What is SMPTE ST2110 and Why Does It Matter?

John Mailhot
Drafting Group Editor, SMPTE ST2110
CTO, Networking, Imagine Communications

SMPTE Standards Update Webcasts

• Series of quarterly 90-minute, interactive webcasts covering select SMPTE standards and topics
• Free for everyone
• Sessions are recorded for on-demand viewing convenience SMPTE.ORG and YouTube
Your Host

Joel E. Welch
Director of Education
SMPTE

Today's Guest Speaker

John Mailhott
CTO Infrastructure
Imagine Communications
SMPTE Fellow
IP Transport Standards in SMPTE

- ST 2022-1/2/3/4: MPEG-2 Transport Stream over IP
- ST 2022-5/6: SDI over IP

- Both of these are "multiplex" standards, where the video, audio, and ancillary data signals (plus blanking and padding) are wrapped up into a single IP stream

- A Recipient who wants just one element still has to take the whole stream from the network, in order to extract the part they want.

IP Transport Standards in SMPTE (2)

- IP is (itself) a multiplex standard
  - Every packet can be part of a different stream
  - Why are we carrying multiplexes inside of multiplexes?

- ST 2110 puts each part of the signal into a different stream
  - Video, Audio(s), and ANC(s) all separately routable

- Recipients can ask for exactly what they want, and get only that
SMPTE 2110-X: Parts

2110-10: System Timing
2110-20: Uncompressed Video
2110-21: Traffic Shaping Uncompressed Video
2110-30: PCM Audio
2110-31: AES3 Transparent Transport
2110-40: Ancillary Data
2110-50: Integration with ST 2022-6

But how do the parts stay in sync?

SDI was good in this regard – the embedded audio and VANC were tightly bound to the video (from a timing perspective)

In ST2110, the separate streams have timestamps

- ST 2059 (PTP) is used to distribute time and timebase to every device in the system
- Senders mark each packet of video, audio, or ANC with an “RTP Timestamp” that indicates the “sampling time” (or equivalent)
- Receivers compare these timestamps in order to properly align the different essence parts to each other

Users can Mix-and-Match essence from any source !!!
ST2110-10: What’s it About?

• Specifies how SMPTE 2059 PTP timing is used for ST2110

• Specifies how the RTP timestamps are calculated for Video, Audio, and ANC signals

• Specifies general requirements of the IP streams

• Specifies using the *Session Description Protocol (SDP)*

• The actual stream formats are in the other parts of the standard

Session Description (SDP) RFC4566

Each Stream has a set of metadata that tells the receiver how to interpret what is inside of it – the receiver needs this info!!

• The SDP (RFC4566) tells the Receiver what it needs to know
• Senders expose an SDP for every stream they make
• The control system (out of scope) conveys the SDP information to the receiver
An Example of an SDP

```
v=0
c=IN IP4 123456 11 IN IP4 192.168.100.2
s=Example of a SMPTE ST2110-20 signal
i=this example is for 720p video at 59.94
m=video 50000 RTP/AVP 112
a=recvonly
a=group:DUP primary secondary
a=mid:primary
m=video 50020 RTP/AVP 112
a=sendonly
a=mid:secondary
```

SMPTE 2110-X: Parts

2110-10: System Timing

2110-20: Uncompressed Video

2110-21: Traffic Shaping Uncompressed Video

2110-30: PCM Audio

2110-31: AES3 Transparent Transport

2110-40: Ancillary Data

2110-50: Integration with ST 2022-6
ST2110-20: Uncompressed Video

- Only the “Active” image area is sent – no blanking
- Supports image sizes up to 32k x 32k
- Supports Y’Cb’Cr’, RGB, XYZ, I’Ct’Cp’
- Supports 4:2:2/10, 4:2:2/12, 4:4:4/16, and more
- Supports HDR (PQ & HLG)

The Samples are Tightly Packed

```
|   C'B00 (10 bits) |   Y'00 (10 bits)  |   C'R00 (10 bits) |
|   0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 |
|   | C'B01 (10 bits) | Y'01 (10 bits) | C'R01 (10 bits) |
|   | C'B02 (10 bits) | Y'02 (10 bits) | C'R02 (10 bits) |
|   | C'B03 (10 bits) | Y'03 (10 bits) | C'R03 (10 bits) |
|   | C'B04 (10 bits) | Y'04 (10 bits) | C'R04 (10 bits) |
|   | C'B05 (10 bits) | Y'05 (10 bits) | C'R05 (10 bits) |
|   | C'B06 (10 bits) | Y'06 (10 bits) | C'R06 (10 bits) |
|   | Y'07 (10 bits)  |   Y'08 (10 bits)  |   C'R08 (10 bits) |
```

4:2:2/10 example
## How Much Bandwidth was Saved?

