ATSC 3.0: What it Will Mean to Broadcasters

October 4, 2016
Specialist Groups and ad hoc groups have made preliminary decisions to select technologies for incorporation in ATSC 3.0.

Selections of all technologies are subject to approval of TG3 and ultimately the Voting Membership in accordance with ATSC due process.
Television Today

ATSC (aka 1.0)
- Constrained
- Maxed-Out
- Inefficient
- Fixed
- “It Feels Old”
What if? ... what might be possible?

ATSC 3.0
- Configurable
- Scalable
- Efficient
- Interoperable
- Adaptable
ATSC 1.0 in Retrospect

Computer
DOS ... Windows 3.1

Cell Phone
Analog 2G

Dial-up
Modem
19.2 kbps

VCR - analog
The “modern” Digital World

WiFi 802.11ac 1300 Mbps

HDTV- Digital – Smart TVs
LED / LCD displays

SmartPhones

4G Networks
12 Mbps

Cable & DSL Modem Up to 100 Mbps

1990: 802.11b (11 Mbps)
2009: 802.11n (600 Mbps)
2013: 802.11ac (1300 Mbps)

Computers

1999: 802.11b (11 Mbps)
2009: 802.11n (600 Mbps)
2013: 802.11ac (1300 Mbps)

Tablets

2007: iPhone (4Gbytes)
2014: iPhone 6 (128 Gbytes)

Wearables
Why do we need change?

- Tablets are in widespread use
- Mobile devices have proliferated
- Audio experience features have advanced
- A strong desire exists for higher resolution images
- Spectrum is becoming increasingly scarce
- Personalization & Interactivity have become expected on the part of consumers
- Major improvements have been made in video compression efficiency
- Delivery paths other than broadcast have become commonplace
- Better audience measurement accuracy is needed and expected
Ultra HD Change is Underway

Sony Video Unlimited 4K
FMP-X10 upgrade
to work with other 4K UHD brands
The Goals of ATSC 3.0

- To improve the television viewing experience
- To add value to broadcasting’s service platform
  - Extending reach, adding possible 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
Benefits to Consumers

- Maintain competitive top-tier picture and sound quality
- Reach new consumer devices with broadcast platforms
- Leverage the power of broadcasting and the Internet
- Tapping new advances for a complete new system
- Potential for a standard widely adopted around the world
Meeting the Needs of Broadcasters

Flexible
- Expanded service offerings
- Coverage areas customized to the terrain

Robust
- New transmission and reception environments
- Mobile and pedestrian operation

Extensible
- A system that can evolve over time
### System Layers and Specialist Groups

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ATSC 3.0 Protocol Stack

Applications (HTML5/JavaScript)
- MPU Player/Decoder
- EME/CNEC
- MMT-specific Signaling
- ROUTE-specific Signaling
- Announcement
- NRT File Delivery
- DASH Player/Decoder
- EME/CNEC
- DASH Segment (ISO BMFF)
- NRT File Delivery
- All Signaling Objects

HTTP Proxy
- MMTP
- LLS (SLT)
- HTTP
- TCP
- IP
- ATSC Link-Layer Protocol (ALP)
- ATSC 3.0 Physical Layer (OFDMA RF)
- Broadcast
- Broadband

Data Link Layer
- Physical Layer
ATSC 3.0 Physical Layer

- The ATSC 3.0 Physical Layer encompasses
  - Common system elements
  - Bootstrap signaling
  - Modulation and coding
  - Waveforms
  - Core broadcast services

- ATSC 3.0 will have considerable flexibility in operating points
  - Low capacity, highly robust
  - High capacity, less robust
Signaling all PHY parameters

- **Bootstrap start point**
  - Robust synchronization
    - Service discovery
    - Coarse time, freq ACQ
    - 5MHz bandwidth
  - < -6dB SNR performance with FER = 1E-2
  - 24 signaling bits
    - Sampling frequency
    - Channel BW
    - EAS Wake Up, Preamble selection...

- **Preamble frame control**
  - Basic
    - Low Level Signaling flag
    - Frame structure starts...
  - Detail
    - Wall clock time
    - Full frame structure, PLP’s, interleaving...
Physical Layer Pipes

- PLPs carry data in various configurations
  - Robustness vs. data-capacity tradeoffs
    - Based on selections of modulation and coding
    - Based on selections among interleaving choices
- PLPs can be arranged in patterns of frequency and time resources
  - Patterns can vary between sub-frames
- Up to 64 active “simultaneously” on a single RF channel
- Up to 4 in a single service – limited by receiver resources
Layered Division Multiplexing

- LDM is a new transmission scheme that uses spectrum overlay technology to superimpose multiple physical layer data streams with different power levels, error correction codes, and modulations for different services and reception environments.

