PBS Engineering Technology Advisory Committee

ATSC 3.0 Position Paper

Introduction

The PBS Engineering Technical Advisory Committee (ETAC)* has created a working group focused on the pending ATSC 3.0 broadcast transmission standard and its impact on PBS member stations. The ETAC ATSC 3.0 Working Group is made up of Public Television station technology leaders with support from PBS.

The current digital broadcast technology was developed in the early 1990s by a large group of industry professionals with overall leadership from the FCC Advisory Committee on Advanced Television Service and the Advanced Television Systems Committee (ATSC).* The standard was published in 1995 and then adopted by the FCC in 1996. In July of 1996, WRAL TV in Raleigh, NC became the first North American television station to broadcast a digital service. In time, the standard we now refer to as ATSC 1.0 was introduced across the country. With the demise of analog television broadcast, it became the operating standard in 2009.

ATSC 2.0 was an enhancement of ATSC 1.0, adding new technologies such as advanced video and audio coding and new features such as second screen and Conditional Access. While ATSC 2.0 did become a standard, it was not widely adopted. Many of the capabilities 2.0 enabled, however, were used and expanded on in ATSC 3.0.

Technology changes rapidly and the need for an advanced broadcast standard not hampered by the backwards compatibility restraints of ATSC 1.0 is clear. Given consumers' rapid adoption of mobile and handheld devices for video consumption, it is clear that broadcasters need to adapt to meet current consumer demands and ensure scalability for future needs.

ATSC 3.0 – The Business Opportunities

The soon-to-be-available ATSC 3.0 standard opens the door to improving the television viewing experience by providing higher audio and video quality, more accessibility, personalization and interactivity, and it adds value to broadcasting's service platform by enabling new distribution paths and business models.

By allowing TV content to be viewed on many different fixed and portable video devices, ATSC 3.0 also enables enhanced advertising capabilities, including tailored messaging for specific audience segments in the form of ads, pop ups, or other messaging based on user preferences. These services could be a value-add for public broadcasters who want to point viewers to related content based on their viewing habits, provide "member only" viewing options, or offer other ways for viewers to access support services.

Ultimately, the advanced technologies that are a part of ATSC 3.0 will create a significant and powerful array of new opportunities for public service partnerships and other revenue generation efforts.

ATSC 3.0 – The Public Service Opportunities

Many Public TV stations embraced and continue to deploy datacasting using the ATSC 1.0 broadcast standard. Those stations work with local school boards, city and local law enforcement entities, using available bandwidth to support their mission, vision and value by delivering multimedia content for education, homeland security, and other services. Leveraging the powerful capabilities of ATSC 3.0, public broadcasters will be able to serve their communities with significantly enhanced data services.

Opportunities might include:

1. Public Safety
    - Deliver media-rich public alerts and mission-critical video and images to local and regional first-responders during emergencies
    - Deliver localized AMBER Alerts with accurate, detailed information about victims and/or suspects leveraging real time images and video
2. Education
    - Deliver customized and targeted distance learning programs to rural and remote areas without access to the internet
    - Deliver localized training and workforce development programs without requiring specialized hardware or software
3. Member Services
    - By combining Video on Demand with Conditional Access, viewers can be given specialized access similar to Membership Video on Demand (MVOD) from within the TV receiver.
    - Using the ATSC 3.0 platform with native HTML 5, kids can enjoy interactive games and adventures along with their favorite show, with or without the use of broadband. Applications can be delivered directly through the broadcast channel. Enhancements such as team play or high score can be implemented through broadband.

ATSC 3.0 – The Technology

Broadcast industry leaders, including many from the Public Broadcast community, have been working within the ATSC over the past few years to develop a new broadcast television standard that will offer a large palette of potential new services based on common internet protocol (IP).

Highlights include:

- Significantly higher data capacity
    - More data capacity >25-30 Mb/s live and Non-Real Time (NRT)
    - More Streams (e.g. multiple HD)
    - Higher quality content
- Flexible spectrum use
    - OFDM* Modulation and coding choices
    - Multiple simultaneous operating points, physical layer pipes
    - Potential for developing a Single Frequency Network (SFN)*
- Physical layer robustness, allowing stations the flexibility to target hard-to-reach areas or moving vehicles

