ATSC 3.0: A Look at the Infrastructure and Possible Impact that Next-Gen TV Will Have on Cable Operations

A Technical Paper prepared for SCTE•ISBE by

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Introduction

ATSC 3.0 is near completion in the broadcast television industry, and is on its way to full-scale deployment in 2020 and beyond. What are the implications for cable operators?

This paper will provide a general overview of the next-generation broadcast television standard, including new features and service enhancements made possible with the technology. It will cover what is involved with receiving ATSC 1.0/ATSC 3.0 within cable headends. While in the beginning since broadcasters will simulcast ATSC 1.0 and 3.0, there may be no needed change to cable headends, over time increasingly broadcasters and multichannel video programming distributors (MVPDs) can collaboratively provide enhanced services for cable customers.

Several different setups for receiving ATSC 3.0 programming from broadcasters will be examined for cable headends, including near- and long-term. In particular, the paper will discuss headend requirements for HEVC IP transport stream delivery, and system architectures for combination of off-air ATSC 3.0 service reception with enhancements delivered from the broadcaster over alternative connections.

Overview of the ATSC 3.0 Standard

ATSC 3.0 promises to help broadcasters deliver advanced over-the-air (OTA) and over-the-top (OTT) services, including ad replacement, service guides, emergency communication support, addressable content delivery, interactive program enhancements, and data broadcast applications. While ATSC 3.0 was specifically developed for broadcast transmissions, cable operators can benefit from its video and audio improvements.

Currently, with ATSC 1.0, broadcasters deliver an MPEG-2 transport stream (TS) containing MPEG-2 Video and AC-3 Audio. MPEG-2 Video encoding is not as efficient as HEVC, the compression technology used to transmit ATSC 3.0 services. HEVC offers a significant improvement in bandwidth efficiency compared with the MPEG-2 Video Codec, which will allow broadcasters to meet the growing consumer demand for superior video quality, including 1080p, high frame rate (HFR e.g. 60 f/s), high dynamic range (HDR) and Ultra HD (UHD), at lower bitrates.

If cable operators have an HEVC infrastructure in place, they can receive HEVC encoded content from broadcasters and subsequently deliver better video quality to subscribers while minimizing bandwidth consumption on their network.

On the audio side, ATSC 1.0 supports 5.1 channel surround sound using Dolby Digital's AC-3 format. ATSC 3.0 will provide a much more immersive audio experience leveraging AC-4, the next-generation format from Dolby. This is another exciting capability that cable operators can take advantage of.

There is also potential for cable operators to leverage applications delivered as part of the ATSC 3.0 OTA broadcast to provide interactive enhancements to programs. These applications are implemented using standard W3C technologies including HTML5, JavaScript and CSS which could execute directly on the cable STB. This would require extensions to the operating environments on the STBs but environments such as the Comcast RDK already support similar applications. In any event, ATSC 3.0 broadcasts will be constructed such that they will still be viewable without the interactivity since not all ATSC 3.0-compatible TVs will necessarily support the interactive environment.

Basic Architecture of ATSC 3.0 and Headend Scenarios

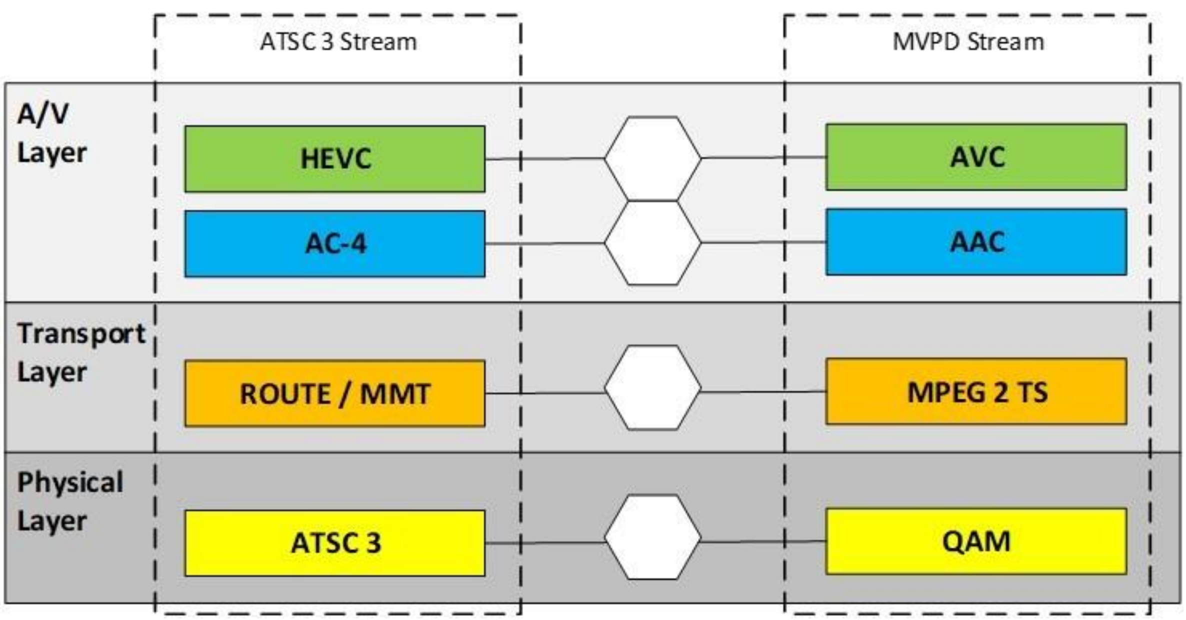
The basic architecture of ATSC 3.0 is different and more complex than ATSC 1.0. Rather than receiving an MPEG-2 TS, cable operators will begin receiving IP signals carrying HEVC and AC-4.

