ATSC 3.0 Overview

- Rich Chernock
  - CSO, Triveni Digital
  - Chair, ATSC TG3

Here be monsters… (not really)
“Unless we change direction, we will end up where we are headed”
Chinese proverb

“May you live in interesting times”
Ancient Chinese curse
Advanced Television Systems Committee

• ATSC is an SDO with membership of 100+ organizations

Two Technology Groups:

• Technology Group 1 (TG1):
  – ATSC 1.0 management
  – ATSC 2.0 development
  – Also 3D; Mobile DTV, etc.

• Technology Group 3 (TG3):
  • ATSC 3.0 development
Today. Tomorrow. And Beyond.

- High Definition
- Multicasting
- 5.1 Digital Surround Sound
- Electronic Program Guides
- Enhanced Closed Captioning
- Mobile Digital TV

ATSC 1.0
- Non-Real-Time Transmission
- Advanced A/V Compression
- Enhanced Service Guides
- Audience Measurement Tools
- Conditional Access
- Interactive Capability

ATSC 2.0
- Flexible & Robust System
- OFDM Transmission
- Ultra High-Definition TV
- Integrated Mobile Capabilities
- Advanced A/V Compression
- Evolvable Architecture
- Enabler of New Services

ATSC 3.0
ATSC 3.0 must provide performance improvement and additional functionality sufficient to warrant implementation of a non-backward compatible system.
Important Considerations

Three areas to consider:

• **Technical** considerations (ATSC)
• **Business** considerations
  - Keeping broadcasting viable
  - Maintaining/extendng consumer value
  - Coordination with other distributors
• **Regulatory** considerations
  - Future TV spectrum availability? Transition?
What has happened since ATSC 1.0

– Technology has advanced significantly
– Physical layer technologies approaching the Shannon limit
– Spectrum is becoming increasingly scarce
– Major improvements in video coding efficiency
  – More and more pixels desired
– Audio has become immersive
– Interactivity has become expected
– Delivery paths other than broadcast have become commonplace
– Mobile devices have proliferated
– Tablets have appeared
ATSC 3.0

Next Generation Broadcast Television

- Significantly higher data capacity
- Higher PHY capacity
- Flexible spectrum use
- Higher PHY robustness
- Future extensibility
- UHDTV support
- Mobile handheld support
- Hybrid broadcast + broadband delivery
- Advanced A/V compression
- Immersive audio
- more…

ATSC 3.0

- Configurable
- Scalable
- Efficient
- Interoperable
- Adaptable
System Layers and TG3 Specialist Groups

S31: SG on System Requirements & Program Management

S32: Physical

S33: Protocols

S34: Applications and Presentation
S31 – System Requirements & Program Management
Development of System Requirements

Use Cases → Usage Scenarios → System Requirements
ATSC 3.0 System Requirements

• High-level “commercial” Requirements
• Derived from global collection of use cases
• Distilled to 13 “Usage Scenarios”
• Generated 148 System Requirements
•Assigned each to one or more SGs
Scenarios Developed

1. Flexible Use of Spectrum
2. Robustness
3. Mobile
4. Ultra HD
5. Hybrid Services
6. Multi-view/Multi-screen
7. 3D Content (Video)
8. Enhanced and Immersive Audio
9. Accessibility
10. Advanced Emergency Alerting
11. Personalization/Interactivity
12. Advanced Advertising/Monetization
13. Common World Standard
Next Steps: Program Management

- Address questions from SGs on Requirements
- Prioritize work
- Keep big picture in mind, tracking progress between and across all groups (x-layer items)
- Verify fulfillment of Requirements
S32 – Physical Layer
ATSC 1.0 Physical Layer

ATSC 1.0 broadcasters have operated with a **SINGLE** constrained PHY throughput of 19.39 Mbps since 1997.

ATSC 3.0 needs flexibility in operating points.