- For each LDM layer, 100% of the RF bandwidth and 100% of the time are used to transmit the multi-layered signals for spectrum efficiency and flexible use of the spectrum.
Layered Division Multiplexing

- Signal cancellation can be used to retrieve the robust upper layer signal first, cancel it from the received signal, and then start the decoding of lower layer signal.
  - The upper layer (UL) is ultra-robust and well suited for HD portable, indoor, mobile reception. The high data rate lower layer (LL) transmission system is well suited for multiple-HD and 4k-UHD high data rate fixed reception.
- Future Extension Layer (FEL) can be added later with full backward compatibility.
A/322, Physical Layer Protocol Functions

- Payload scrambling
- Low density parity check (LDPC) forward error correction
- Bit interleaving
- Non-uniform constellations
- Single / multiple physical layer pipes
- Time / frequency / layered cell-multiplexing combinations
- Layered division multiplexing
- Multiple input / multiple output
- Single frequency network
- Time interleaving
- Orthogonal frequency division multiplexing modulation
- Frequency interleaving
- Pilot / tone reservations
- Channel coding
- Peak-to-average power ratio reduction
- Large guard interval range
- A/321 bootstrap signal discovery
- Hierarchical robust preamble signaling
The ATSC 3.0 Management and Protocols Layer encompasses
  ◦ Service delivery and synchronization
  ◦ Service announcement and personalization
  ◦ Interactive services and companion screens
  ◦ Redistribution support / watermarks

IP transport will be used for broadcast delivery of both streaming and file content
  ◦ ATSC 1.0 uses MPEG-2 Transport; ATSC Mobile/Handheld uses IP
Management Layer Key Elements

- Common elements include
  - Use of IP Transport
  - Use of ISOBMFF as a content format for streaming delivery
  - Use of UTC (or some other form of "absolute" time) for synchronization and buffer management
Benefits of IP Transport

- Broadcasting is no longer an independent silo
  - IP takes advantage of evolution speed of the Internet
- Puts broadcast and broadband as peer delivery mechanisms
  - Enables new types of hybrid services
  - Seamlessly incorporates niche content
- Enables new business models
  - Localized insertion of ads or other content
  - New revenue model for broadcasters that has previously been available to only cable or IPTV operators
The ATSC 3.0 Applications and Presentations Layer encompasses:
- Video coding
- Audio coding
- Presentation logic and service frameworks
- Runtime environment
- Accessibility

ATSC 3.0 offers “hybrid” delivery:
- Broadcast (over-the-air) and broadband (over the Internet)
- Use cases include:
  - Main A / V components delivered via broadcast, alternate components (e.g., alternate language) delivered via broadband
  - Main program delivered via broadcast, alternate interstitials delivered via broadband (e.g., targeted ad insertion)
  - Temporary “hand-off” from broadcast to broadband and back for brief fades in reception
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 coding
  - Targeting small screens (HD) and large screens (UHD)
  - Multiple, selectable video components
  - 3D support

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

- Several HDR proposals submitted and under evaluation
  - Video quality (compression efficiency)
  - Backward compatibility with SDR (100nit, ITU Rec.709)
  - Production workflow considerations
Reference bit rate is 709 color space, 1080/30p, 8 bit. Chart courtesy of NBC/Universal and CableLabs.
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
      - Metadata allows rendering at the decoder, customized to the user’s sound system
      - The decoder places the sound in the most accurate position that the user’s sound system can support
  - Targeting 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
7.1.4 Immersive Audio
Height Audio from Upward-Firing Speakers
Key Application 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
  - Synchronized second-screen applications
  - Immersive audio — user control of tracks and mix
  - Audience measurement capabilities

- 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
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
Key Accessibility Features

- New public service capabilities
  - 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

- ATSC 3.0 feature set supports
  - Visually Impaired (VI)
    - Video Description
  - Hearing Impaired (HI)
    - Closed Captions
    - Closed Signing
    - Dialog Enhancement
  - Emergency alerts and messaging
    - Emergency crawls and audio tracks
ATSC 3.0 Security

- Security enables new business models for ATSC 3.0
  - Subscription services
  - Monthly fee for access to the service
  - “Freemium” (i.e., user registers and then content is free)

- Subscription options for alternate components
  - Custom views: e.g., pay for “dashboard cam” video in an auto racing event
  - Pay-per-view programs
Advanced Emergency Alerting

- Next step in robust delivery of emergency information to the public
- Provides a more robust and reliable public warning and safety information communications system, unaffected by cellular network congestion
- Leverages broadcasters’ major role as public-information provider with disaster-resistant facilities
- Offloads data and video traffic during times of emergency to preserve LTE for what it does best: point-to-point voice communications
Opportunity for Broadcasters