The FCC mandates that high-power and Class-A broadcasters simulcast ATSC 1.0 and 3.0 for at least five years; therefore, the immediate impact on cable headends will be minimal. If cable operators want to continue receiving MPEG-2 TS as usual, they can do so without making any infrastructure changes. However, this mandate does not apply to low-power broadcasters.

But, at some point, operators will need to make infrastructure changes, especially if they want to benefit from the improvements in video and audio quality provided by ATSC 3.0. Moreover, in the long term, the transition to ATSC 3.0 may impact how cable operators acquire signals from broadcasters. The ability to receive an ATSC 3.0 system will improve generally of the DMA because of the new capabilities of the ATSC 3.0 physical layer. However, since new transmission systems may be deployed in different locations, there may be the need to tune antennas to see the new ATSC 3.0 transmission.

There are two ways cable operators can receive ATSC 3.0 signals: Over the air or via direct connection over broadband. The direct connection can be either a legacy MPEG2 Transport Stream carrying MPEG2 Video and AC-3 Audio, an MPEG2 transport stream carrying HEVC Video and AC-4 audio, or a set of one or more ATSC 3.0 IP streams containing HEVC and AC-4. What is sent by the broadcaster will be dependent on the agreements in place.

The ATSC 3.0 suite of standards includes an A/V layer with codec support, a transport layer, and physical layer. Within each layer, shown in the figure below, it's likely that one or more of the content of these layers needs to change. However, making changes to one layer does not necessarily impact another. The figure below shows the various layers and the aspects of each layer that need to be transformed.



Operators with legacy MPEG-2 over QAM systems will need to convert the broadcast signal from ATSC 3.0 to MPEG-2 TS. This can be done at the cable headend receive site with a transcoder that converts ATSC 3.0 to MPEG-2 TS. An operator that receives multiple feeds from broadcasters will need to ensure the signals are muxed together correctly. Alternatively, headends with a fiber connection to the station master control can receive the legacy MPEG-2 TS directly on the fiber link, similar to how they do in the ATSC 1.0 environment. Finally, CATV systems with advanced IPTV systems can use the higher order signals on their cable system without downconverting to MPEG-2 TS (case by case basis).

For IPTV, the system is typically not going to be based on ROUTE or MMT; therefore, a transformation needs to be done. If the IPTV content is delivered in HLS or another adaptive bitrate transport mechanism, buffering will need to occur to convert from the push broadcast transport scheme into the pull IPTV transport scheme.

Figure 1 shows a headend scenario where an operator is outside of the ATSC 3.0 reception area and is only able to receive the local broadcast via ATSC 3.0. Here the operator can transcode the ATSC 3.0 signal into MPEG-2 TS using a receiver-converter. This does not require any significant infrastructure changes on behalf of the cable operator.

