UHDTV: TELEVISION A POINT?

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Some ‘Anecdotal’ Positive Shaping Factors

- The consumer electronics industry constantly needs new products. (‘feed me, feed me’)
- We (human beings) are always looking for something better than we have now.
- Our expectations for quality rise over the decades.
- We like to see ‘big numbers’ on electronics.
- In the store, many think the TV with the brightest screen is the best.
- It may be politically important not to fall behind in technology.
Japan Roadmap for 4K/8K

Start of 4K broadcasting

Start of 8K broadcasting (Previous plan)

Two years ahead of schedule

Four years ahead of schedule

Super Hi-vision (4K and 8K)

Satellite Broadcasting (CATV / IPTV)

Smart TV

The Shift to Digital Terrestrial Broadcasting

Brazil (Rio) World Cup

Rio de Janeiro Olympics and Paralympics Terrestrial Broadcasting

Japan Roadmap for 4K/8K

2014

2016

2020

Start of 8K broadcasting

Tokyo Olympics
Government funding in Japan for UHDTV

- 30 million dollars to construct a test bed for 4k/8k.
- 15 million dollars to accelerate 4k/8k installation – transmitters, receivers, displays, IBB, IP.
- 45 million dollars over 3 (?) years.
## Satellite trials by Eutelsat and SES

Terrestrial trials as in table below.

<table>
<thead>
<tr>
<th>Country</th>
<th>Transmitter site</th>
<th>Covering</th>
<th>ERP</th>
<th>DTT System</th>
<th>Transmission Mode</th>
<th>Multiplex Capacity</th>
<th>Signal bit rate</th>
<th>Video Encoding Standard</th>
<th>Picture Standard</th>
<th>Frequency used</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>Eiffel Tower</td>
<td>City of Paris</td>
<td></td>
<td>DVB-T2</td>
<td>32k, extended mode, GI = 1/128, 256QAM, FEC2/3, PP7</td>
<td>40.2 Mbit/s</td>
<td>24 Mbit/s</td>
<td>HEVC</td>
<td></td>
<td>50 frames/s 10 bits per pixel</td>
</tr>
<tr>
<td>Spain</td>
<td>ETSI Telecomunicación</td>
<td>Ciudad Universitaria, Madrid</td>
<td>125W</td>
<td>DVB-T2</td>
<td>32k, extended mode, GI = 1/128, 64QAM, FEC5/6, PP7</td>
<td>36.72 Mbit/s</td>
<td>35 Mbit/s (other bit rates also tested)</td>
<td>HEVC</td>
<td>3840x2160p 50 frames/s 8 bits per pixel</td>
<td>754 MHz (Ch 56 in Region 1)</td>
</tr>
<tr>
<td>Sweden</td>
<td>Stockholm Nacka</td>
<td>City of Stockholm</td>
<td>35 kW</td>
<td>DVB-T2</td>
<td>32k, extended mode, GI = 192/256, 64QAM, FEC3/5, PP4</td>
<td>31.7 Mbit/s</td>
<td>24 Mbit/s</td>
<td>HEVC</td>
<td>3840x2160p 29.97 frames/s 8 bits per pixel</td>
<td>618 MHz (Ch 39 in Region 1)</td>
</tr>
<tr>
<td>UK</td>
<td>Crystal Palace</td>
<td>Greater London (serving over 4.5 Million households)</td>
<td>40 kW</td>
<td>DVB-T2</td>
<td>32k, extended mode, GI = 1/128, 256QAM, FEC 2/3, PP7</td>
<td>40.2 Mb/s</td>
<td>Variable (some trials at 35 Mb/s)</td>
<td>HEVC</td>
<td>Mixture of 3840x2160p 50 frames/s and 3840x2160p 59.94 frames/s</td>
<td>586 MHz (Ch 35 in Region 1)</td>
</tr>
<tr>
<td></td>
<td>Winter Hill</td>
<td>North-west of England, including Manchester and Liverpool (serving 2.7 Million households)</td>
<td>22.5 kW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Most of the trial at 8 bits per pixel, some at 10 bits per pixel</td>
</tr>
<tr>
<td></td>
<td>Black Hill</td>
<td>Central Scotland, including Glasgow and Edinburgh (serving 1 Million households)</td>
<td>39 kW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>586 MHz (Ch 35 in Region 1)</td>
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Some ‘Anecdotal’ Negative Shaping Factors

• The more pixels the more the cost.
• The costs of production equipment will be higher – at least in the beginning.
• Programme production will need more care.
• Programme storage will cost more.
• New technology implementation cycles and longer that new technology ideas and standardisation cycles. They trip over each other.
• Europe may have least to gain by UHDTV
Where is 2160p and 4320p?

