

EBU **TECHNICAL**



HDTV: concatenated compression EBU test results

**Credits to the EBU projects P/HDTP (M.Visca, RAI) and
D/HDC (R.Schaefer, IRT) and their Members**

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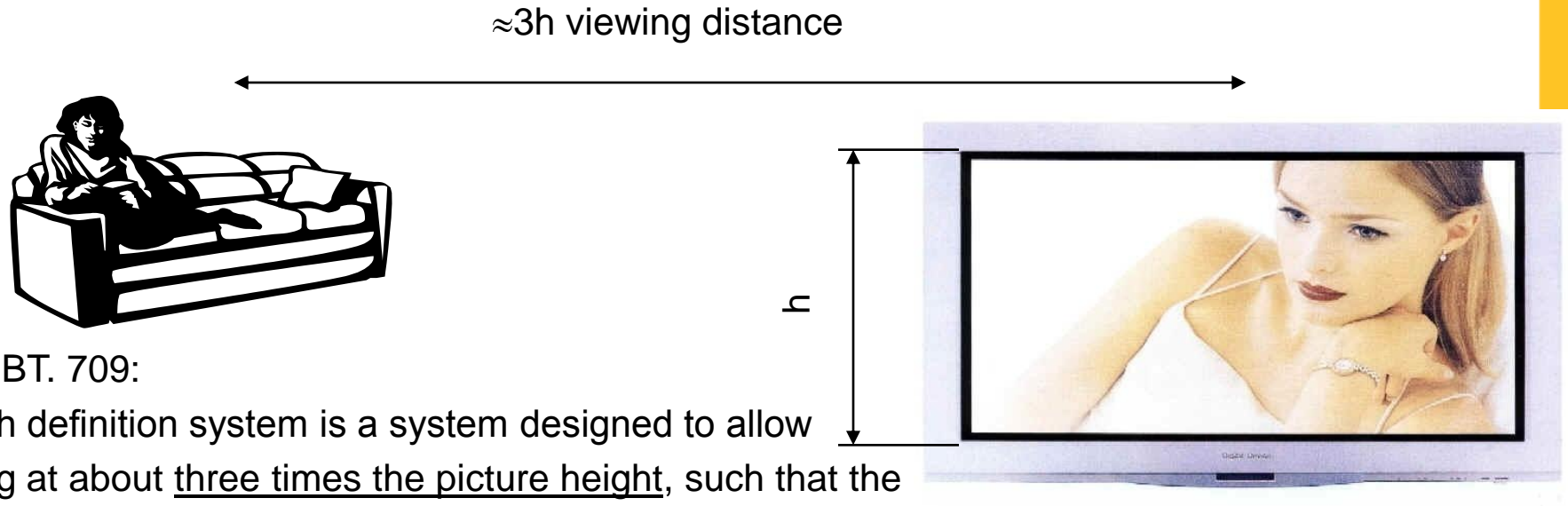


Agenda

- ❑ Requirements on HDTV compression
- ❑ Systems under test
- ❑ Stand alone tests
- ❑ Concatenated tests production and emission
- ❑ The future 1080p/50?
- ❑ Demo



Definition HDTV according to ITU-R



ITU-R BT. 709:

„A high definition system is a system designed to allow viewing at about three times the picture height, such that the system is virtually, or nearly, transparent to the quality or portrayal that would have been perceived in the original scene or performance by a discerning viewer with normal visual acuity.“

Simple non technical definition for HDTV :

- HDTV AudioVisual quality has to be **clearly** better than SDTV when viewed on large flat panel displays at 3h viewing distance

Test requirements on HD compression

Distribution / Emission

- What are the required bit rates for 1080i/25 and 720p/50 with MPEG-4 (H.264/AVC) encoders
- Any impact of the production codec?

