ATSC 3.0 Next Gen TV in Florida

Agenda

- Opening Remarks by Frank Torbert, SMPTE Section Chair
- Planning and Coordination – Brian Darragh, WMOR-TV
- Intra-market Connectivity – Alan Young, LTN Global Comm.
- Encoding and VQ – Joel Wilhite, Harmonic
- High Dynamic Range – Ian Macaulay Dolby
- New Audio Features – Larry Schindel, Linear Acoustic
- Signaling and DASH – Dave Catapano, Triveni
- Using the Internet for a STL – Phil Whitebloom, VideoFlow
- A3SA and A3FA, What are they? – Pete Van Peenen, Pearl TV

Overview

Joe Addalia – Hearst Television
ATSC 3.0 Next Gen TV in Florida

Overview

- Features
  - Great Pictures: HDR, WCG and 4K
  - Superior Audio: Immersive Surround, Enhanced Dialog
  - Secure Broadcasting
  - Non-Real-Time: Merges Internal and OTA Delivery

- How Do We Get There
  - No Second Channel
  - “Lighthouse” Concept
    - One Channel to Carry the Load
    - Expand to Group of Channels
    - Ultimately Leading to a 1.0 Lighthouse

- https://www.watchnextgentv.com

Tampa DMA Lighthouse

Brian Darragh, WMOR-TV – Hearst Television
WMOR-TV Tampa, Florida

Tampa DMA Lighthouse

• WMOR was set up in a good position to support the ATSC 3.0 conversion, repack enhancements include new Gates Air ULXTE 100, pair of Maxciva Exciters, New Main Antenna, and Aux Antenna system.

• As an Independent TV Station (ATSC 1.0) WMOR has a very strong UHF OTA Signal that supports many cost-conscious OTA Viewers, a vocal MeTV Audience and Estrella TV.

• Special Thanks to Tom Mikkelsen of Bitpath for scheduling all the planning meetings, documenting the changing status, and making this a Tampa Market project not a WMOR project.

WMOR-TV Tampa, Florida

December 1, 2020 ATSC 1.0 OTA Signal

• Task: Send all our streams to 3 different television stations and they will mux them into their current pools and transmit them Over The Air in ATSC 1.0.

  • The Three ATSC 1.0 services delivered to the 3 partner stations.
    • Bit rates, Closed Captions, SAP channel, CALM Compliance
    • “Do No Harm” to the current broadcasts

  • New source monitoring infrastructure designed and installed.

  • Intercompany communication trees needed to be documented.
WMOR-TV Tampa, Florida

ATSC 3.0 Lighthouse, Trust but Verify

- Establish methods to monitor Signals
  - Incoming LTN IP Stream
  - GuideBuilder output
  - Gateway output
- Test and Convert the “New Rig” into a “New Signal”
  - Very few tuners can decode
  - All test gear is new and cutting edge (may not work)
  - Current only method to view decoded captions is on a television.
- Role is sort of a referee!
- All the outbound ATSC 3.0 services must have the same “Standards and Practices” as ATSC 1.0 + New Features

WMOR-TV Tampa, Florida

Post Deployment Items to Note

- First issue viewer education phone calls and emails (mostly from MeTV Audience) about rescan and antenna selection. Broadcast is now dependent on the partner signal gain and coverage.

- The gift that keeps giving, like herding cats, seems every change made to the systems can trigger an increase in errors, basically having to start over the trouble shooting process.

- Cannot rest on a version of software, constantly changing and trying to implement new features.
Intra-Market Connectivity

Alan Young
LTN Global Communications
Robust intra-market connectivity is a must

- ATSC 1.0 feeds from the ATSC 3.0 host need to be distributed to the other stations in the market; all stations in the market need to distribute their feeds to the ATSC 3.0 host for broadcast

- This all needs to be done with very high reliability and low latency in a cost-efficient manner, so LTN provides a fully managed, end-to-end intra-market connectivity service over our all-IP network — 11 markets have been completed and seven more are in the pipeline
  - Baseband video is encoded into IP and vice versa as required
  - All equipment is provided and managed by LTN

- LTN’s intra-market connectivity service uses the internet but does not rely on the internet
  - FEC/ARQ on every hop results in low latency
  - Dynamic Multicarrier Routing results in very high reliability
  - ‘Plain old internet’ (ISP) last-mile connectivity results in cost efficiency
Tampa market
Deployment date Dec 1, 2020

