats ?
- In production: High End Format
- Permit high quality 720p/50 or 1080i/25 generation

EBU Role

- Neutral information of its members and to help them in strategic questions
- Support of the technical investigations of the members
- Standards Debate: avoid “half-truths”
- Important activities in PMC, BMC, NMC
 - P/HDTP; B/HDC; B/TQE; N/HD-NET, Eurovision tests.
 - Investigate the need for a non-CRT display study group
- Provide test content for members
- “General Directors” Meeting 30. Nov.