Production environment

- To maintain the HDTV image quality headroom in production, even after 7 multi-generations
- To support IT based production environments and no overkill for networks and non-linear storage
- Cost effective for main-stream production applications



EBU P/HDTP tests for studio compression

Test of legacy systems:

Sony HDCAM, Panasonic DVCPRO-HD, Sony HDCAM-SR

Sony XDCAM 35

Test of new systems:

Sony XDCAMHD422

MPEG-2, GOP, 50Mbps, 8 bit

Panasonic AVC-I,

I-frame, 50-100 Mbps, 10 bit

GVG Infinity,

JPEG2000, 50-75-100 Mbps, 10 bit

Avid DnxHD,

VC3 120..180Mbps, 8-10 bit

Apple ProRes422

prop. codec, 122..184Mbps, 10 bit

NO COMPARATIVE TESTS HAVE BEEN PERFORMED



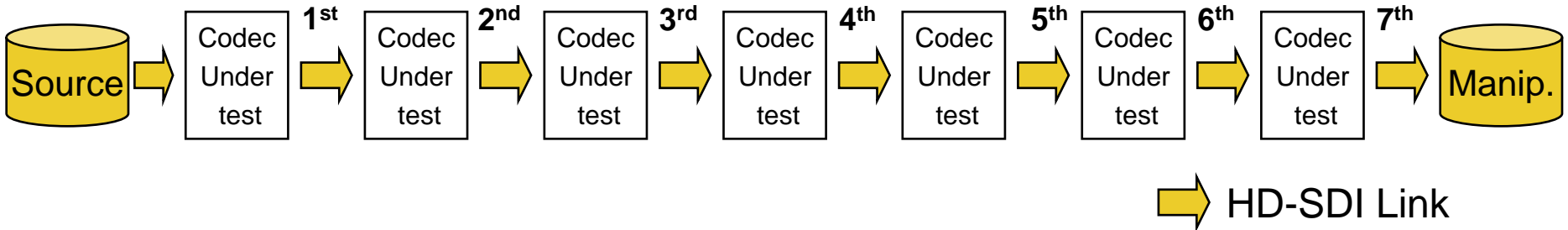
Test Plan

- **Generated test Content in 720p/50, 1080i/25, 1080p/25**
 - Derived from 1080p/50 studio shootings (HDC1500)
 - Shot in original formats
 - Part of normal HD broadcasts (movie, sport etc.)
 - Upconverted SDTV
- **Test of the studio and emission codecs in stand alone**
 - PSNR (careful!)
 - Comprehensive subjective expert viewings
- **Test in concatenation**
 - PSNR (careful!)
 - Comprehensive subjective expert viewings
- **Test plan was agreed with each vendors, and each vendor participated in his product tests**

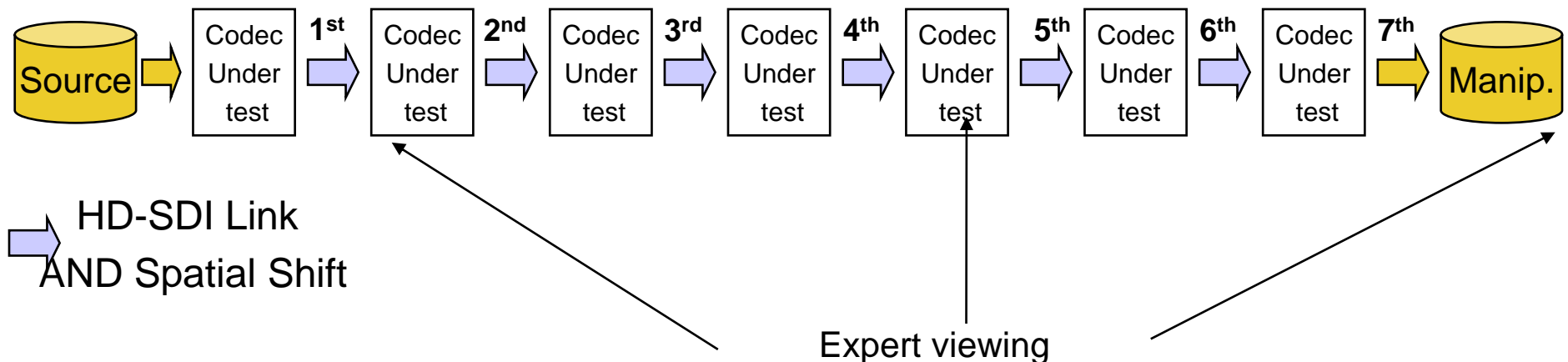


Stand alone chain tests

7° Generation without Shift (very classical test...)