- Mobile / handheld support
    - Utilizing “gateway”* devices or tuners to extend their broadcast viewing from the traditional TV to mobile devices (mobile phones, tablets, etc.)
    - Utilizing second screen devices and synchronized content to allow individuals to access related content and services without disruption or display on the large communal display
- Hybrid broadcast and broadband delivery
    - Internet Protocol (IP)* transport puts broadcasting on the same fast track as the Internet
    - Simultaneous broadcast and broadband delivery
    - New types of hybrid services such as alternate languages, camera angles, etc. are now possible
    - Non-real time (NRT)* content or localized inserts
- Advanced A/V compression
    - An advanced compression scheme, HEVC Main 10* profile specified as core
    - Enormous performance gains over the current system
- Immersive audio, Ultra High Definition (UHD)* video
    - Expanded audio including immersive and personalized audio
    - Supports alternate languages and other personalized audio choices
    - Use of channels and objects or “elements” rendered up to 22.2 channels of audio
    - UHD/4 K Video
    - High Dynamic Range (HDR)* and Wide Color Gamut (WCG)* video
- Interactivity and personalization
    - Use of familiar tools to create interactive experiences (HTML5)*
    - Synchronized second-screen applications
- Advanced emergency alerting (AWARN)*
    - ATSC 3.0 has enhanced alerting capabilities for first responders and consumers
    - Receiver wake up on alert
    - With the new modulation scheme, emergency alerts will be available to a far larger audience in times of crisis
    - Due to its “one to many” delivery mechanism, and the addition of rich media such as evacuation routes, radar images, etc., emergency communications will not be compromised when the cellular phone systems are overloaded
- A scalable path to the future of broadcasting
    - World standard
    - Extensible through bootstrap* signaling to allow new services without obsolescence, making possible a future version ATSC 3.1 or higher that provides new services or transmission schemes without interfering with 3.0 users.

ATSC 3.0 – Station Cost

There are four major cost areas that need to be considered before a station makes the decision to deploy this technology. They are:

1. Transmission cost – Primary Transmitter

Many stations will not need to replace their existing transmitters provided they have the ability to handle the higher power needs of ATSC 3.0. However, stations will need to make sure that the components downstream of the transmitter can handle the extra power. Additional components may need to be replaced as well. Stations will also need to invest in an ATSC 3.0 transmitter exciter. Exciters take the incoming video and data feeds and prepare them for broadcast. Vendors are also developing new exciters that will be capable of both ATSC 1.0 and ATSC 3.0 transmission, thereby making the transition easier (see Deployment). Stations employing translators will also have to replace that infrastructure at considerable cost.

2. Transmission cost – Additional Transmitters (SFN)*

A Single Frequency Network (SFN) is a broadcast network planning strategy that allows efficient utilization of spectrum by expanding coverage/service without additional frequency allotment. SFNs provide path diversity for reception and increased field strength throughout a coverage area. Though SFN deployment can be costly, the savings to co-located stations could make the concept viable.

3. Distribution cost Studio to Transmitter Link (STL)

For stations whose transmitters are located very close to their studio locations, link costs will vary. For statewide translator networks and other multi-transmitter sites, the cost could be significant as it is likely that current microwave or fiber optic distribution systems would have to be significantly upgraded or replaced completely.

4. Studio needs

ATSC 3.0 will be best delivered via new High Efficiency Video Encoder (HVEC)* technology. The encoders to provide this will initially be expensive but will likely see price reductions as the market matures. Ancillary items such as DASH*/MMT* packagers and schedulers would also be required for transport of the video content replacing today's transport stream.

Some ATSC 3.0 transmission equipment will be only incrementally more expensive than the original cost of existing ATSC 1.0 hardware. However, if a station wishes to develop a 4K and HDR* infrastructure, they will have to make a substantial investment in cameras and internal production equipment. Production in ATSC 3.0 (whether HD or 4K/HDR) could lead to enhanced content creation, including content beyond linear video, such as interactive games, educational and customized or personalized content that could be made available to "members" only. (See figure 1)