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Small benefit

Large benefit
Baromètre de la télévision numérique n° 9
Édition spéciale – Haute Définition

Décembre 2008

Baromètre de la télévision numérique – Édition spéciale HD
Le téléspectateur dans tous ses états

Charles Tijus, professeur de psychologie cognitive, directeur du LUTIN
Stéphane Jauguet, anthropologue, chercheur au LUTIN

Étude réalisée pour TDF, en partenariat avec TF1 et M6 qui ont aimablement mis à disposition les contenus utilisés.

Jeudi 4 décembre 2008
The TDF results in 2008 comparing SD and HD

- HD has a subliminal calming influence on viewers, and their stress level falls.
- HD brings greater emotional involvement – we ‘live the program’ more.
- HD extends the ‘time till zapping’ (audience time) by about 25%
- People remember more and comprehend more.
- The same pattern may occur with the move from HD to UHDTV
The Wood Triangle

*idea from Felix Poulain EBU*

- Increasing viewer involvement and audience time
- Image and Sound Quality
- Production Values
- Story value

**Find and access the content**
The NHK STRL results

Figure 1. Sense of being there and the sense of realness for different video resolutions in relation to viewing distance.
“Quality factors”

- Static resolution
- Dynamic resolution
- Color fidelity
- Contrast
- Contouring
- Artifacts
- Sound
- (Depth cues)
- Need: improving them in a way which creates a ‘wow’?
UHDTV ‘Quality Factors’ to consider

- Color Fidelity
- Compression Effects
- Audio Experience
- Dynamic Resolution
- Static Resolution
- Contrast Range
- Audio Experience
Recommendation ITU-R BT.2020-1
(06/2014)

Parameter values for ultra-high definition television systems for production and international programme exchange

BT Series
Broadcasting service
(television)
Recommendation ITU-R BS.2051-0
(02/2014)

Advanced sound system for programme production

BS Series
Broadcasting service (sound)
UHDTV IMAGE - ITU-R BT 2020

• Two UHDTV levels – 8Mpixels and 32Mpixels images – 2160p and 4320p
• Assembled multiples of 1080p/1920 – 4 and 16.
• Parameter values were chosen to be ‘future-proof’, so...
• Image rates up to 120Hz (yes and no 120/1.001Hz)
• New wider ‘color primaries’ (beyond OLED).
• Option of ‘constant luminance YUV coding’.
• Bit depth 10 and 12 bits/sample.
• option of additional OETF for HDR.
• (Advanced Sound System)
UHDTV SOUND – ITU BS 2051

• **Three types** of sound system, all designed to allow “3D Audio” – the ability to discern the direction of the sound component vertically as well as laterally. Producers have the choice of recording method. Viewers can personalise the effects.

• These groups of formats are termed ‘channel based’, ‘object based’ or ‘scene based’ audio. Each ‘sound element’ can represent a loudspeaker channel, an object, or a sound intensity at a point in the room. Combinations can be used.

• A series of ‘sound elements’ are broadcast – an audio signal plus metadata that says what it is.

• The receiver adapts to your home loudspeaker arrangement and possibly room acoustics.

• The user can also tailor the sound to what he likes.
Why High Dynamic Range?

- Today’s displays can present only a small fraction of the luminance range we can perceive.
- Displays with a greater luminance range should be available in future, and offer the potential to increase realism.
- Greater luminance range will require more bits to avoid artifacts – at least 10 bit/sample.
- New OETF/EOTF needed to better reflect human contrast sensitivity – which is complex.
- Currently four proposals for new OETF.
The DVB 2160p Plan

• Two ‘UHD-1’Phases needed linked to decoder availability.
• **Phase 1** includes 2160p at up to 60Hz and HEVC compression, for use in 2014/15. (Rec. 709, no HDR, simple audio)
• **Phase 1 Spec** agreed – Q2/2014. Subsets of vertical and horizontal resolution useful for streaming. First commercial service from DirecTV
• **Phase 2** will include 2160p at up to 120Hz for use in 2017/18, HDR, etc. Specification under discussion.
What about 4320p (aka 8k)?

• DVB has not yet discussed 4320p (32Mpixel image) because there have been no plans for marketing UHD-2 displays.
• Situation may have changed with plans in Japan to market 8k displays in 2016, for start of NHK UHD-2 broadcast services.
• NHK colleagues say 8k displays will also be made in China at that time.
• A 4320p system (Phase 3) would be quite simple to put together.
• DVB is developing a 4320p (Phase 3) RF system for cable.
• Watch this space.
Main areas of discussion for Phase 2

- The timeframe for services.
- The degree of compatibility with DVB UHD-1 Phase 1.
- The kind of HDR system needed.
- The kind of sub-title system needed.
- The kind of audio system needed.
- The kind, if any, of piracy protection system.
- The externalities (BDA).
Ask, and you will be given?

