SMPTE ST2110 & NMOS IS-08: Audio Transport and Routing

- Andreas Hildebrand –
  RAVENNA Technology Evangelist
  ALC NetworX, Munich
Andreas Hildebrand, RAVENNA Technology Evangelist
• more than 25 years in the professional audio / broadcasting industry
• graduate diploma in computer science
• R&D, project & product management experience
• member of AES67 TG and ST2110 DG

ALC NetworX GmbH, Munich / Germany
• established 2008
• R&D center
• developing & promoting RAVENNA
• Partnerships with > 40 manufacturers

RAVENNA
• IP media networking technology
• designed to meet requirements of professional audio / broadcasting applications
• open technology approach, license-free
• fully AES67-compliant (built-in)
SMPTE 2110 - Professional Media over Managed IP Networks

• Defines transport and synchronization of elementary essence streams (video, audio, ancillary data)
• Primarily targeting at live production applications
• References / builds on existing standards:
  – Timing: SMPTE 2059 (SMPTE PTP Profile)
  – Video: RFC 4175 (RTP Payload Format for Uncompressed Video)
  – Audio: AES67 & RAVENNA
  – Ancillary data: RFC 8331 (RTP Payload for SMPTE ST 291-1 Ancillary Data)
SMPTE 2110

Source

Video
Ancillary
Audio

SDI

ST2110 Sender

ST2110 Receiver 1

Group of Elemental RTP Streams

IP Network

ST2110 Receiver 2

Accumulate, Decapsulate & Synchronize

ST2110 Sender

Encapsulate, Packetize & Time Stamp

Video
Ancillary
Audio

Multicast

Accumulate, Decapsulate & Synchronize

Video
Ancillary
Audio

Audio

Multicast

Accumulate, Decapsulate & Synchronize

Video
Ancillary
Audio

Audio
SMPTE 2110 - Professional Media over Managed IP Networks

Document structure:

• 2110-10: System Timing & Definitions
  – defines transport layer and synchronization (SMPTE2059, clocks, RTP, SDP etc.)

• 2110-20: Uncompressed Active Video
  – defines payload format for raw video (RFC4175, RTP, SDP, constraints)

• 2110-21: Traffic Shaping and Delivery Timing for Uncompressed Active Video
  – defines timing model for senders and receivers (traffic shaping requirements)
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Document structure:

• 2110-30: PCM Digital Audio
  – defines payload format for linear audio (AES67, constraints)

• 2110-31: AES3 Transparent Transport
  – defines payload format for non-linear audio (RAVENNA AM824)

• 2110-40: Transport of SMPTE Ancillary Data
  – defines RTP payload format for SDI ancillary data (new IETF draft)
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Document structure (audio):

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**SMPTE 2110 - Professional Media over Managed IP Networks**

**Document structure (linear PCM audio):**

- **2110-10:** System Timing & Definitions  
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- **2110-30:** PCM Digital Audio  
  - defines payload format for linear audio (AES67, constraints)
AES67-2018 Standard for Audio Applications of Networks:

High-performance Streaming Audio-over-IP Interoperability

published on September, 11th, 2013
# AES67 technology components

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification/Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discovery</td>
<td>Not specified (NMOS IS-04/05)</td>
</tr>
<tr>
<td>Connection Management</td>
<td>SIP (unicast), IGMP (multicast)</td>
</tr>
<tr>
<td>Session Description</td>
<td>SDP (RFC4566, RFC7273)</td>
</tr>
<tr>
<td>Encoding</td>
<td>L16/L24, 1..8 ch, 48 samples</td>
</tr>
<tr>
<td>QoS</td>
<td>Differentiated Services (DiffServ w/ 3 CoS)</td>
</tr>
<tr>
<td>Transport</td>
<td>RTP / UDP / IP, unicast &amp; multicast</td>
</tr>
<tr>
<td>Media Clock</td>
<td>48 kHz</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>IEEE 1588-2008 (PTPv2)</td>
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⇒ AIMS WP on
AES67 / ST2110 Commonalities & Constraints
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Constraints of 2110-10 & -30 w/ respect to AES67

• 6 conformance levels (packet setup):
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<tr>
<td>B</td>
<td>Level A + 1 to 8 channels at packet times of 125 µs</td>
</tr>
<tr>
<td>C</td>
<td>Level A + 1 to 64 channels at packet times of 125 µs</td>
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AES67 compliant
**SMPTE 2110 - Professional Media over Managed IP Networks**

**Constraints of 2110-10 & -30 w/ respect to AES67**
- 6 conformance levels (packet setup):

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<th>Supported by the Receiver</th>
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</thead>
<tbody>
<tr>
<td>AX</td>
<td>Level A (⇒ 48 kHz) + Reception of 96 kHz streams with 1 to 4 audio channels at packet times of 1 ms</td>
</tr>
<tr>
<td>BX</td>
<td>Level B + AX + 1 to 8 channels at packet times of 125 µs</td>
</tr>
<tr>
<td>CX</td>
<td>Level C + AX + 1 to 32 channels at packet times of 125 µs</td>
</tr>
</tbody>
</table>
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What else is required for a working system?

