The Future of Television
ATSC 3.0

NOVEMBER 2016
Introduction

• ATSC 3.0 is a revolutionary advance in television broadcasting

• A first of its kind offering Internet-like IP transmission over-the-air

• It is unique in the world; a marriage of OTA and Internet technologies

• Supports seamless compatibility with terrestrial delivered Internet content.
The Goals of ATSC 3.0

• To improve the television viewing experience

• To add value to broadcasting’s service platform
  - Extending reach, adding new business models
  - Providing higher audio and video quality, more accessibility
  - Personalization and interactivity

• To address changing consumer behavior and preferences
  - TV content on all devices, both fixed and mobile
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
Key Technology Enhancements in 3.0

• Flexible, robust transmission system - OFDM-based modulation
  o Greater capacity (more bits per channel)
  o Flexible configuration – receivability vs capacity
  o Integrated mobile capabilities

• Increased Capacity
  o Existing program channels can display higher quality
  o Additional program channels – HEVC video compression

• Enhanced Consumer Experience
  ▪ Improved Video Quality
    o Higher Resolution - UHD
    o More realistic looking pictures - HDR
    o Enhanced color reproduction - WCG
    o Improved motion rendition – HFR
  ▪ Enhanced Audio Experience
    o Multiple languages & descriptive audio
    o Viewer controlled prominence of dialog
    o Immersive sound
Flexible Receivability in 3.0
## What Can Fit in a 6 MHz Channel?

### ATSC 1.0 = 13 capacity units

### ATSC 3.0 = 36 capacity units

\( \{3 \text{ times the Capacity}\)
Next Generation Audio

• Higher quality less Bandwidth
• Immersive – Builds a 3D sound field that envelops you
• Personalized experience
  ▪ Alternative languages
  ▪ Descriptive audio
• Native support for user defined Dialog Enhancement
• Loudness Control
• Targeted to various devices (fixed, mobile) and set-ups
• Improved down-mix compatibility
Internet Compatibility

• Goal is to deliver a personal and dynamic experience
  - HTML5 / Internet overlay graphics
  - Hybrid delivery — merging broadcast and internet
  - Dynamic ad insertion
  - Personalized graphics
  - Interactivity capabilities
  - Synchronized second-screen applications
  - Audience measurement capabilities

• Aligns with the web
  - Based on W3C technologies
  - Easy to adapt web apps for TV and vice versa

• Content can be streamed in real time (i.e., linear or streaming on demand content) via both broadcast and broadband

• Content can be delivered in non-real time and cached locally via both broadcast and broadband
New Public Service Capabilities

• Emergency Alerting
  ▪ Extremely robust EAS “wake up” signaling
  ▪ Advanced EAS messaging capabilities including rich media
  ▪ Ability to reach indoor, battery-powered receivers

• Robust Audio and Closed-Caption transmission even when picture fails

• Improved audio intelligibility for hearing impaired
  ▪ New capabilities for improved dialog/narrative intelligibility (track – specific volume control)
  ▪ Continued support for Video Description Services
World Series Broadcast in ATSC 3.0
Schedule

• ATSC 3.0 is a suite of standards
  ▪ One or more standards per layer
  ▪ Each standard moves through the process independently
  ▪ Most will move to Candidate Standard in 2016

• Final approval of most documents is expected in 2016, with completion of all in the first / second quarter of 2017

• FCC considering change in rules to authorize use of ATSC 3.0

• ATSC 3.0 selected by South Korea
Summary

- Next generation broadcast television
  - Significantly higher data capacity
  - Flexible spectrum use
  - Higher physical layer robustness
  - Future extensibility
  - Mobile / handheld support
  - Hybrid broadcast + broadband delivery
  - Advanced A / V compression
  - Immersive audio, UHD video
  - Interactivity and personalization
  - Potential for new business models
  - Provide a path to the future of broadcasting
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QUESTIONS?
The Future of Television
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Extra Slides
What is New in ATSC 3.0?
Capabilities beyond 1.0

• Robust Transmission
  - Flexible configuration – receivability vs capacity
    - Able to tune transmission parameters to optimize mobile vs. fixed viewers
    - SFN
    - On channel repeaters
    - Mobile reception - tablets
    - Deep indoor reception – reduced need for rooftop antennas
  - Can be configured to individual DMA needs

• Future proof
  - Designed to evolve – technology stays state of the art
    - Created in modules for straightforward updates
    - Signaling incorporated to signify alternate choices
  - Flexible configurations
Requirements for the New System

• Flexible, robust transmission system
  ▪ Greater capacity (more bits per channel)
  ▪ Ability to trade-off capacity for robustness
  ▪ Integrated mobile capabilities