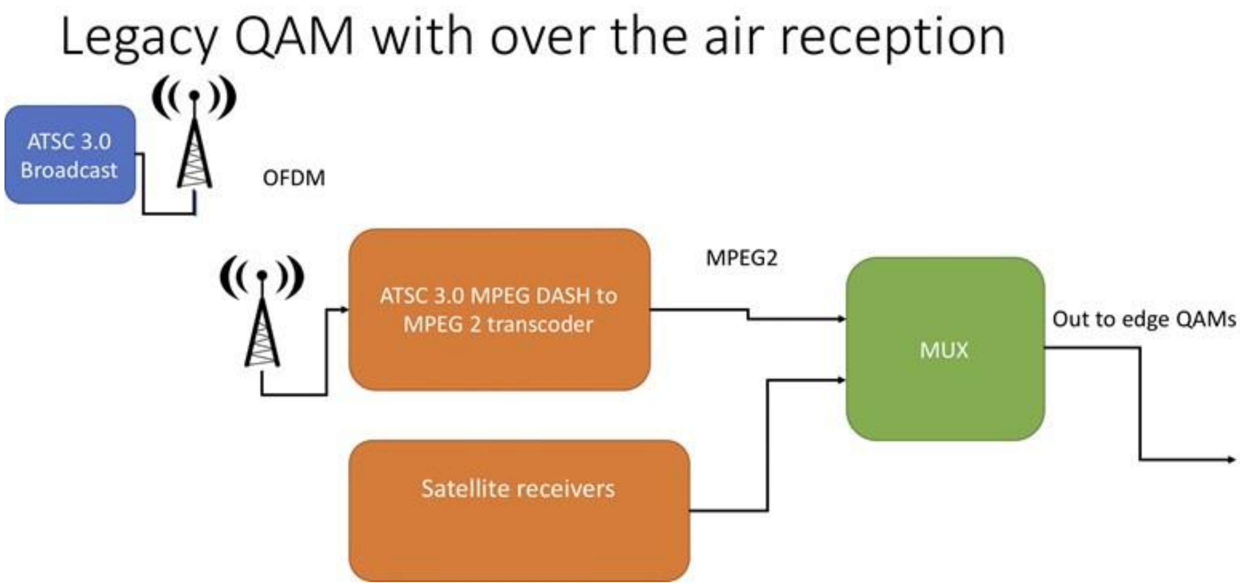


Figure 1 – Headend scenario showing legacy QAM system with OTA reception

Figure 2 demonstrates an MVPD that is operating a fiber link between the legacy MPEG-2 TS connection and the network switch. Cable operators with a fiber link will need to ensure there is an ATSC 3.0 compliant modulator at the broadcast television station or in the headend. Fiber signals are received in the cable headend by a demodulator. After the link is demodulated at the headend, it will go into the same ATSC 3.0 to MPEG-2 TS receiver and be muxed in with the other MPEG-2 services as HEVC and AAC streams.

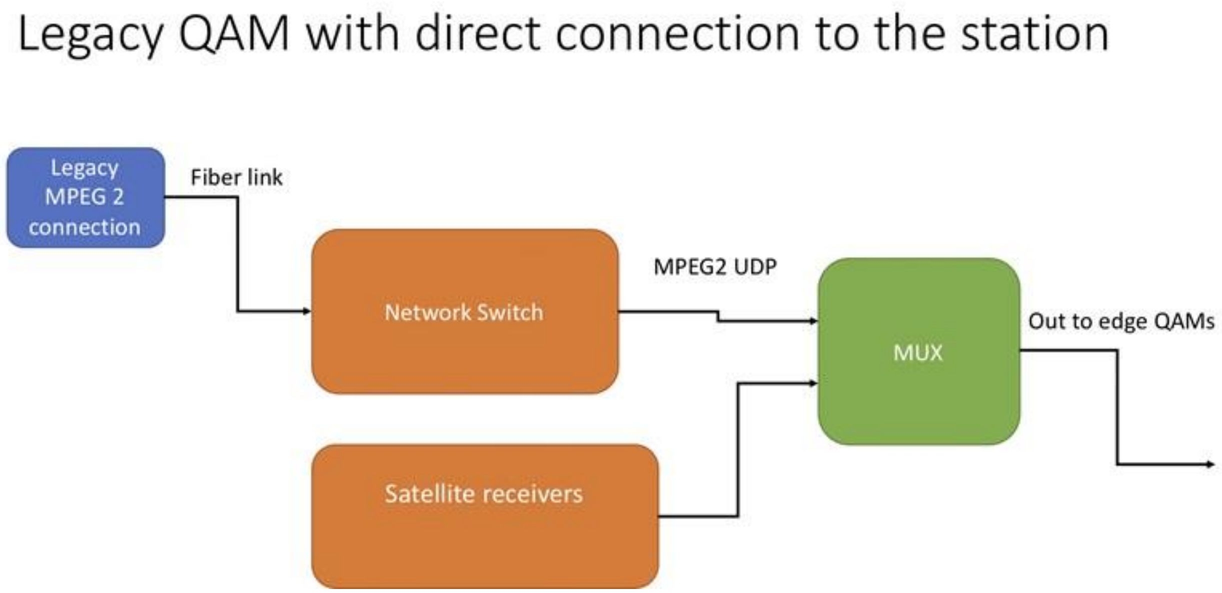


Figure 2 – Headend scenario showing legacy QAM with direct connection to station via fiber link

