End User experience improvements and Broadcaster advantages

Arlington - January 16th, 2020
Richard Lhermitte
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Peter Wharton Happy Robotz

WITHOUT THEIR VOLUNTEER EFFORTS THIS SUMMIT WOULD NOT BE POSSIBLE
### Morning Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 AM - 9:00 AM</td>
<td>Registration and continental breakfast</td>
</tr>
<tr>
<td>8:55 AM - 9:00 AM</td>
<td>Welcome from SMPTE, SBE and AES</td>
</tr>
<tr>
<td>9:00 AM - 9:05 AM</td>
<td>Kishore Persaud, SBE Baltimore, Fred Willard, SBE Washington</td>
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<tr>
<td>9:05 AM - 9:35 AM</td>
<td>Peter Wharton, SMPTE Membership VP and Chris Lane, Chief Engineer, WETA</td>
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<tr>
<td>9:35 AM - 10:00 AM</td>
<td>Lynn Claudy, SVP Technology, NAB and Chairman, ATSC Board of Directors</td>
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<tr>
<td>10:00 AM - 10:35 AM</td>
<td>Joonyoung Park, VP and Fellow, DigiCAP</td>
</tr>
<tr>
<td>10:35 AM - 11:15 AM</td>
<td>Lynn Claudy, SVP Technology, NAB and Chairman, ATSC Board of Directors</td>
</tr>
<tr>
<td>11:15 AM - 11:30 AM</td>
<td>Content Reception Enhancements</td>
</tr>
<tr>
<td>11:30 AM - 11:50 AM</td>
<td>Consumer Applications for Combined 5G &amp; NextGen TV Networks</td>
</tr>
<tr>
<td>11:50 AM - 12:15 PM</td>
<td>Case Study: Hybrid Services at &quot;Chicago 3.0&quot;</td>
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<tr>
<td>12:15 PM - 01:20 PM</td>
<td>Buffet Lunch</td>
</tr>
</tbody>
</table>

### Afternoon Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>01:25 PM - 01:45 PM</td>
<td>Protecting the NextGen TV Consumer</td>
</tr>
<tr>
<td>01:45 PM - 02:15 PM</td>
<td>Monetizing the NextGen TV Consumer</td>
</tr>
<tr>
<td>02:20 PM - 03:03 PM</td>
<td>Personalizing the Consumer Experience</td>
</tr>
<tr>
<td>03:03 PM - 03:40 PM</td>
<td>The Consumer Out-of-Home Experience</td>
</tr>
<tr>
<td>03:40 PM - 04:10 PM</td>
<td>The ATSC 3.0 Roadmap</td>
</tr>
<tr>
<td>04:10 PM - 04:35 PM</td>
<td>The Consumer Technology Roadmap</td>
</tr>
<tr>
<td>04:35 PM - 05:00 PM</td>
<td>Station Group and Industry Deployment Plans</td>
</tr>
<tr>
<td>05:00 PM - 6:00 PM</td>
<td>Cocktail Reception</td>
</tr>
</tbody>
</table>

**Notes:**
- **Registration and continental breakfast**
- **Welcome from SMPTE, SBE and AES**
- **Introduction**
- **NextGen TV: Transforming the Consumer Experience**
- **Creating New Opportunities with NextGen TV**
- **Improved Television Reception for Consumers**
- **Benefits of a Converged Broadcast and IP Platform**
- **Content Reception Enhancements**
- **Consumer Applications for Combined 5G & NextGen TV Networks**
- **Case Study: Hybrid Services at "Chicago 3.0"**
- **Buffet Lunch**
- **Protecting the NextGen TV Consumer**
- **Monetizing the NextGen TV Consumer**
- **Personalizing the Consumer Experience**
- **The Consumer Out-of-Home Experience**
- **The ATSC 3.0 Roadmap**
- **The Consumer Technology Roadmap**
- **Station Group and Industry Deployment Plans**
- **Cocktail Reception**
Agenda

- Content preparation and compression
- Protocol / Delivery for OTA & OTT Convergence
- Reception enhancement with ATSC 3.0 Physical layer
Broadcast Overall Architecture