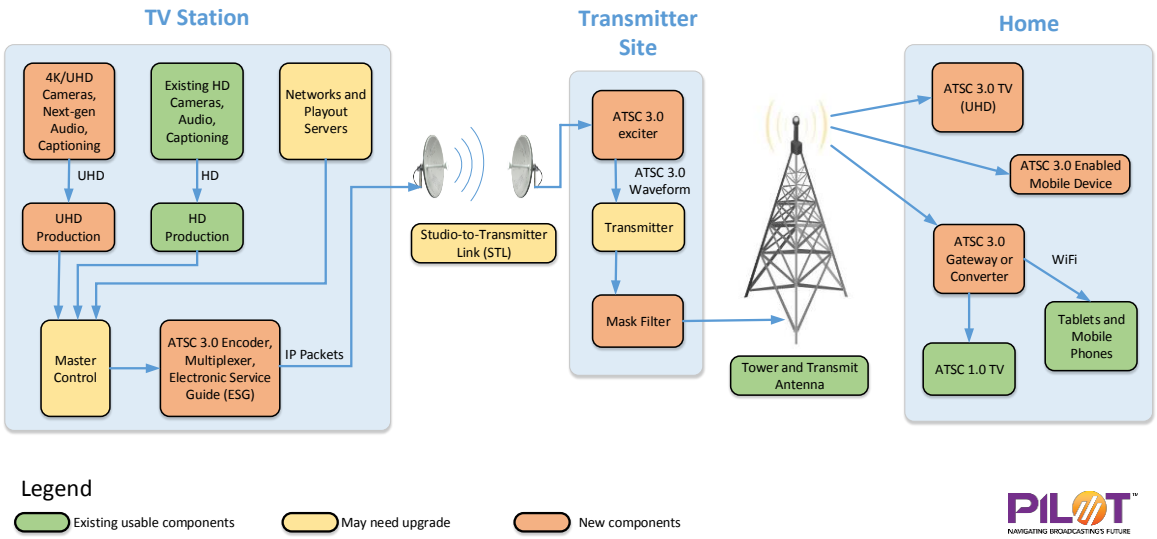


Figure 1 ATSC 3.0 Flow Diagram for Typical Station

ATSC 3.0 – The Challenges

1. Non-Backwards Compatibility

ATSC 3.0 is not backwards compatible. It is a totally new system requiring new receiving equipment for viewers. Many new televisions will be compatible with the standard, but for legacy displays or displays without tuners, proposed products include ATSC 3.0 receiver "sticks" that would plug in to a TV's HDMI port or mobile phone cases with built-in ATSC 3.0 receiver technology that would plug into a phone and provide a mobile viewing experience. There are also future, yet-to-be-realized opportunities for technological innovation using this standard.

It is anticipated that most but not all consumer electronics manufacturers will be quick to begin installing ATSC 3.0 receivers in TVs and it is hoped that cellular phone providers would do the same.

2. ATSC 3.0 is voluntary

The request to the FCC is to allow for a market-driven deployment and moving to ATSC 3.0 would be voluntary by the station.

3. Pay TV

Another challenge is that cable and satellite services are not likely to use ATSC 3.0 at the outset. ATSC is working closely with cable and satellite providers to ensure a smooth transition.

4. Deployment

There is discussion within the broadcast industry on deployment scenarios to provide continuous service for existing ATSC 1.0 viewers while providing a path for ATSC 3.0. The "lighthouse"* idea is to use channel sharing within a market to help with the transition. The "lighthouse" concept would allow one station to provide all the 3.0 services for a group of stations within a market while the other stations take on the 1.0 service(s) for the 3.0 "lighthouse" host.

As more stations migrate to 3.0, a single 1.0 host may be required until a full transition takes place. Then the reverse would occur, as there would be one ATSC 1.0 "lighthouse" acting for the group within the market. Because of their non-commercial status, public media stations could serve as either the 3.0 or 1.0 "lighthouse." (See Figure 2)