- Approximately two weeks prior to launch, all parameters for LTN Transport services were finalized
- Late-stage onboarding process focused on testing bandwidth and end-to-end connectivity
- LTN provided a launch day multi-viewer that included video, audio bars, and closed captioning for all channels
- LTN architecture, project management and onboarding teams were all actively engaged in launch-day activities
- LTN engineers actively participate in weekly post-launch calls as required

The Road Trip
ATSC 3.0 + 1.0
THE PATH LEAST / LAST TRAVLED

Joel Wilhite, Harmonic
Repack set the stage for spectrum consolidation leading up to the installation of ATSC 3.0 and will include technology to support new and innovative use cases. The reason for this is ATSC 3.0 leverages 3 main elements:

**Transmission Technology** – 3.0 specification A/321 and A/322 make a very compelling case making VHF making it useful again, includes station bonding and supports SFN and MIMO so the doors are open to ultra portability, and could run on a smart phone equipped with 5G. The horsepower of the specification follows the Shannon curve.

**Information Technology** – 3.0 is based on DASH and or MMT but in either case, the DASH specification is used for Internet streaming and now for broadcast delivery too. CMAF and CPIX are in the pipeline

**Technology Advantages** – HEVC, HDR, DRM, DAI, HFR, UHD 4k, Hybrid Delivery, Watermark, 5.1.4 audio, and of course EAS, AEAS, ABR multiplexes, Datacasting...
This is your new portable television... in HDR too!

Please note – we know consumers who still run “coupon receivers” to this day.
For 55 years, the growth of the television market was predictable. But then in 2009 the trend stopped cold with the completion of the reverse auction and repack.

Channel sharing makes 3.0 fit in Tampa...

Now think about the New York, Los Angeles and Chicago?
Channel Share

References


https://dashif.org/software/


HDR in ATSC 3.0

Ian Macaulay, Dolby

What is HDR?

- **Higher Resolution** (e.g. 4K and above)
- **Higher Frame Rate** (HFR)
- **High Dynamic Range** (Brighter and Darker Pixels)
- **Wide Color Gamut** (More Colorful Pixels)

Enabled by HDR
**HDR Options in 3.0**

SMPTE 2084 + 2086  ( also known as HDR10 )

SMPTE 2094-10* = HDR10 with Dynamic Metadata  ( also known as Dolby Vision )

*2094-10 is also known as DM App#1 (Dynamic Metadata Application #1)

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**The Metadata is there to preserve creative intent**

Creative Intent

With Metadata

HDR with no Metadata
Presently not much source content in HDR for ATSC

How to bridge to future of plentiful source content?

The metadata preserves creative intent for SDR as well as it does for HDR

Use the HDR tools to deliver better SDR as a bridge to more HDR source content!

CONSISTENT SDR VIDEO PLAYBACK ACROSS DEVICES

With Metadata
HDR workflow is very simple

Source Content

1080i29.97
3G-SDI
SDR-Rec709

De-interlace
Upconvert to 2160
BT2020PQ

2094-10 metadata generation

Encode

Container Conversion

* Follow Moviels recommendation
**HDR workflow is very simple**

**Source Content**
- 1080i29.97
- 3G-SDI
- SDR-Rec709

**Video Encoder**
- De-interlace
- Upconvert to 2160
- BT2020PQ
- 2094-10 metadata generation
- Encode

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**Audio in ATSC 3.0**

*Larry Schindel, Linear Acoustic*
Key New Features Supported in ATSC 3.0

- Immersive Audio (Dolby Atmos)
- Dialogue enhancement (VOICE+)
- Personalized audio
- Loudness control
- Personalization

The home of media professionals, technologists, and engineers
**AUDIO IN ATSC 3.0**

VOICE+, Loudness, Dolby AC-4

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**DATA RATE COMPARISON**

Dolby AC-4 vs Dolby Digital (AC-3)

<table>
<thead>
<tr>
<th>Channel Configuration</th>
<th>Recommended AC-4 Data Rate</th>
<th>Equivalent AC-3 Data Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereo (2.0) CM</td>
<td>64 kbps</td>
<td>192 kbps</td>
</tr>
<tr>
<td>5.1 CM</td>
<td>144 kbps</td>
<td>448 kbps</td>
</tr>
<tr>
<td>Stereo CM + Stereo CM/AD</td>
<td>128 kbps</td>
<td>384 kbps (192 + 192)</td>
</tr>
<tr>
<td>5.1 CM + Stereo CM/AD</td>
<td>208 kbps</td>
<td>640 kbps (448 + 192)</td>
</tr>
</tbody>
</table>

