Next Generation DTV: ATSC 3.0
The DTV Standard

- High-Definition
- Multicasting
- 5.1 Digital Surround Sound
- Electronic Program Guides
- Enhanced Closed Captioning
- Enabled government goal of reclaiming spectrum
- Backwards compatible enhancements
ATSC 3.0

- ATSC 1.0, is 20 years old!
  - It incorporates technologies are about 25 old
- Industries prosper by leveraging new technology
  - Broadcasting is no different
- Broadcasting needs new capabilities and increased capacity
  - While spectrum is being reduced
ATSC 3.0

• Revolution
  – Complete new system
  – Non-backwards compatible
  – Will offer significant performance improvements and new services
ATSC 3.0 Overview

- ATSC 3.0 will add value to broadcasting’s services
  - Extending reach, adding new business models
    - Content on all devices, fixed, mobile and handheld
  - Providing higher quality, audio and video
    - UHDTV & Immersive Audio
  - Improved accessibility
  - Personalization and interactivity
  - Leverage the power of broadcasting and broadband
  - More flexible and efficient use of the spectrum
Overview - ATSC 3.0 System Layers

- **Transmission (Physical Layer)**
  - Sending Bits over the air in 6 MHz
  - System Discovery & Signaling

- **Protocols**
  - Data Organized as Streams and Files
  - Sending Bits over the air in 6 MHz
  - Finding the Signal

- **Presentation**
  - Pictures & Sound
  - Data Organized as Streams and Files
  - Sending Bits over the air in 6 MHz

- **Applications**
  - Software
  - Finding the Signal

- **Signaling**
  - System Discovery & Signaling
  - Sending Bits over the air in 6 MHz
  - Data Organized as Streams and Files
  - Pictures & Sound
  - Software

- **Unique Sequence**
  - OFDM

- **Internet Protocols**
  - OFDM

- **Immersive Audio**
  - UHD
  - HD & SD multicast

- **Screen is a web page**

- **Unique Sequence**
  - UHD
  - HD & SD multicast
  - Immersive Audio

- **System Discovery & Signaling**
  - OFDM
  - Unique Sequence
ATSC 3.0: Physical Layer

• **Flexible**, robust transmission system
  – Greater capacity (more bits per Hz)
  – Ability to trade-off capacity for robustness
  – Robust System Discovery and signaling
  – Integrated mobile/handheld capabilities
  – Flexible bit rate and coverage area choices
  – Enable on-channel repeaters for robust indoor and mobile reception
  – Channel bonding enables spectrum sharing
  – Return channel option for emerging markets
  – Spectrum Efficiency
Physical Layer Similarities

- Same FFT sizes of 8K, 16K and 32K
- Time Division multiplexing option
- Physical Layer Pipe concept is same, Multiple PLP is a likely use case
- Hierarchical preambles preceding frames
- Low Density Parity Check for Forward Error Correction is similar, but there are new codes with different code rates
Physical Layer Enhancements

• Bootstrap signal has -10dB C/N robust performance for synchronization and tracking of system types
• Non Uniform Constellations provide more than 1dB performance gain
• Higher modulation order options (up to 4096 QAM)
• Layered Division Multiplexing addresses robust service area
• Wider range of SNR operating points (-6dB to over 30dB)
• 4 PLPs per service assignment for graceful operation (robust audio, scalable video coding options)
• Channel bonding enables spectrum sharing
Low Capacity, More Robust

High Capacity, Less Robust

A/153

A/53
Network Flexibility

> Indoor penetration

No spill-over into adjacent market
Management & Protocols

• Management and Protocols Layer
  – Service delivery and synchronization
  – Service announcement and personalization
  – Interactive services and companion screens
  – Redistribution support / watermarks

• **IP transport (only) will be used for broadcast delivery of both streaming and file content**
  – Broadcasting is part of the internet!
Benefits of IP transport

• Broadcasting no longer an independent silo
  – Take advantage of evolution speed of Internet
• Broadcast & Broadband as peer delivery mechanisms
  – Enables new types of hybrid services
  – Ability to seamlessly incorporate niche content
• Enable new business models
  – Localized Insertion
    • Ads or other content
    • Allows revenue model for broadcasters that has been available to cable or IPTV operators
Key features of ATSC 3.0 Management & Protocols

- IP-based protocols
  - *no use of MPEG-2 TS*
- ISOBMFF as the streaming media format
- UTC as the clock reference
Applications and Presentation

• The application and presentation layer is focused on what the consumer experiences
  – Video
  – Audio
  – Closed Captions
  – Interactivity, personalization, alternative component selection, etc.
ATSC 3.0: Video

• UHDTV is a key goal of ATSC 3.0
  – 4k is the current focus, with 8k possible in the future
    • Resolution of 3840 × 2160
    • Frame rate of 60 Hz; 120 Hz is under consideration
• High dynamic range
• Wide color gamut (Rec. 2020)
• 10 bits/pixel
• HDTV delivery to mobile and handheld devices such as tablets
ATSC 3.0: Video

• The ATSC 3.0 video system will take advantage of recent advances in coding technologies

• MPEG HEVC
  – Scalable video coding is being carefully studied
    • Attractive for possible efficiency gains
    • System complexity may be an issue
    • A promising system for delivery to multiple platforms
Video: Multiple Degrees Of Freedom