- Establishing connections!
- Not covered by SMPTE 2110

- AMWA: Advanced Media Workflow Association
- NMOS: “A growing family of specifications [...] which are complementary to and co-exist with industry specifications like ST2110 and AES67”
AMWA NMOS - Networked Media Open Specifications

NMOS specifications:

• IS-04: Discovery & Registration
  – enumeration and registration of available system resources

• IS-05: Connection Management
  – connecting receivers to available streams

• IS-06: Network Control
  – controlling network resources (configuring routing tables)
AMWA NMOS - Networked Media Open Specifications

NMOS specifications:

- IS-07: Event & Tally Specification
  – communicate current states and state changes
- IS-08: Audio Channel Mapping
  – how to match flow channels with inputs / outputs
- BCP-002-01: Grouping of NMOS Resources
  – identifying which flows are related to each other
- ... more in the works...
AMWA NMOS - Networked Media Open Specifications

Key elements
AMWA NMOS - Networked Media Open Specifications

Identity

Node

Device

Source

Receiver

Flow

Sender

256E5638-0EB2-4E70-B45B-3B24EB6A478

83C42DF8-284E-4351-8349-E50DA22AC19

6A752884-F055-4E32-9D7F-9619DA3146A

6C46C3F0-97F0-4B52-9D85-8D4B0325A488

23F85482-7AE1-4366-90D3-8D843957A91

A38548F4-99EE-48CF-9582-9A4518BCAC1
Ensure that parts of a networked media system can find each other.
AMWA NMOS - Networked Media Open Specifications

Node
- 83C42DF8-284E-4351-8349-E50DA22AC419

Device
- 256E5638-0EB2-4E70-B45B-3B24BEB6A478

Source
- 60C752BB4-F055-4E32-907F-86150A31466A

Flow
- 23F854B2-7AE1-4366-90D3-8D84B3957401

Receiver
- 6C46C3F0-97F8-4852-9085-80D4B325A488

Sender
- A38548F4-99EE-40CF-9582-9A65B1BAD3

Registry

Registration

Query
AMWA NMOS - Networked Media Open Specifications

IS-05
Connection Management
Make it simple for applications to (dis)connect flows
AMWA NMOS - Networked Media Open Specifications

Node
Device
Sender

Node
Device
Receiver

IS-04 Registry

Query
Registration

Create Connection

Application Logic

stream
any format / protocol

AMWA NMOS - Networked Media Open Specifications

A. Hildebrand: SMPTE ST2110 & NMOS IS-08 – Audio Transport & Routing
AMWA NMOS - Networked Media Open Specifications

Challenge:

6 channel surround audio
AMWA NMOS - Networked Media Open Specifications

Challenge:
AMWA NMOS - Networked Media Open Specifications

Challenge:

Option 1:
6 unicast streams with individual channels

⇒ not very efficient
AMWA NMOS - Networked Media Open Specifications

Challenge:

Option 2:
1 multicast stream w/ all 6 channels
AMWA NMOS - Networked Media Open Specifications

Challenge:

1 multicast stream w/ all 6 channels
AMWA NMOS - Networked Media Open Specifications

IS-08
Audio Channel Mapping

Map flow channels (tracks) to device I/O channels
AMWA NMOS IS-08 - Audio Channel Mapping

Device

Sinks

NMOS IS-08

Output1

2ch

Sources

Input1

2ch
AMWA NMOS IS-08 - Audio Channel Mapping

- Interaction with NMOS IS-05 – connecting incoming stream channels to device output channels
AMWA NMOS IS-08 - Audio Channel Mapping

X-nmos/channelmapping/v1.0/io
AMWA NMOS IS-08 - Audio Channel Mapping

Controller

- Get SDP file from sender connection management API
- Patch staged endpoint with SDP file and activate to establish connection
- Use ID information to resolve the receiver ID to an input in the API, enumerate channels and discover permissible routings.
- Created desired input/output mapping by patching staged map endpoint and activating

NMOS IS-05

NMOS IS-08
AMWA NMOS IS-08 – Audio Channel Mapping

IP-SDI Gateway

A. Hildebrand: SMPTE ST2110 & NMOS IS-08 – Audio Transport & Routing

IP SHOWCASE THEATRE AT NAB – APR. 8-11, 2019
AMWA NMOS - Networked Media Open Specifications

More information on

NMOS wiki on Github:

https://github.com/AMWA-TV/nmos/wiki
Thank you for your attention!

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www.ravenna-network.com