• Advanced audio / video coding systems
  ▪ Ultra-high-definition video
  ▪ Immersive and personalized audio

• Future capabilities
  ▪ Extensibility and scalability
ATSC 3.0 PHY Layer Operating Range

Capacity Curve in AWGN at BER=1E-6

Huge number of possible operating points for broadcaster

Low Capacity, Very Robust

High Capacity, Less Robust

ATSC 1.0 a SINGLE PHY 19.39 Mbps
7.1.4 Immersive Audio
ATSC 1.0

- HDTV & SD multicast
  - HDTV – MPEG-2 (12 – 18 Mbps)
  - SDTV – MPEG-2 (3 – 5 Mbps)
- Dolby Digital (AC-3) 5.1 surround sound

Standard Dynamic Range and Color
100-nit color grading, Rec. 709 color, 8 bits/pixel

ATSC 3.0

- UltraHD and/or HD and/or SD multicast
  - UHD-HDR-WCG – HEVC (18 – 30 Mbps)
  - HD 1080p-HDR- WCG – HEVC (6 – 8 Mbps)
  - HD – HEVC (2 – 6 Mbps)
  - SD – HEVC (0.75 – 1.5 Mbps)
- Next-Generation Audio (Personalized …Immersive)
  - Dolby AC-4 in the US; MPEG-H in Korea

High Dynamic Range and Wide Color Gamut
1000-nit color grading, Rec. 2020 color, 10 bits/pixel
Key Video Features

• The ATSC 3.0 video system will support
  ▪ UHD (4K) delivery is a key goal of ATSC 3.0
  ▪ Enhanced HD
  ▪ Wide color gamut, high dynamic range, scalable
  ▪ Targeting small screens (HD) and large screens
  ▪ Multiple, selectable video components
  ▪ 3D support

• State-of-the-art video compression
  ▪ HEVC Main 10 Profile specified
    o 35 – 50% performance gains vs AVC/H.264

• Several HDR proposals submitted and under evaluation
  o Video quality (compression efficiency)
  o Backward compatibility with SDR (100nit, ITU Rec.709)
  o Production workflow considerations
More Channel Capacity Than ATSC 1.0

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3 times the Capacity
Key Audio Features

The ATSC 3.0 audio system will feature

• An enhanced, immersive experience
  ▪ Sound with improved azimuth, elevation, and distance perspective
  ▪ Use of channels and objects or “elements” and metadata
    o Metadata allows rendering at the decoder, customized to the user’s sound system
    o The decoder places the sound in the most accurate position that the user’s sound system can support

• Targeted to various devices (fixed, mobile) and set-ups

• Personalization

• Support for audio-only content as well as A / V content

• Hybrid broadcast / broadband delivery will be supported

• Normalization of content loudness and contouring of dynamic range
  ▪ Based on the specific capabilities of a user’s fixed or mobile device, and the unique sound environment
### Key Applications Environment Features

- **Goal is to deliver a personal and dynamic experience**
  - HTML5 / Internet overlay graphics
  - Hybrid delivery — merging broadcast and internet
  - Dynamic ad insertion
  - Personalized graphics
  - Interactivity capabilities
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  - Immersive audio — user control of tracks and mix
  - Audience measurement capabilities

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Key Interactive Services

- **ATSC is specifying an interactive application environment for ATSC 3.0**
  - The standard will enable interoperability between the receiver runtime environment and the apps that producers and broadcasters author

- **Based on W3C technologies**
  - Goal is to align with the web as much as possible
  - Ideally, application authors will be able to easily adapt web apps for TV and vice versa

- **ATSC 3.0 will add TV-centric functions to the W3C technologies**
  - Change the channel
  - Check parental control setting
  - Access the device’s PVR
  - Response to a timed event in the program
Interactivity – Information Bar

News Program

Program Image

UI Module

Send Buttons
Interactivity – Shopping
Key Technology Enhancements in 3.0

Integrated Internet Compatibility

- Unique convergence of OTA and terrestrial internet
- Over the air delivery of up to 24Mb/s broadband IP into homes
- Fully integrated broadcast (OTA) / broadband (BB) core
  - Content can be seamlessly provided to consumer over broadcast and broadband & combined at receiver
  - Localized insertion of ads or other content
  - Network handoff – 3.0 to/from LTE & Wi-Fi depending on most reliable network available (inside home or on the go).

- Downloadable interactive applications
  - Second screen
  - WEB based browser environment
- Provides for non-real time delivery
ATSC 3.0 Is The Glue

ATC 3.0

Existing Broadcast Ecosystem

Existing Internet Ecosystem

Live TV

Catch-up and VOD

New Business Models

VIEWERS

BROADCAST

INTERNET
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