<table>
<thead>
<tr>
<th>Scan Format</th>
<th>2022-6 (Gb/s)</th>
<th>2110-20 (Gb/s)</th>
<th>difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2160p @ 59.94</td>
<td>12282.2</td>
<td>10279.6</td>
<td>-16.3%</td>
</tr>
<tr>
<td>1080p @ 59.94</td>
<td>3070.7</td>
<td>2570.1</td>
<td>-16.3%</td>
</tr>
<tr>
<td>1080i @ 29.97</td>
<td>1535.4</td>
<td>1285.0</td>
<td>-16.3%</td>
</tr>
<tr>
<td>720p @ 59.94</td>
<td>1535.4</td>
<td>1142.5</td>
<td>-25.6%</td>
</tr>
<tr>
<td>2160p @ 50</td>
<td>12294.8</td>
<td>8754.9</td>
<td>-30.3%</td>
</tr>
<tr>
<td>1080p @ 50</td>
<td>3074.1</td>
<td>2143.9</td>
<td>-30.3%</td>
</tr>
<tr>
<td>1080i @ 25</td>
<td>1537.4</td>
<td>1071.9</td>
<td>-30.3%</td>
</tr>
<tr>
<td>720p @ 50</td>
<td>1537.4</td>
<td>953.0</td>
<td>-39.9%</td>
</tr>
</tbody>
</table>

## What about Audio?

How SMPTE 2110-30 makes it better
### SMPTE 2110-X: Parts

- 2110-10: System Timing
- 2110-20: Uncompressed Video
- 2110-21: Traffic Shaping Uncompressed Video

#### 2110-30: PCM Audio

- 2110-31: AES3 Transparent Transport

- 2110-40: Ancillary Data
- 2110-50: Integration with ST 2022-6

---

### 2110-30: Important Facts

**Built On AES67 -- PCM Audio (only)**

Many things *allowed* but only a few *required*

- **48kHz sampling** is required for all devices
- **1ms packet time** is required for all devices
- **1..8 channels per stream** is required for all devices
- **16 & 24 bit depth** required for all devices

Outside the *required*, must read specs carefully
**IP Digital Audio for Video People**

- **Sampling Rate**
- **Channels Per Packet (a choice)**
- **Packet Time** (1ms usually)

---

### A little more about channels/stream

Send every channel separately?
- Lots of streams, more configuration, not typical

Send bigger streams (2, 4, or 8 channels per)
- Switching in IP will switch all (2/4/8) channels
- Downstream sub-selecting makes this a bit better

Giant “stems” up to 64 channels are possible

Different Devices make different trade-offs
- Ask about the number of streams, not just channels
How “big” is an audio stream?

Tiny (compared to the video)

A 2-channel stream is:
(2 channels) * (24 bits) * (48000 samples) * (1.08 RTP)
= 2.5 Mbits/sec

An 8-channel stream is:
(8 channels) * (24 bits) * (48000 samples) * (1.05 RTP)
= 9.7 Mbits/sec

What about Non-PCM Audio?

2110-30 deals only with PCM audio

2110-31 provides bit-transparent AES3 over IP
  • Can handle non-PCM audio
  • Can handle AES3 applications that use the user bits
  • Can handle AES3 applications that use the C or V bits

2110-31 is always “stereo” (like AES3)
What about Ancillary Data?

How SMPTE 2110-40 makes it work

SMPTE 2110-X: Parts

2110-10: System Timing
2110-20: Uncompressed Video
2110-21: Traffic Shaping Uncompressed Video
2110-30: PCM Audio
2110-31: AES3 Transparent Transport
2110-40: Ancillary Data
2110-50: Integration with ST 2022-6
2110-40: Important Facts

Over the years, lots of things have been put into the SDI “Ancillary Data” system
  • Some are tightly related to the video signal
  • Some are really separate essence
  • Some are just along for the ride

Audio is handled a better way – don’t use this method for audio

IETF has a draft RFC (done very soon) for wrapping these ancillary data items in IP, generically
2110-40 says how to use this RFC with ST2110

Break-Away Routing Ancillary Data?

This is a capability we’ve never had before…

What could you do with this kind of ability ?

Today – we loop through a lot of VANC inserters

Future – the SDI (if you need it) is “composed” from the parts
VANC Data Routing – Just Like Audio?

Summary – What We Learned Today

- ST 2110 Enables separate routing of Video, Audio ANC over IP
- ST 2110 uses/requires ST2059 PTP timing
- ST 2110 saves bandwidth by not sending blanking
- ST 2110 enables break-away routing of Audio and VANC
Questions

John Mailhott
CTO Infrastructure
Imagine Communications
SMPTE Fellow

Questions?

John Mailhot, CTO Infrastructure,
Imagine Communications