One operating point

---

[triveni digital]
Physical Layer needs of Broadcasters

- **Flexibility**: Different service offerings, Different service areas and terrain
- **Robustness**: Different transmission and reception environments, Mobile and pedestrian operation
- **Efficiency**: A physical layer that can evolve over time
PHY Layer CFP

- Call for Proposals on Physical Layer issued March 26th
  - Posted at www.atsc.org
  - Wide distribution around the world
- Proposals submitted Sept 27, 2013 by international community
  - 7 complete systems
  - 4 technology pieces
  - All requirements have submissions
- Evaluations continue through mid-2014 for baseline system
  - Optional technologies continue further
Physical Layer Skeleton Architecture

Skeleton architecture is being filled with details.
Baseline Features...so far

- OFDM based modulation
  - Wide range of guard intervals to mitigate multipath
- LDPC based FEC
  - Wide range of code rates in 2 code lengths (supporting mobile and fixed)
- Wide range of constellation sizes
Physical Layer

Broadcasters need operating options:

- Flexible, robust and efficient operation
- PHY layer that can evolve over time

Broadcasters can choose 4K, HD, mobile or any combination within a channel capacity
### Example operating point selection

<table>
<thead>
<tr>
<th>Distribution path</th>
<th>User device</th>
<th>Antenna</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional OTA</td>
<td>Fixed</td>
<td>External MIMO</td>
<td>High C/N range</td>
</tr>
<tr>
<td>Cable / Satellite</td>
<td>Vehicular</td>
<td>Indoor</td>
<td>Mid C/N range</td>
</tr>
<tr>
<td>Broadband</td>
<td>Portable</td>
<td>Extendable</td>
<td></td>
</tr>
<tr>
<td>Dense Cell</td>
<td>Handheld</td>
<td>Integrated</td>
<td>Low C/N range</td>
</tr>
</tbody>
</table>

**New consideration of transmission and reception connections.**
**Can support all paths simultaneously (within a given channel capacity)**
Future

- Finalize baseline functionality
- Return path definition
- Optional technologies (MIMO, TFS, Layered, etc.)
- Goal is to have a standard by 2016, with worldwide application
S33 – Management & Protocols
Functional Blocks under development by S33

- Announcement
- Personalization
- Content Advisory
- Reporting
- Usage
- Error Recovery
- 2nd screen
- Interactivity
- redistribution
- Protection
- Support
- Emergency Alerts

S33-1
S33-2
S33-3
TG3-4
Delivery Commonalities, so far…

- The group has already reached consensus on the use of **IP** transport for broadcast delivery of both streaming and file content.
- Common elements thus far (at a high level) are the use of **ISOBMFF** as a content format for streaming delivery (not yet agreed as the exclusive format) and the use of **UTC** (or some other form of "absolute" time) for synchronization and buffer management.
Service Announcement and Personalization

• No desire to reinvent the wheel

• Agreed to use OMA BCAST 1.0 as a starting point
  – As modified for ATSC MH (A/153 Part 4)
  – Further extended / constrained to match the ATSC 3.0 Service Conceptual Model

• Content Advisory & Personalization work yet to commence
Interactive Services & Companion Screen…

- **Tasks include:**
  - Interactive application signaling and protocols, including a return path
  - Companion device communication protocols
  - Redistribution support

- **Current main focus is on redistribution support**
  - Goal is to enable receivers connected to MVPD distribution networks (e.g., cable, satellite, 3GPP) that may have access to a subset of the ATSC 3.0 broadcast components to access missing components via alternative networks (e.g., Broadcast or Broadband), to the extent possible.
Interactive Services & Companion Screen

- **Automatic Content Recognition (ACR)**
  - Redistribution support needs to work when the receiver only has access to uncompressed audio and video and no other signaling or metadata
  - ACR is expected to form the cornerstone of redistribution support
  - Fingerprint and watermark solutions will both be specified
  - Fingerprint solution will be based on ATSC 2.0
  - A CFP for watermark solutions has been issued
    - Initial responses received

- **Liaison communications with SMPTE OpenID are ongoing**
S34 – Applications & Presentation
Applications and Presentation Layer

– Essentially – what the consumer experiences

– Specifically:
  • Service models and types
  • Multiple device support
  • Video, audio, and closed captions
  • Interactivity, personalization, alternative component selection, etc.
Service Model - Main Concepts

- **Content** – the Essence (e.g., video, audio, data) and its associated metadata
  - Comprised of Content Components – Essence of a single type (e.g., video, audio, data) and its associated metadata

- **Programs** – content intended to be treated as a unit from a consumption standpoint
  - Comprised of Segments

- **Services** – packages of content offerings from a broadcaster, e.g., a linear channel or an OnDemand library
Services – Two Types

• Linear Services – Scheduled content
  – Basically, TV as we know it today
  – Content delivered according to a schedule determined by the broadcaster
  – Can be enhanced with applications