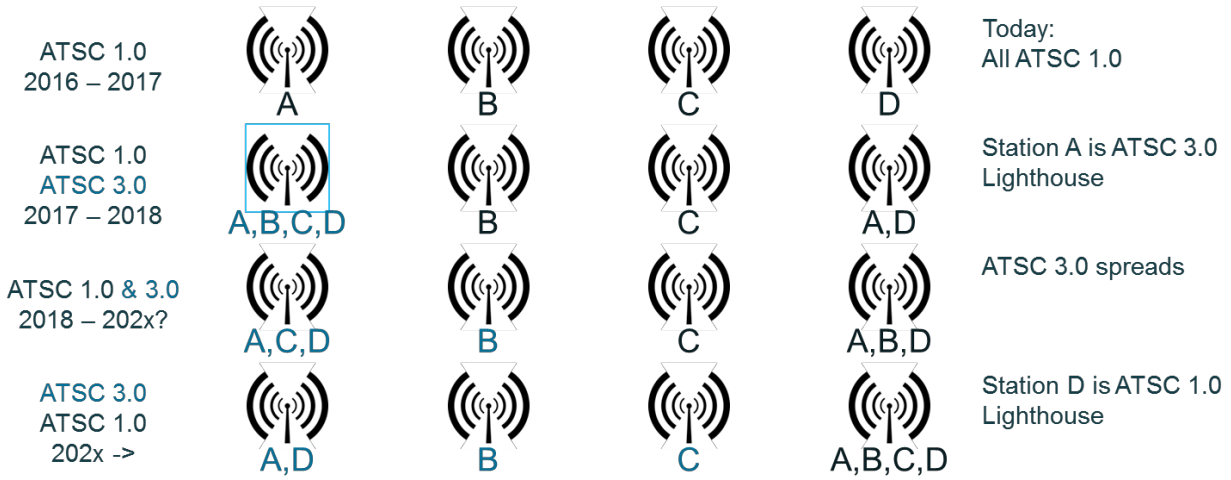
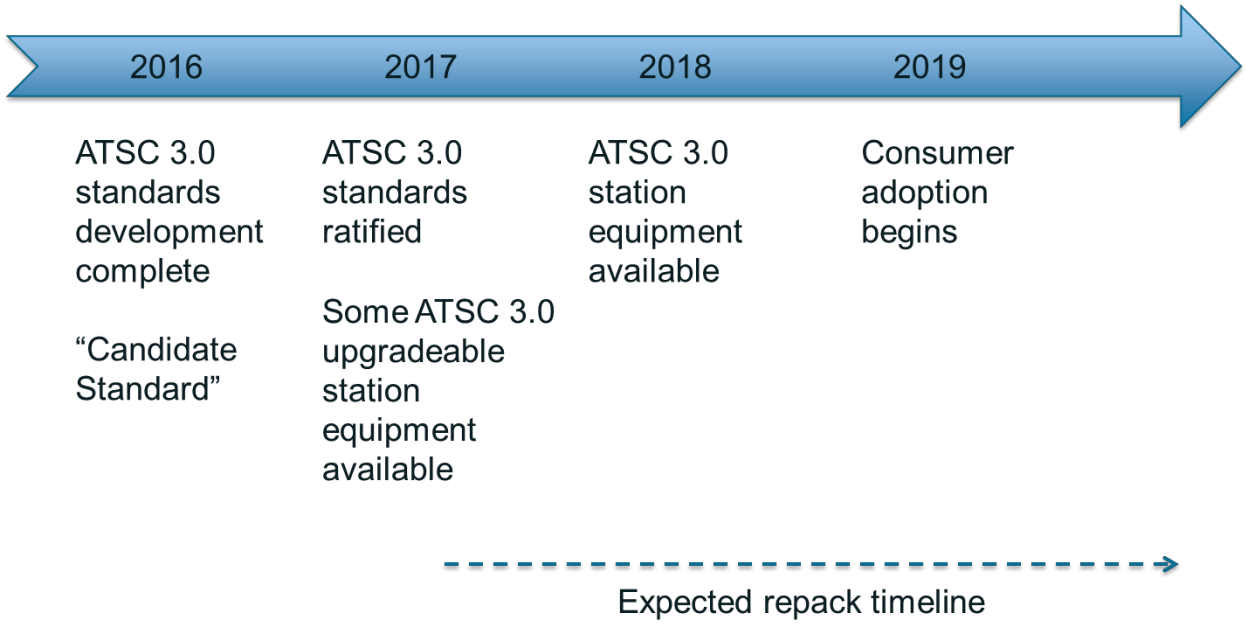


Figure 2 ATSC 3.0 Deployment

ATSC 3.0 Schedule

ATSC 3.0 is moving rapidly and as you can see by the diagram below, it may well fit within the expected repack timetable.



PBS ETAC Positioning on ATSC 3.0

The implementation of ATSC 3.0 comes with challenges and costs, but it also paves the way toward enormous future benefits, flexibility and scalability. ETAC strongly believes that this is a technology every PBS station should be prepared to adopt when possible. The benefits of the aforementioned service enhancements make this a very desirable upgrade path, given that the current ATSC standard has hit its maximum capabilities. Adopting ATSC 3.0 opens the door for a wide range of opportunities for all broadcasters and particularly for many public television stations.

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Appendix A: Glossary

This is a glossary of terms and acronyms used in this document.

ATSC The Advanced Television Systems Committee, Inc., is an international, non-profit organization developing voluntary standards for digital television. The ATSC member organizations represent the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries.

AWARN Utilization of ATSC 3.0 Advanced emergency alerting represents a major upgrade to America's emergency communication system. AWARN uses next-generation terrestrial broadcasting to deliver rich-media, geo-targeted public alerts. AWARN wakes up devices, delivering alerts even when the cellular network is jammed or the power grid is down.