7° Generation with spatial (and temporal) Shift (very classical test...)



Expert viewing has been performed ONLY on the chains including SPATIAL (and TEMPORAL if relevant) shift



Results for stand-alone systems

Detailed test reports available for EBU Members, only.

EBU – BPN 079	EBU – BPN 078	EBU – BPN 077	EBU – BPN 076	EBU – BPN 080
New HD Comp	New HDT Compre	New HDTV Studio and Acquisition Compression System Analysis	New H Con	New HDTV Studio Compression System Analysis
		GVG/Thomson J2k Codec		Apple ProRes422 HD CODEC
		Status: Phase 1 Report		Status: Phase 1 Report
		Geneva December 2007		Geneva January 2009



Results for stand-alone systems – Acquisition (see Recommendation 124 on [www://tech.ebu.ch](http://www.tech.ebu.ch))

- The acquisition format should use 4:2:2 sampling
- No further horizontal or vertical sub-sampling should be applied.
- 8-bit bit-depth is sufficient for mainstream programme but 10-bit bit-depth is preferred for high-end acquisition.
- If the format is to be based on I-frames only, the bitrate should not be less than 100 Mbit/s.
- If the format is to be based on long-GOP MPEG-2, the bitrate should not be less than 50 Mbit/s.
- Users should be aware that maintaining the above criteria would ensure quasi-transparent quality up to at least 4 to 5 multi-generations