• App-based Services – Unscheduled content
  – Consumers access content on-demand via an app
  – Consumers choose what content to access and when
New Service Models and Features

- Enhanced linear TV, plus on-demand support
- Subscription and PPV support
- Conditional access and DRM capabilities
- Multiple device and companion device support
- Hybrid delivery (broadcast and broadband)
- Automatic content recognition (ACR)
- Flexibility for future business opportunities
Flexible Component Configuration

– Alternative components can be selected and combined at the receiver
  • Different delivery methods
  • Different delivery times (NRT, real-time continuous stream)
  • Components can be selected automatically by the receiver (e.g., low/high bit rate versions)
  • Components can be selected by the viewer (e.g., alternative camera angle component)

– And synchronized
New Video Features

– UHD support
  • High dynamic range and wide color gamut in discussion

– High efficiency compression

– Multiple, selectable video components
  • Alternate camera angles
  • Multi-view (e.g., picture-in-picture)
  • Multi-screen and companion device support
ATSC 3.0 HD Enhancements

- 1080p formats with HDR and/or HFR are anticipated
- While integer and fractional frame rates will both be supported, details are being worked through on combination use
  - Strong input received from broadcasters to support fractional frame rates
- Additional resolutions are being considered (e.g., 2560 x 1440)
- HD content is also targeted to mobile devices
ATSC 3.0 UHD

- General agreement:
  - Progressive only for UHD resolution
  - Codec based on HEVC
  - 4k only (not 8k)
- To be addressed:
  - Fractional frame rates – 59.94? 119.88?
    - Strong input received from broadcasters to support 59.94 and consider 119.88
  - Scalable HEVC extension?
  - HDR, wider color gamut, etc.?
ATSC 3.0 Audio

• New personalization features:
  – Control of dialog, use of alternate audio tracks and mixing of assistive audio services, other language dialog, special commentary and music and effects
  – Normalization of content loudness and contouring of dynamic range, based on the specific capabilities of a user’s fixed or mobile device and unique sound environment

• Enhanced immersive experience:
  – high spatial resolution in sound source localization in azimuth, elevation, and distance, and provides an increased sense of sound envelopment

• Targeted to various devices (fixed, mobile) and speaker set-ups
• Hybrid broadcast/broadband delivery is supported
• Support for audio-only content as well as audio/video content
Robust App Runtime Environment

– Based on ATSC 2.0 and HbbTV 2.0
  • Personalization and Interactivity
  • HTML5 support
  • Companion device support
  • Wide range of APIs to enable your vision

– ATSC 2.0 currently Candidate Standard phase

– HbbTV 2.0 tracking just ahead of ATSC 3.0
But wait… There’s more!

– Audience measurement
– Advanced emergency alerts
– Advanced accessibility features
– Extensibility – aspects can evolve independently
Changes coming...

– More flexible & robust broadcast delivery mechanism
  – Broadcasters will have options, based on their business model
– Fatter pipe, skinnier content
  – More bits per hertz
  – More efficient coding (for same “quality”)
– Hybrid service support
  – Broadcast combined with Broadband
– Richer service model
  – Services beyond simple linear television
– Commonality with other delivery systems
  – IP transport replacing MPEG-2 TS
  – ISOBMFF or DASH likely to replace streams
– Extensibility at the core
2013

- March 2013: PHY Layer CFP Issued
- July 2013: System Requirements Released
- September 2013: Proposals Due
- August 2014: Baseline Technology Selection
- March 2015: Elevate to Candidate Standard

2014

- PHY Layer Proposal Evaluation
- Working Draft Development

2015

- M&P Technology Evaluations
- Working Draft Development
- March 2015: Elevate to Candidate Standard

2016

- April 2015: Elevate to Candidate Standard
- December 2015: Ballot to Elevate to Proposed Standard

Physical Layer (S32)

Management & Protocols (S33)

Applications & Presentation (S34)
Summary

- Will not be backward compatible to the legacy
- Acknowledges changes of user environments and needs
- Understands broadcast spectrum regulation issues
- Supports viability and new business models of broadcasters
- Flexible and future extension proof
ATSC
3.0 BOOT CAMP
May 7, 2014
Washington, DC
TODAY, TOMORROW & BEYOND

2014 ATSC BROADCAST TELEVISION CONFERENCE

May 8th in Washington, DC
Thanks
Questions??

rchernock@trivenidigital.com