CM = Complete Main service  
AD = Audio Description service
Internet Experience
Personalized & Dynamic

Dave Catapano, Triveni
Applications

**ATSC 1.0**

- Pictures, Graphics and Sound are “burned in”
- Same experience for entire audience

**ATSC 3.0**

- HTML5/Internet overlay graphics
- Hybrid delivery - merge broadcast & internet
- Dynamic Ad Insertion
- Personalized Graphics
- Interactivity
- Synchronized second-screen applications

**Overview - ATSC 3.0 System Layers**

- **Software**
  - Applications
    - Screen is a web page
  - Presentation
    - UHD
    - HD & SD multicast
    - Immersive Audio
  - Protocols
    - Internet Protocols
  - Transmission (Physical Layer)
    - OFDM
  - Finding the Signal
    - Unique Sequence

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

- **Data Organized as Streams and Files**
  - Internet Protocols

- **Sending Bits over the air in 6 MHz**
  - OFDM

- **Finding the Signal**
  - Unique Sequence
ROUTE, MMTP & HTTP Transports

- **ROUTE** = Real-time Object delivery over Unidirectional Transport
  - ROUTE ← FLUTE ← LCT ← ALC
  - Allows source stream and repair (FEC) stream
  - All data streams including Essence streams
- **MMTP** = Multimedia Multiplexing Transport Protocol
  - MPUs wrap ISO BMFF files with metadata for broadcast delivery
  - Essence streams only
- **HTTP** = Hypertext Transport Protocol
  - Pull data using TCP/IP session

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ATSC 3.0 to 1.0 Signaling Comparisons

- **SLT**
  - Similar to PAT
  - Well-known Address/port
  - Bootstraps all services
- **SLS**
  - Service-specific bootstrap
  - Service-specific address/port (TSI: 0, TOI: 0)
  - References SLS is actually a ROUTE object
- **EFDT**
  - SLS Similar to PMT
  - Defines ROUTE/LCT sessions
  - Route Sessions contain LCT Sessions
  - LCT Sessions (similar to Elementary streams)
- **ROUTE objects**
  - DASH media segments
  - NRT objects (ESG/APP/Media/etc)
ATSC 3.0 Service Structure view

Example Bootstrap & Service Discovery
Public / Private Data Signaling using ATSC 3.0

• ATSC 3.0 Broadcast Applications / NRT
  • Signaling defined in A/331 (224.0.23.60:4937 -> STL, STT, AEAT, SMT, CDT, etc)
  • Signaling (LLS/SLS) is cryptographically signed (A/360)
  • PHY layer signaling of LLS flag and AEAT wakeup
  • Enables signaling / delivery of HTML5 applications delivered either via broadband and/or broadcast

• Private Data Signaling / Delivery
  • Business specific use case / implementation
  • Signaling / delivery protocol can be done in proprietary manner
  • ATSC standard recommends usage of LLS table type FF - UserDefined
    • Enables benefits of PHY layer signaling (ideal for service discovery on battery powered devices)
    • Leverages signaling security model
    • Reuse / extend as needed (ROUTE Source/Repair, FDT, etc)
    • Different classes of data have different signaling requirements (files, messaging, streaming)

Public/Private Data using common bootstrap
Ensuring that the Tampa STLTP Connection is Reliable

Phil Whitebloom, VideoFlow

VideoFlow moves your video/audio/data content over any lossy IP network reliably, securely and with the highest quality. Yes, even over POI (plain old internet).

www.video-flow.com
The VideoFlow toolset isolated multiple issues throughout the “chain”. It was able to diagnose issues that were impacting multiple components in the system.

Ensuring that the Tampa STLTP Connection is Reliable

Packet loss ratio is 86.2%
Native STLTP Transport

ATSC A324 specification has modified and repurposed RTP header fields:
- Marker
- TimeStamp
- SSRC – now called offset
- Payload type
- SMPTE2022 FEC using the above values

Added capabilities:
1. VideoFlow can run the STLTP across multiple paths in a bonded or load share configuration that provides higher delivery resilience (SRT is missing this capability).
2. VideoFlow UDPVPN authentication and encryption is using AES256 + dynamic key rotation (every minute) for extra security.
3. VideoFlow UDPVPN allows for inband command and communication with 3rd party devices that are attached to the VideoFlow instance (like exciter and monitoring equipment).
4. VideoFlow support Multicast for coming SFN deployments, with optimized VideoFlow’s patented ‘FEC on Demand’ to reduce recovery overhead.