• Hope for dialogue with Digital Europe.
• What will be possible/likely in UHD-1 TV sets in 2016/17/18?
• Specific point – what peak screen brightness? This will influence the need for HDR.
• May be a kind of ‘chicken and egg’ situation?
• DE asked for more time to discuss internally the possible impact of EU measures to limit screen brightness
Other inquiries

- Will production be ready for UHD-1 Phase 2?
- When will rank order of OETFs be available?
- Viable limits for UHDTV regarding bandwidth and bit rates?
- Are there adaptive streaming constraints?
- Are there constraints due to IBB?
- Prospects for new modulation schemes?
- What is timetable for encoding HDR content with HEVC?
The price of backwards compatibility

• Ideally Phase 1 receivers would still work with Phase 2 delivery.

• Technically, scalable systems are possible that will allow this.

• But there is a price for the scalable systems. For example the bit rate for a 100Hz scalable system may be 10-20% higher than the bit rate needed for a non scalable 100Hz system.

• When does scalability become ‘worth it’?

• Do we need both compatible and non compatible systems?
Do we need UHD peak luminance control - 1?

• Do we need a ‘green’ broadcast system?
• Should the system be designed to limit/optimise the display energy consumption?
• Is this a social responsibility for DVB?
• For example, should the statistical distribution of luminance be controlled?
• Do we need the luminance equivalent of loudness control?
Do we need UHD peak luminance control - 2

• Set makers may decide on different ‘bands’ for UHD sets.
• The bands might be low cost/quality, medium cost/quality, and high cost/quality.
• These bands may have different features such as peak luminance.
• Should the broadcast format provide for this?
Subtitles for UHD-1

- CM-AVC-SUB and TM-SUB developing new non bit mapped system (though some members are interested in bit mapped systems) that will be applicable for DVB UHD-1 Phase 1. Available in early 2015.
- DVB UHD-1 Phase 2 includes HDR (form not yet decided) CRs and Spec may need review for Phase 2.
- Single universal worldwide system for Phase 2 may be a possible using W3C IMSC language system?
Sound advice for UHD Phase 2 Audio

• MPEG-H is working on multichannel advanced audio (in its Part 3), including object based coding.
• ITU-R working on a parallel system
• MPEG-H Hope for system spec. to be available in early 2015.
• DVB probably will need to choose options for broadcast formats
• For UHDTV, is there may be a need for DVB to specify a reference system for the receiver rendering engine.
Will DVB new higher capacity modulation systems?

• The bit rate needed by UHD-1 services will depend on the degree of transparency of the broadcast signal, but may be 20-30Mbit/s.
• The bit rate needed will also depend on the encoder design.
• There is growing pressure on terrestrial spectrum.
• Japan developing MIMO system for DTT with 80-90Mbit/s capacity.
Why UHDTV may come quickly?

- **For Viewers**
  - greater emotional involvement
  - greater retention of contents
  - outstanding for sports and natural history
- **For broadcasters**
  - longer viewing time before zapping
  - greater use of products.
- **For consumer electronics industry**
  - new products to manufacture and sell
  - new USPs
Why UHDTV may come slowly?

• **For viewers**
  - Benefits of higher static resolution are viewing distance dependant.

• **For broadcasters**
  - Higher costs of UHDTV production and storage (‘more care needed’)
  - Re-equipment needed (plus lenses don’t follow Moore’s law)

• **For set makers**
  - TV sets that exploit all quality factors more complex and more costly
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Thank You!

wood@ebu.ch
skype: davidinnov
The EBU bit on UHDTV

A. KOUADIO – Senior Project Manager – EBU T&I
EBU TR 028 views

The EBU Technical Committee believes that the current focus of the CE industry to provide only an increased resolution (“4k”) and ignoring other enhancements is not a sufficiently large step for the introduction of successful new broadcasting services.

An 1080p-based HD format could be an appealing option for some broadcasters and should be taken into account in the standardization and investigation process. The EBU proposes that an enhanced 1080p format be developed for broadcasting.
EBU : PSM POSITION on UHDTV

UHDTV is BETTER PIXELS!
Higher Dynamic Range.
Higher Frame Rate (especially for sport)

http://tech.ebu.ch/tr028.pdf

Follow our investigations:
http://tech.ebu.ch/groups/beyondhd
New Test Sequences generated at the European Athletics 2014 in Zurich.

UHDTV (2160p) and HDTV with:
- Higher Frame Rate from 100Hz to 300Hz.
- Higher Dynamic Range (provided with different EOTFs and in OpenXR format).

Available soon!
THANK YOU!