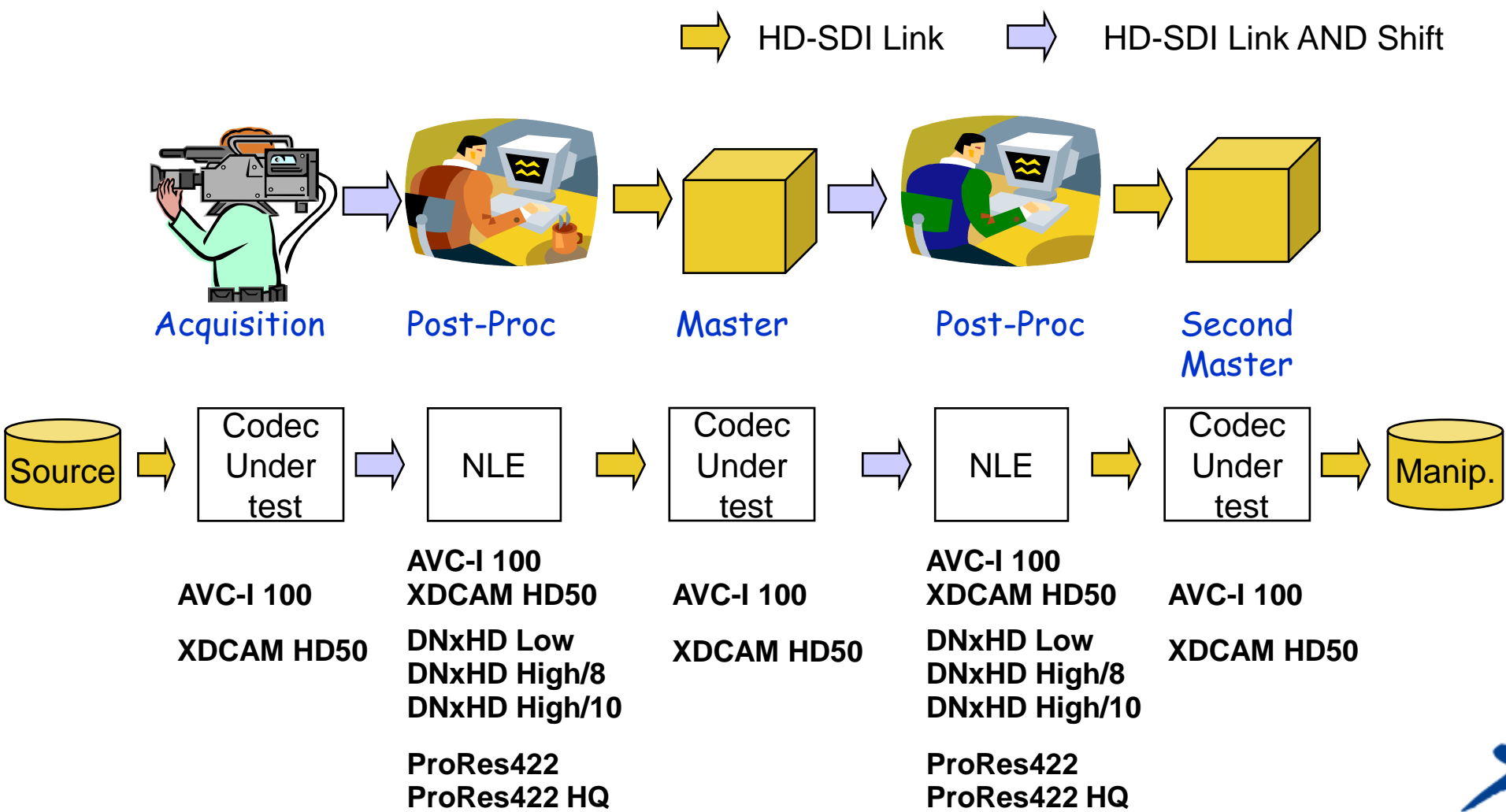
Results for stand-alone systems - NLEs

Details are in the EBU test reports (for members only); but

- Very good performance of the compression algorithm for higher bit rate (~ 180) versions
- For lower bit rate versions (~ 120-115) a small price in terms of loss of resolution and increase of noise has to be paid through multi-generation for critical scenes.
- Progressive signals provided a better coding performance



Concatenated chains

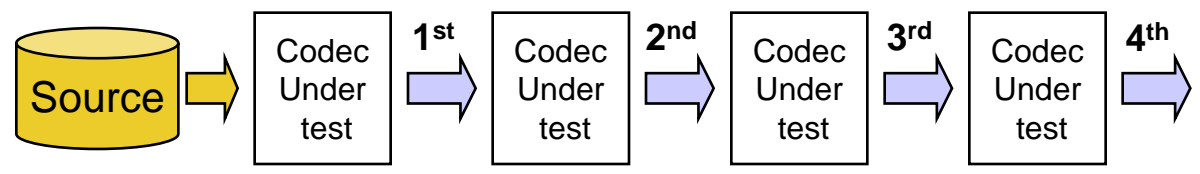
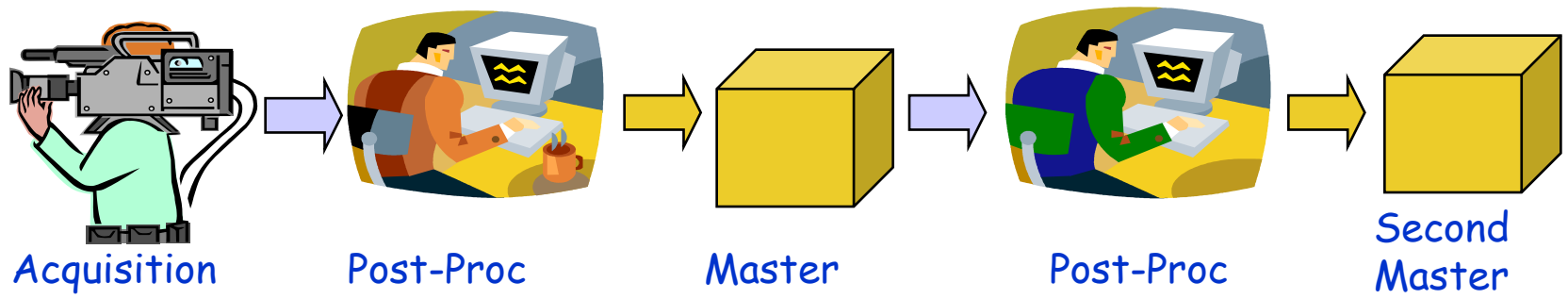


