The Audio Parts of ST 2110 Explained

- Andreas Hildebrand –
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  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)
A. Hildebrand: The Audio Parts of ST 2110 Explained

AoIP Pavilion Stage @ 145th AES – Oct. 17-19, 2018

A. Hildebrand: The Audio Parts of ST 2110 Explained
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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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
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
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IP

AES67

WheatNet

Dante

RAVENNA

Livewire

Q-LAN
AES67 technology components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</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>
</tr>
</tbody>
</table>
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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:localmac=<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=mediaclock: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:**

<table>
<thead>
<tr>
<th>Level</th>
<th>Supported by the Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (mandatory)</td>
<td>Reception of 48 kHz streams with 1 to 8 audio channels at packet times of 1 ms</td>
</tr>
<tr>
<td>B</td>
<td>Level A +&lt;br&gt;1 to 8 channels at packet times of 125 µs</td>
</tr>
<tr>
<td>C</td>
<td>Level A +&lt;br&gt;1 to 64 channels at packet times of 125 µs</td>
</tr>
</tbody>
</table>
**SMPTE 2110 - Professional Media over Managed IP Networks**

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

- 6 conformance levels:

<table>
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<th>Level</th>
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</tr>
</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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SMPTE ST 2110-30 is a subset of AES67, adding constraints to clocking and streaming

**AES67 mandatory**
- `a=pctime:1`

**AES67 optional**
- `a=pctime:0.12`

**SMPTE ST 2110**

AES-R16-2016 PTP Configuration
Option to operate device in PTP slave-only mode
- `a=mediackl.direcl=0`

**ST 2110-30 Level A**

**ST 2110-30 Level B**
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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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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

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

- retains all other SDP parms
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AES67 / ST2110 audio compatibility?
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AES67 / ST2110 audio compatibility?
Thank you for your attention!

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