- Enhance the station’s brand for weather, essential information and public service in times of emergency
- Provide a pipeline for extensive information beyond simple text, for disaster preparation and recovery in addition to acute warnings
- Create public policy support for transitioning to ATSC 3.0 and unlocking mobile devices for broadcast TV reception
AEA Features

- ATSC 3.0 and AEA designed to reach many types of receivers
  - Fixed, portable, mobile, handheld
- ATSC 3.0 specifies an optional robust-level AEA wake-up signal for all types of receivers in “sleep” mode
- The emission standard enables receivers to display the following:
  - Primary text alert message displayed as banner or crawl overlay
  - Audio announcement of primary alert message
Alert messages are capable of targeting receivers in specific geographic locations
  ◦ Works with receivers that “know where they are”

AEA supports **optional** delivery of multiple types of rich media content in support of enhanced alerting
  ◦ File- and stream-based rich media including:
    • Weather radar, evacuation routes, live news and weather reporting, instructions for what to do
  ◦ Content from stations’ news and weather services, or from official agencies
Rich Media Content Guide Displayed on Small Screen
BREAKING NEWS
Hurricane Irene has made landfall and is tracking up the NC coast.

WEATHER SATELLITE CENTER

THE BASICS
- 3 DAYS OF FOOD, WATER
- PERSONAL HYGIENE ITEMS
- RADIO, BATTERIES
- PRESCRIPTIONS

Weather Map  Current Utility Information  Hurricane Irene has made landfall
Interactive Services Possible with ATSC 3.0
Components can be delivered via broadcast or broadband

Components can be dynamically selected and combined at the receiver

ATSC 3.0 Service Models

Interactive App
Closed Captions 2
Closed Captions
Audio
Video
App
App
CC
CC
Audio 2
Video 2
Video
Video
Audio
Audio
Audio

Program (time)
Interactivity

- Synchronized multi-screen applications
- Data sharing between devices
- Discover and exercise services such as DLNA
- Turn any touch-enabled device into a track-pad for Television
- And more...
Trivia (Quiz)

USE CASE

Users can answer a quiz related to concurrent news story or advertisement.

EXAMPLES

Ads: Could be used to engage viewers in brand awareness. (Ex: what year did Coca-Cola first use cans?)

Live Content: Apply any number of trivia related opportunities for a particular vertical. (news, weather, sports, etc.)

Notes

· Proven method of user engagement
· Useful metrics
Quiz

When was LeBron James born?

Correct!

1984 Press 1
1982 Press 2
1979 Press 3
1986 Press 4

Interactive Content
USE CASE

Users can answer an opinion poll related to concurrent news story. Unlike quizzes, polls aggregate the response and can display the results instantly or delayed after a pre-determined period of time.

EXAMPLES

Ads: Can be used as a Sentiment Meter to “vote” on the relevance of an ad. (Ex: did you like this ad – Y or N?)

Live Content: Select the segment functionality, making the news more interactive.

Notes

· Proven method of user engagement
· Applicable to multiple content types (sports, weather, etc)
L-Bar

ABC Action News At 6PM
March 12th, 2013
Local news, sports and weather:
Share: Email SMS

Local News
Neighborhood: 94708, Berkeley North
- 59°F
- Partly Cloudy
- Humidity: 64%
- Precipitation: 0%
- Wind: W at 9 m

San Francisco Gate
March 16th, BART to Allow Bikes on All Trains Next Week
Share: Email SMS
Sports: Replay key moments

USE CASE
Replay highlights of a game.
Especially relevant when joining late or missing key moments (and associated linear replay)
Shopping

Press to watch in Full Screen

For more products, visit us online at shop.history.com
Coupon Template

BUY 10 - GET 3 FREE!
Click To Receive Coupon

Coupon sent to mobile phone or email

Brand Logo
Dynamic Image
Linear Ad
Social Media integration

USE CASE
Like or tweet while watching a show
Multi-screen application

- Tablet/smartphone shows real-time information on actors in a scene
- Clothing and accessories worn by characters available for purchase
- Targeted advertising
- Director’s commentary on second screen
  - Amazing Spiderman mobile app had a timeline on the second screen synchronized to Blu-ray playback
- Games across multiple screens
  - Smurf-O-Vision app for the movie Smurfs
Companion Screen: Better synchronization

**USE CASE**

Play along with game show

- Frame accurate media sync
- App can discover the TV, and vice versa
Companion Screen (continued)

USE CASE
Audio description or alternative commentary streamed to an app on the phone and listen on headphones. (Avoid annoying everyone else in the room)
Companion Content

USE CASE
Get more detail on a news segment – viewed on second screen
Data sharing

- Companion apps enable consumers to be part of the movie/show experience
  - Ex: Recording your voice for a movie or TV-show
- Grab shareable clips from the playing content to the second screen
- New applications for ‘broadcast’ data
USE CASE

Users can view a Message or Fact related to concurrent news story or ad.