Some test results (I)

- Cascading of Acquisition with NLE at lower bit rates
~ 120 Mbps can introduce artefacts in the range of just perceptible to perceptible
 - reduces the quality headroom
- Cascading of Acquisition with NLE at high bit rates
~185 Mbps provides transparent quality to the acquisition material for uncritical sequences and just perceptible artefacts for critical sequences

Further interesting test results (II)

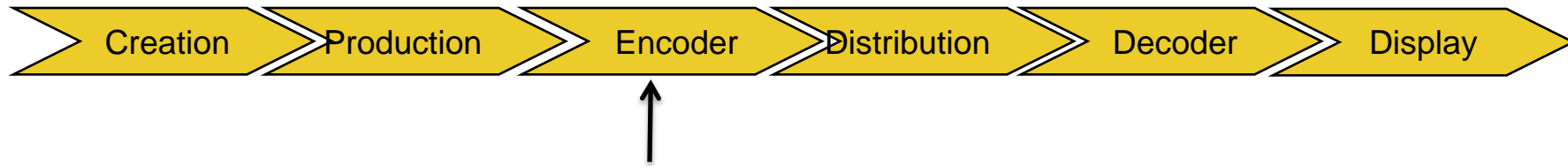
Cascading with NLE at higher bit rate (~185 Mbit/s)



The comparison between the whole production chain at about 185 Mbit/s, and the fourth generation of a single compression algorithms, provides nearly identical performance.



HDTV – Distribution Codec Tests



- EBU project D/HDC tested five MPEG-4 H.264/AVC encoders (Ateme, Harmonic, Tandberg, Thomson, Scientific Atlanta)
- Comparison against a very good MPEG-2 encoder as anchor and reference set at 24 Mbit/s
- Test formats:
 - 1280x720p/50
 - 1440x1080i/25
 - 1920x1080i/15
 - Stand-alone tests and with encoded (4th gen.) content

General test results (II)

- In general, new MPEG-4 H.264/AVC encoder allow at least 50% bit rate saving compared to MPEG-2
- For concatenated tests, there is little dependency of production codec
- Recommended min. bit-rates “for critical material but not unduly so”
 - 10,5 Mbit/s minimum CBR for 1280 x 720p/50
 - 12,1 Mbit/s minimum CBR for 1440 x 1080i/25
 - 12,8 Mbit/s minimum CBR for 1920 x 1080i/25



1080p/50-60 in TV – What's needed?

- 1080p/50-60 can be used as a quality argument and solves the “1000line-marketing” problem of 720p
- In production, it is a good master, but totally new infrastructures are required
- Consumer needs large displays (available) but a new receiver/STB too (H.264/AVC L4.2 or SVC)
- The delta in image quality difference to 1080i or 720p must be perceptible for the consumer @ 3h viewing