Applications & Security

Pete Van Peenen, Pearl TV
Enabling Broadcaster Applications

**Application Framework Alliance (A3FA)**

Broadcaster Application Framework

- Common ‘plumbing’, making it easier to develop applications
  - App developer does not need deep knowledge of ATSC 3.0 standards (or even broadcast technology)
  - Broadcasters can focus on features to enrich the viewing experience
  - Enable innovation
  - Develop new kinds of value-added experiences
  - Test consumer value propositions

- Provides consistency in user navigation and overall app behavior
- Minimize CE device test burden
- Minimize development and support costs
Architecture

Common Consumer Application
- Common Home screen UI
- Common Startover TV (TBD)
- Link to VOD screen and service (TBD)
- Broadcaster applications
- Broadcaster-specific UI content, metadata
- Broadcaster specific future services (TBD)

Common Component Framework
- Security & Protection
- Content Replacement
- Application management
- Storage management
- Identity & privacy management
- Addressable & Audience Data
- Guide data
- Startover service

ATSC 3.0 Receiver
- APIs
- Storage
- Audio & Video
- Runtime & media player
- Watermark extraction
- Security & Protection

Application Cloud Services
- Program Information
- OTT, audio, iTV delivery
- Application content
- Application management
- Security & Protection
- Ad delivery

Broadcasters support a shared broadcaster application to deliver a consistent OTA consumer experience.

Broadcasters share a common software framework to consistently support any 3.0-ready receiver.

Each CE device has the runtime and supports the broadcaster framework and business models.

Broadcaster-controlled cloud services manage the application and content.

“call-to-action” prompt appears when triggered by the broadcaster

ILLUSTRATIVE CALL-TO-ACTION
Basic 2020 white label menu “out-the-box”

Menu structure and content is configurable
Protecting content and services

ATSC 3.0 Security Authority (A3SA)
What Happens Every Day on the Internet

- Web sites use encryption to secure communications between web browsers and servers
  - SSL certificates are installed on servers; certificates are digitally signed to authenticate the servers’ identity to the client
  - Client certificates are installed on laptops by corporations; certificates are digitally signed to authenticate the employee’s identity to the server.
- Session keys are used to encrypt data
- App stores secure apps and app delivery
  - Digitally signed applications
- Streaming video is secured
  - Encryption and licenses prevent unauthorized viewing/copying
    - Netflix, YouTube (live and VOD)

ATSC 3.0 Standards Support Security

- For service protection, the standards are prescriptive in the use of X.509 digital certificates
- When it comes to Content Security, standards only specify the underlying technologies:
  - EME (Encrypted Media Extensions)
  - A/344 Web Socket APIs
  - CENC (Common Encryption)
  - DASH (Dynamic Adaptive Streaming over HTTP)
NextGen TV: Content Security and Service Protection

**Encrypts** Content

**Protects against unauthorized re-distribution**
Issues and applies licenses and cryptographic keys
Optional – underlying technology specified in A/360

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**Issues & validates Digital Certificates**

**Protects against spoofing, hacking, signal intrusion**
Allows receivers to verify that the apps & signaling were broadcast by a trusted broadcaster and have not been changed.
Required - Specified in A/360 and A/331 required for signing signaling & apps

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In comes the ATSC 3.0 Security Authority …

- Coordinating body for ATSC 3.0 content security and service protection
  - Defines requirements for content security (including security against viruses and hacking)
  - Defines supplementary compliance and robustness rules
    - Building on existing rules
  - Creates, establishes and maintains agreements with ecosystem participants
  - Serves as funder of and policy authority for the Public Key Infrastructure
    - Enables all broadcasters to authenticate their ATSC 3.0 services, as required by ATSC
    - Enables receiver manufacturers to authenticate their A3SA-enabled receivers
  - Maintains criteria for device certification/validation/revocation
    - Approves test procedures and test companies (and self-test requirements)
  - Authorizes ATSC 3.0 receivers to access Group and Individual rights management licenses
Who participates in the A3SA Ecosystem?

- Independent Test House(s)
- Content Owners/Producers
- ATSC 3.0 Security Authority (A3SA)
- ATSC 3.0 Broadcast Stations
- Device Manufacturers (3.0 receivers)
- PKI Vendor (digital certificates)
- Rights Management Vendors

**ATSC 3.0: Next Gen TV in Florida**

**Questions**
Thank you!