EXAMPLES

**Ads:** Ad engagement metrics can be derived by tracking how many users expand and/or dismiss a message event.

**Live Content:** Could be used to drive deeper engagement with specific stories via imagery, URL links, etc. (Ex: link to the agenda of a public hearing)
Local Finder (Location)

**USE CASE**

Users can view a relational map related to concurrent news story or ad. This event would leverage geoLocation with API integration to mapping service.

**EXAMPLES**

**Ads:** User can see the closest outlet in relation to their location on a map. (Ex: shows the nearest Pep Boys store to the user’s location)

**Live Content:** User can see where a specific event is in relation to their location. (Ex: traffic accident, fire or parade).

**Notes**

- Unique enhancement to static maps used today
- Demonstrates integration with external systems
**Traffic Widget (w/refine-the-area)**

**USE CASE**

Users can view regional traffic map. This event would leverage geoLocation with API integration.

**EXAMPLES**

**Ads:** While stations could think of creative uses (e.g. showing congested rush-hour traffic during a vacation getaway ad), this event is probably better suited for Broadcast Content.

**Live Content:** During morning or evening rush hour when numerous alerts are active, a user may save time on her commute by seeing traffic delays which pertain specifically to their area.
Weather Widget

USE CASE
Users can view 24 hour or 5-day regional weather forecast

EXAMPLES
Ads: This is another example where the event is probably better suited for Broadcast Content.

Live Content: Local visibility to possible strong thunderstorm activity.

Notes
· Weather information is popular – local refinement adds to the engagement
· Teaser for meteorologist detailed forecast
Player Watch

USE CASE
Follow along with detailed stats for particular players
Display Banner

Jim Bradley Ford - Port Clinton, OH
Buy a New Ford Truck for $203/Month
$0 Down!
Catch-up (or Start-over)

USE CASE
Play a previous episode, or restart from the beginning.
The Path to ATSC 3.0

1. **Planning** (2010–2011)
4. **Products** (2017→...)
Schedule

- ATSC 3.0 is a suite of standards
  - One or more standards per layer
  - Each standard moves through the process independently
- Final approval of each document is expected in the first or second quarter of 2017
- FCC considering change in rules to authorize use of ATSC 3.0
- ATSC 3.0 selected by South Korea
ATSC 3.0 Document Structure and Status, October 2016

- **ATSC 3.0 “Parent” System Standard A/300** (Points to Each Separate Standard Document)

- **RF Transmission**
  - Video Standard: A/341
  - Audio Standard: A/342
  - Captions & Subtitles: A/343
  - Service Announcement: A/332
  - Delivery, Signaling & Sync: A/331
  - Link Layer Protocol (ALP): A/330
  - Scheduler, STL & SFN: A/324
  - PHY Layer D/L Standard: A/322
  - Sys. Discovery & Signaling: A/321

- **Essence (Audio, Video, Captions)**
  - Companion Devices: A/338
  - App Runtime Environment: A/344
  - Application Signaling: A/337
  - Content Recovery in Redistribution Scenarios: A/336
  - Video Watermark Emission: A/335
  - Audio Watermark Emission: A/334

- **Emergency Alerting**
  - Security Standard: A/360
  - Personalization Standard: A/345
  - Service Usage Reporting: A/333
  - PHY Layer U/L Standard: A/323

- **Watermarks**
  - Working Draft
  - Candidate Std. Ballot Open
  - Candidate Standard
  - Proposed Std. Ballot Open
  - Proposed Standard
  - Standard

- **Interactivity**
  - Pending Reference Availability

- **Personalization**

- **Companion Devices**

- **Phy Return Channel**

- **Service Usage**

- **Security**
Deploying the ATSC 3.0 Broadcast System
What we’ve achieved

• Ultra-HD capable: HEVC, HDR, HFR, WCG
• Immersive audio
• Smart Media Transport
• Advanced PHY: OFDM, LDPC, high order NuQAM, LDM for mixed services and local content insertion.
  – From large screen & rooftop antenna to high mobility handheld/portable devices, and anything in between
• IP-centric system: convergence of broadcast and wireless broadband
• Part of the 5G eco-system: P2MP, IoT, high speed, ultra-reliable, lifeline communications...
In Summary...

- Will not be backward compatible to the legacy system
- Acknowledges changes of user environments and needs
- Understands broadcast spectrum regulation issues
- Supports viability and new business models of broadcasters
- Flexible to accommodate future improvements and developments
ATSC 3.0: What it Will Mean to Broadcasters

Questions?