The Audio Parts of ST 2110 Explained

- 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

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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**AES67**

**AES67-2018** Standard for Audio Applications of Networks:

*High-performance Streaming Audio-over-IP Interoperability*

published on September, 11th, 2013
**Scope:**

- **Interoperability guidelines** for professional, low-latency audio over campus and local area IP networks *using existing protocols wherever possible.*
- **Excludes:**
  - Non-IP networking
  - Low-bandwidth media
  - Data compression
  - Low-performance WANs and public Internet
  - Video (should provide good basis for follow-on video project)

**Goal:**

- Technology providers may choose to implement interoperability as a special mode, or transition to it as their native mode
### AES67 technology components

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</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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Constraints of 2110-10 & -30 w/ respect to AES67

- Synchronisation & Timing -

- PTP:
  - support of SMPTE 2059-2 required
  - message rate according to AES-R16-2016 (AES67 PTP Media profile)
  - defaultDS.slaveOnly=true to intentionally prevent devices from entering PTP master state
  - \(a=\)ts-refclk:ptp=traceable and \(a=\)tsrefclkt=refclk:mac=mac_addr allowed

- RTP clock: offset= 0 w/ respect to media clock / reference clock
  - \(a=\)mediaclk:direct=0

AES67 synchronization & media clocks

- Offset \(R\) is established on stream start-up
- \(R\) may be random to defeat crypto-text attacks
- This offset will be constant throughout the stream’s lifetime

- The offset \(R\) will be conveyed via SDP (\(a=\)mediaclk:direct=<offset>) – must be “0” in ST2110
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Constraints of 2110-10 & -30 w/ respect to AES67

- Protocols -

- Support of RTCP not required (but must be tolerated)
- Support of SIP (or any other connection management protocol) not required
- Redundancy (optional): SMPTE 2022-7
  - no identical IP source and destination addresses
- Channel assignment map (SDP attributes - optional)
  - a=fmtp:<payload type> channel-order=<convention>.<<order>
  - Example: a=fmtp:101 channel-order=SMPTE2110.(51,ST)

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Constraints of 2110-10 & -30 w/ respect to AES67

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

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<td>Reception of 48 kHz streams with 1 to 8 audio channels at packet times of 1 ms</td>
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**AES67 compliant**
### Constraints of 2110-10 & -30 with respect to AES67

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</tr>
<tr>
<td>C</td>
<td>Level A + 1 to 64 channels at packet times of 125 µs</td>
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### Constraints of 2110-10 & -30 with respect to AES67

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<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>
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2110-31 – transparent transport of AES3 audio data

- Builds on RAVENNA’s AM824 (IEC 61883-6) payload definition:
  - retains AES67 definitions for synchronization and RTP usage
  - uses 3 bytes for PCM24 + 1 byte for AES3 meta data

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 |
| B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| P | C | U | V | D | A | T | A | 2 | 4 | A | M | 8 | 2 | 4 | / | 4 | 8 | 0 | 0 | 0 | / | n | c | h | a | n | >

- RTP payload format signaled in SDP:
  a=rtpmap:<pt> AM824/48000/<nchan>

- retains all other SDP parms
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2110-31 – transparent transport of AES3 audio data

- Can transport any format which can be encapsulated in AES3
  - L24 PCM w/ AES3 subframe meta data (PCUV bits)
  - non-PCM audio and data formats as defined by SMPTE ST 337 / 338
    (i.e. Dolby®E etc.)

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AES67 / ST2110 audio compatibility?
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