Bootstrap is a mechanism that provides the universal entry point for signal discovery. The Bootstrap precedes the Preamble, at the top of the signaling hierarchy, and allows each frame to be entirely different in modulation and structure; moreover, even non-ATSC related waveforms are allowed. The frames are signaled individually in the bootstrap so that an existing ATSC 3.0 service can continue without interruption when new types of frames are added to the channel.

DASH Dynamic Adaptive Streaming over HTTP (DASH), also known as MPEG-DASH, is an adaptive bitrate streaming technique that enables high quality streaming of media content over the Internet delivered from conventional HTTP web servers. Similar to Apple's HTTP Live Streaming (HLS) solution, MPEG-DASH works by breaking the content into a sequence of small HTTP-based file segments, each segment containing a short interval of playback time of content that is potentially many hours in duration, such as a movie or the live broadcast of a sports event.

ETAC The PBS Engineering Technical Advisory Committee (ETAC) was formed to represent the diverse interests of all PBS Member Stations in the development and implementation of information management and technical operations strategies, including hardware, software, connectivity and business process innovations. ETAC will work as a partner with PBS staff to identify and maximize the opportunities for technical standardization across the system while simultaneously attempting to mitigate any impact due to station-specific operational requirements.

Gateway Devices are used to integrate over the air ATSC 3.0 broadcasts with traditional broadband capability of the internet. This could allow viewers to extend their broadcast viewing from the traditional TV to mobile devices (mobile phones, tablets, etc.), PC's and other devices, as "anywhere/anytime" viewing of broadcast content over an IP transport is the future.

HDMI (High-Definition Multimedia Interface) is a proprietary audio/video interface for transferring uncompressed video data and compressed or uncompressed digital audio data from an HDMI-compliant source device, such as a display controller, to a compatible computer monitor, video projector, digital television, or other device.

HDR is the ability to display a wider and richer range of colors, much brighter whites, and much deeper, darker blacks. This gives the TV picture a more 'dynamic' look, which is where the name comes from.

HEVC High Efficiency Video Coding also known as H.265 and MPEG-H Part 2, is a video compression standard, one of several potential successors to the widely used AVC (H.264 or MPEG-4 Part 10). In comparison to AVC, HEVC offers about double the data compression ratio at the same level of video quality, or substantially improved video quality at the same bit rate. It supports resolutions up to 8192×4320, including 8K UHD.

HTML is the latest evolution of the standard that defines HTML. The term represents two different concepts: It is a new version of the language HTML, with new elements, attributes, and behaviors, and a larger set of technologies that allows more diverse and powerful Web sites and applications.

IP Internet Protocol is the principal communications protocol in the Internet protocol suite for relaying datagrams across network boundaries. Its routing function enables internetworking, and essentially establishes the Internet.

Lighthouse is a concept where multiple stations in a market allow one station to carry the main program stream for all stations for either ATSC 1.0 or ATSC 3.0 to allow for a smooth transition.

MMT MPEG media transport specified as ISO/IEC 23008-1 (MPEG-H Part 1), is a digital container standard developed by Moving Picture Experts Group (MPEG) that supports High Efficiency Video Coding (HEVC) video. MMT was designed to transfer data using the all-Internet Protocol (All-IP) network.

OFDM Orthogonal frequency-division multiplexing (OFDM) is a method of encoding digital data on multiple carrier frequencies. OFDM has developed into a popular scheme for wideband digital communication, used in applications such as digital television and audio broadcasting, DSL Internet access, wireless networks, powerline networks, and 4G mobile communications.

SFN A single-frequency network is a broadcast network where several transmitters simultaneously send the same signal over the same frequency channel. A simplified form of SFN can be achieved by a low power co-channel repeater, booster or broadcast translator, which is utilized as gap filler transmitter. The aim of SFNs is efficient utilization of the radio spectrum, allowing a higher number of radio and TV programs in comparison to traditional multi-frequency network (MFN) transmission. An SFN may also increase the coverage area and decrease the outage probability in comparison to an MFN, since the total received signal strength may increase to positions midway between the transmitters.

UHD Ultra-high-definition television (also known as Ultra HD television, Ultra HD, UHDTV, UHD, UHD-1, Super Hi-Vision, and 2160p) today includes 4K UHD (2160p) and 8K UHD (4320p), which are two digital video formats that were first proposed by NHK Science & Technology Research Laboratories and later defined and approved by the International Telecommunication Union (ITU).

WCG Wide Color Gamut is the term used to describe video with more color saturation than traditional video. Not “different” colors, but richer, more saturated colors. These new image standards are described in a SMPTE spec called “Rec. 2020.” This is similar in concept, but not in values, to the Rec. 709 spec we use for HD or Rec. 601 we used for SD.