TV Station
- 4K/UHD Cameras, Next-gen Audio, Captioning
- UHD
- UHD Production
- ATSC 3.0 Encoder, Multiplexer, Electronic Service Guide (ESG)
- Master Control
- Networks and Playout Servers
- Existing HD Cameras, Audio, Captioning
- HD Production
- IP Packets

Transmitter Site
- ATSC 3.0 exciter
- ATSC 3.0 Waveform
- Transmitter
- Mask Filter
- Studio-to-Transmitter Link (STL)
- Tower and Transmit Antenna

Home
- ATSC 3.0 TV (UHD)
- ATSC 3.0 Enabled Mobile Device
- ATSC 3.0 Gateway or Converter
- WiFi
- Tablets and Mobile Phones
- ATSC 1.0 TV

Legend
- Existing usable components
- May need upgrade
- New components
ATSC 3.0 Delivery workflow
Content, Packaging & Delivery, OTA Signal

Presentation | Protocol | Transmission

Content
- Live Services
- RT Contents
- Encoding
- AEA Server
- ESG Server
- Data
- NRT

Packaging & Delivery
- DASH/WPA
- Services + Signaling
- Broadcast Gateway

OTA Signal
- ATSC 3.0 TX Sites
- SFN Coverage
- ATSC 3.0 Exciter
- STLP
Content preparation

Compression

- Advanced Audio & Video compression
  - Video = HEVC (H265)
  - Audio = AC4 or MPEG-H

- Using less bandwidth

<table>
<thead>
<tr>
<th>Video Codec</th>
<th>Distribution</th>
<th>Bitrate (Mbps)</th>
<th>2 hrs (GB)</th>
<th>Qf</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPEG2</td>
<td>DVD (typical)</td>
<td>32.0</td>
<td>26.8</td>
<td>.64</td>
</tr>
<tr>
<td></td>
<td>Online (max.)</td>
<td>16.7</td>
<td>14.0</td>
<td>.34</td>
</tr>
<tr>
<td>H.264</td>
<td>Blu-Ray (typical)</td>
<td>25.0</td>
<td>21.0</td>
<td>.50</td>
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<tr>
<td></td>
<td>Online (max.)</td>
<td>10.0</td>
<td>8.4</td>
<td>.20</td>
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<tr>
<td></td>
<td>Broadcast (typ.)</td>
<td>6.0</td>
<td>5.0</td>
<td>.12</td>
</tr>
<tr>
<td>H.265</td>
<td>Online (max.)</td>
<td>6.0</td>
<td>5.0</td>
<td>.12</td>
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<tr>
<td></td>
<td>Broadcast (typ.)</td>
<td>4.0</td>
<td>3.4</td>
<td>.08</td>
</tr>
</tbody>
</table>

- Improve audio & video quality for a Better end user experience
- More Content on one RF Channel
Video preparation

End User Advantages

- **Better image quality**
  - SD, HD and UHD using HEVC
  - High Frame rate
  - High Dynamic Range & Wide Color Gamut
Audio preparation
End User Advantages

- Audio with Dolby AC4 or MPEG-H
  - Immersive audio: sound from any directions
  - Object based:
    - User choose what he want to listen
    - Sound is restituted at home according to user audio system
    - Efficiently transmitted: no audio / sound duplications
## Audio preparation

### Broadcaster Advantages

<table>
<thead>
<tr>
<th>Signaling Information</th>
<th>Audio Programme Components</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M&amp;E</td>
</tr>
<tr>
<td>Default Preselection</td>
<td>M&amp;E</td>
</tr>
<tr>
<td>(English)</td>
<td></td>
</tr>
<tr>
<td>Italian Preselection</td>
<td>M&amp;E</td>
</tr>
<tr>
<td>Italian Audio Description Preselection</td>
<td>M&amp;E</td>
</tr>
<tr>
<td>English Team Radio Preselection</td>
<td>M&amp;E</td>
</tr>
<tr>
<td>M&amp;E Only Preselection</td>
<td>M&amp;E</td>
</tr>
</tbody>
</table>