The headend scenario presented in Figure 3 show the infrastructure changes that cable operators need to make in order to take advantage of the advanced audio and video capabilities of ATSC 3.0. Instead of transcoding from ATSC 3.0 to ATSC 1.0, or DASH to MPEG-2, the operator fully receives the ATSC 3.0 broadcast signal. In this case, the operator must upgrade its infrastructure to support HEVC and AC-4.

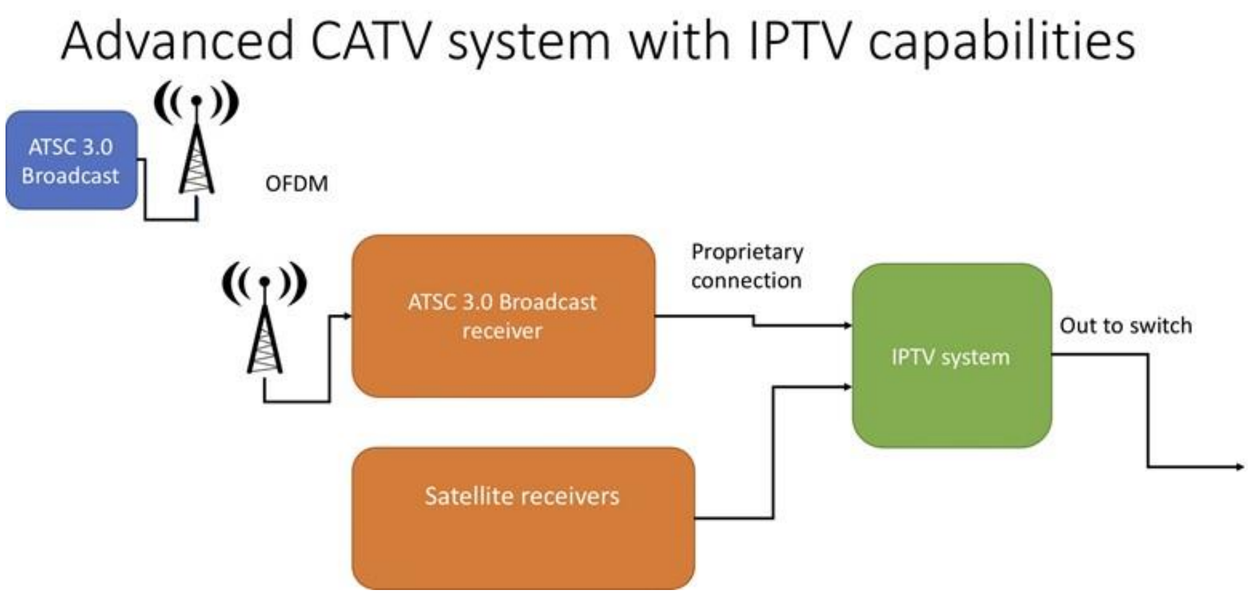


Figure 3 – Headend scenario showing advanced CATV system with IPTV capabilities

Conclusion

In the short term, cable operators will not need to make any changes to their infrastructure, as broadcasters will simulcast both ATSC 1.0 and ATSC 3.0 signals. Yet, at some point in the foreseeable future, changes will be required. Communicating directly with broadcasters about what changes they'll be making to their own infrastructure is essential. Operators will also want to learn how long broadcasters plan to simulcast and when they plan to fully transition to ATSC 3.0.

Down the line, operators may need a transcoder or CATV system with IPTV capabilities. Once operators are able to support the ATSC 3.0 suite of standards, they can start delivering some of the exciting improvements it offers, including better picture quality and more immersive audio.

Abbreviations

HDR	high dynamic range
MVPD	multichannel video programming distributor
OTA	over the air
OTT	over the top
TS	transport stream
UHD	Ultra HD

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