1080p/50-60 in TV – Current situation

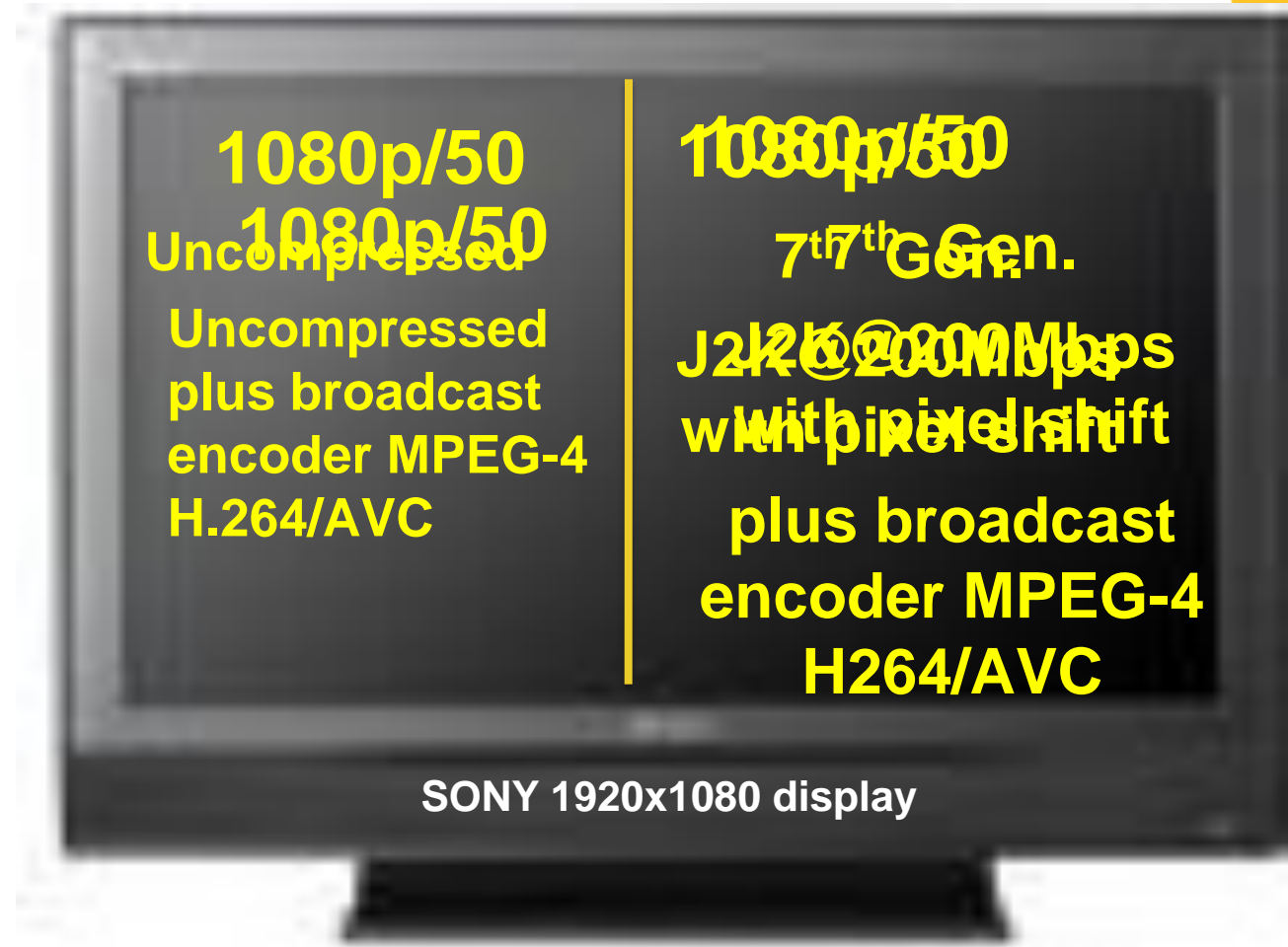
- DVB – AVC has decided in its last meeting to include the 1080p/50-60 in DVB specs (H.264/AVC L4.2)
- In production 3G SDI available, cameras available (sensor issue)
- But many new components need to be developed such as studio compression systems for mainstream purposes
 - We think around +200 Mbps for an I frame system.....(DEMO)
- Good question: what bit-rate required in emission/distribution for 1080p/50?
 - Today we know – about the same as for 1080i/25.....(DEMO)



1080p/50 Experiment (special thanks to DVS & Sony)



DUAL LINK
DVI
Uncompressed
1080p/50



SONY 1920x1080 display

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Thank You

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