**MME = Main or Music & Effects**
ATSC3.0 Protocol stack

Presentation, Protocol, Transmission

- Physical Layer (e.g. ATSC 3.0)
- Data Link Layer (e.g. GSE or TLV or ALP)
- Presentation Protocol Transmission
- UDP
- IP
- NRT
- DASH/MPU
- NRT
- Signaling
OTA OTT Convergence
Linear TV Delivery

- ATSC 3.0 decided that the linear TV will be
  - Package as OTT
  - Using ISO BMMF Segments: DASH or MPU

- CE device could then receive content through
  - ATSC 3.0 air interface
  - And / or through Broadband connection

- Easy Mix OTA, OTT, VOD on same device
- Deliver additional component through Broadband
- Deliver additional content through Broadband
Multi receiver
ATSC 3.0 on connected devices

- DASH as content packaging
- ROUTE as file delivery
- CE devices will receive segments
  - That could be decoded by any OTT player
  - Embedded in the CE device
  - Or store locally and access using any OTT local player
NextGen TV for connected devices
ATSC3.0 for all CE with DASH delivery

© LowaSIS
Content enrichment

Interactivity

- Interactivity based on
  - HTML5 & JavaScript based
  - With dedicated TV Service API

- Create easily a portal / universe around the linear service
- Mix OTA, OTT, VOD on same device
- Include additional information and videos around primary Live TV services
# Physical Layer

## ATSC 1.0 & ATSC 3.0 Comparison

### ATSC 1.0 physical layer
- 8 level Vestigial Sideband modulation
- Reed-Solomon Forward Error Correction (FEC)
- One bit rate – 19.39 Mbps
- One coverage area – 15 dB CNR (rooftop)
- Gap-filling with echo-cancellation considerations
- Service flexibility – HDTV, multicast, data

#### 8-VSB with fixed (188,210) RS FEC

19.4 Mbps

### ATSC 3.0 physical layer
- Orthogonal Frequency Division Multiplexing Modulation
- LDPC FEC (more powerful correction, sharper roll-off)
- More bps/Hz – near theoretical limit
- Flexible bit rate and coverage area choices
- Enable on-channel repeaters and SFN for robust indoor and mobile reception with power-add considerations
- Multiple simultaneous “Physical Layer Pipes”

#### OFDM with variable code rate LDPC FEC

~25Mbps
Modulation Performance
OFDM Based
ATSC3.0 air interface

Bandwidth - Robustness

- Better robustness =
  - Better indoor reception for all TV at home =
  - Better end user satisfaction

- Increase coverage = more TV viewer

- Additional bandwidth = additional services
  - Linear services
  - Push of content
Physical Layer Pipe - 3

Main concept

➔ ATSC1 = 1 Multiplex / TS per RF channel

➔ ATSC3.0 MPLP = several Multiplexes per RF channel
MultiPLP - QoS classes scenario

Addressing different receivers

UHD Service

PLP #1
- 64 QAM
- 64800 LDPC
- 1/15 FEC

SD Service

PLP #2
- 16 QAM
- 64800 LDPC
- 5/15 FEC

Radios

PLP #3
- QPSK
- 64800 LDPC
- 5/15 FEC

6 MHz, TDM, 16k FFT, 64QAM, 64800 LDPC, 148us GI

8.70 Mbps
14.28 dB(1)
17.44 dB(2)

2.97 Mbps
2.82 dB(1)
4.32 dB(2)

0.66 Mbps
-1.70 dB(1)
-0.55 dB(2)

(1) AWGN
(2) Rayleigh
Single Frequency Network (SFN) Topology and advantages

- **Better RF coverage**
  - Several lower amplifiers instead of only one highly powered transmitter

- **Increase power reception**

  ![Diagram showing better RF coverage through SFN](image)

- **OFDM is more tolerant to multipath and echos compare to 8VSD**

- **Single Frequency Networks (SFN)** employs multiple transmitters to cover a service area

  - Better coverage
  - Increase coverage
Thank You

ENENSYS TeamCast Inc

Email richard.lhermitte@enensys.com
THANK YOU

FROM THE SMPTE WASHINGTON DC SECTION