Image Size
(Spatial Resolution)
- 4k
- 720/1080p
- 480p

Depth Resolution
(Bit Depth)
- 10 bit
- 8 bit
- 6 bit

Frame Rate
(Temporal Resolution)
- 24/30
- 60
- 120

Color Volume
(Color Space)
- RGB/709
- DCI/P3
- REC 2020

Dynamic Range & Luminance
(Contrast Ratio)
- CRT
- LCD/LED
- OLED/QD
Relative Bandwidth Demands Of 4K, HDR, WCG, HFR

Bandwidth Increase

- 4K UHDTV
- High Frame Rate - 120FPS
- High Frame Rate - 60FPS
- HDR
- Color Gamut
- 10-Bit Bit Depth
SHVC: Layered Video Coding

- HEVC with scalable extensions (aka SHVC)
  - 2x spatial scalability between base layer (BL) and enhancement layer (EL)
  - Base layer optimized for mobile reception
  - Enhancement layer optimized for UHD resolution
ATSC 3.0: Audio

- Immersive audio features will provide
  - High spatial resolution in sound source localization
    - Azimuth, elevation, distance
  - Increased sound envelopment for an enhanced “suspension of disbelief”
- ATSC 3.0 audio targeted to various devices
  - Fixed, mobile & handheld
  - Differing speaker set-ups, and headphones
    - Including sub-optimal set-ups
ATSC 3.0: Audio

- ATSC 3.0 audio will provide for selectable, mixable audio components
  - Control of dialog
    - Hearing-impaired can raise dialog level
  - Alternate audio tracks
    - Multiple language tracks
    - Special commentary, and music and effects tracks
  - “Being there mode”
    - Allows viewers to select elements of the program mix and adjust to their preferences
ATSC 3.0: Audio

• A Call for Proposals for ATSC 3.0 audio technologies was issued in December 2014
  – Two systems now under consideration
    • Dolby
    • MPEG-H Alliance (Fraunhofer, Technicolor & Qualcomm)

• Test content has been collected and selected
• Proposed systems are being evaluated
ATSC 3.0: Interactive

• Robust App Runtime Environment with HTML5 support
• Based on HbbTV 2.0 with restrictions and extensions
  – HbbTV 2.0 was published earlier this year
  – 20+ extensions being documented, several based on ATSC: A/105 (aka “ATSC 2.0”), now in Candidate Standard phase
  – Changes being documented due to ATSC 3.0 IP delivery solution (HbbTV is based on MPEG-2 TS)
Interactive – a few sample uses

• Targeted ad insertion
• On demand interface
• Multiple videos, eg PiP
• T-commerce
• Voting/polling
• Games
• News and sports feeds
• Notifications/reminders
ATSC 3.0: Accessibility

• Initial focus is Closed Captioning
• General agreement Closed Captions is its own essence
  • Decouple CC from video in ATSC 3.0
ATSC 3.0: Watermark

• Programs delivered to a TV via multichannel video program distributors (MVPDs) typically do not contain all components of the original terrestrial broadcast
  – Cable, satellite, HDMI
• Certain ATSC 3.0 functionality designed to be discovered and interpreted by the TV could be lost
  – For example, interactive applications associated with the main program
• Watermarking based Automatic Content Recognition (ACR) is a promising solution being pursued
ATSC 3.0: Watermark

• Evaluation is complete
  – Video watermark
  – Audio watermark
  – Fingerprinting specification currently under development (A/105, “Interactive Services Standard”) likely to be included

• ATSC is staying abreast of related work in other SDOs
  – SMPTE, OpenID
Advanced Emergency Alerts

- Builds on AWARN system (aka M-EAS, ATSC: A/153 part 10)
- Receivable on ALL devices: Mobile and Fixed Home
- CAP & IP compatibility
- Ability to deliver rich media content
- Targeted alerting and content delivery
  - Geo-locational and User Types
  - No all-market interruption of TV service
- Ability to wake up targeted receivers
- Robust delivery
ATSC 3.0: Ecosystems

- Produce Block Diagrams
  - Characterizing ATSC 3.0 Ecosystem by Layers
  - Models Sufficient to Cover Wide Range of Cases
  - Not Explicitly Representative of Any Specific Cases
- Produce Report Explaining ATSC 3.0 Ecosystem
- Aid Development of ATSC 3.0 Standards
- Aid Implementation of ATSC 3.0
- Educate Eventual Implementers
Ecosystem Example: Video – 1-5 Yrs
CEA R4WG18

- Receivers for Next Generation Broadcast Television
  - Develops recommended practices and technical reports on ATSC 3.0 receiver characteristics
  - Receiver Profiles
ATSC 3.0 Participation

- 373 individuals on reflector/document system
  - Many others focused on 3.0 development efforts
- 110 organizations
  - Broadcasters
  - Consumer Electronics Manufacturers
  - Professional Equipment Manufacturers
  - R&D Laboratories
  - Universities

- International Participation
  - Canada
  - China
  - Europe (including DVB)
  - Japan (including NHK)
  - South Korea
  - United States
Schedule

• ATSC 3.0 is a suite of standards
  – One or two standards per layer
  – Each Standard moves through the process independently
  – Most will move to Candidate Standard in 2015
  – Final approval of each document expected in 2016 with completion of all in the first/second quarter of 2017
In Summary

- Will not be backward compatible to the legacy system
- UHDTV & Immersive Audio
- Personalization
- Robust delivery to multiple platforms
- Supports viability and new business models of broadcasters
- Flexible to accommodate future improvements and developments
THANK YOU!

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