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SMPTE Professional Development Academy – Enabling Global Education

What is SMPTE ST2110 and Why Does It Matter?

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

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Joel E. Welch

Director of Education
SMPTE

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Today's Guest Speaker

John Mailhott

CTO Infrastructure
Imagine Communications

SMPTE Fellow

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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.

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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

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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

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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 !!!

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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

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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

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An Example of an SDP

```
v=0
o=- 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
t=0 0
a=recvonly
a=group:DUP primary secondary
m=video 50000 RTP/AVP 112
c=IN IP4 239.100.9.10/32
a=rtpmap:112 raw/90000
a=fmtp:112 sampling=YCbCr-4:2:2; width=1280; height=720; exactframerate=60000/1001;
depth=10; TCS=SDR; colorimetry=BT709; PM=2110GPM; SSN="ST2110-20:2017";
a=ts-refclk:ptp=IEEE1588-2008:39-A7-94-FF-FE-07-CB-D0:37
a=mid:primary
m=video 50020 RTP/AVP 112
c=IN IP4 239.101.9.10/32
a=rtpmap:112 raw/90000
a=fmtp:112 sampling=YCbCr-4:2:2; width=1280; height=720; exactframerate=60000/1001;
depth=10; TCS=SDR; colorimetry=BT709; PM=2110GPM; SSN="ST2110-20:2017";
a=ts-refclk:ptp=IEEE1588-2008:39-A7-94-FF-FE-07-CB-D0:37
a=mid:secondary
```

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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)

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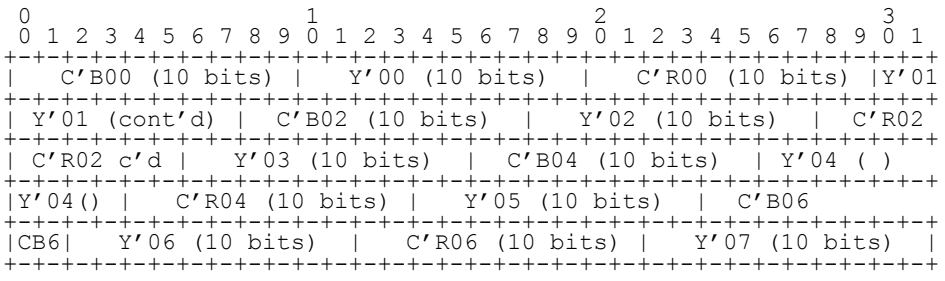
The Samples are Tightly Packed



4:2:2/10 example

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How Much Bandwidth was Saved ?

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

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What about Audio?

How SMPTE 2110-30 makes it better

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SMPTE 2110-X: Parts

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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

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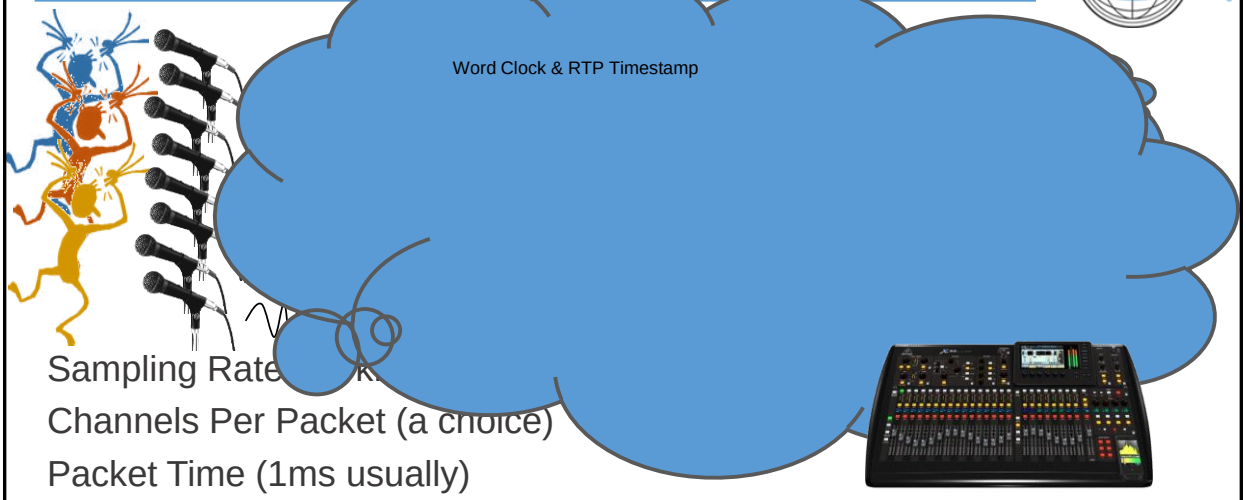
IP Digital Audio for Video People



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

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A little more about channels/stream

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

Send biger 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

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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

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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)

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What about Ancillary Data?

How SMPTE 2110-40 makes it work

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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

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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

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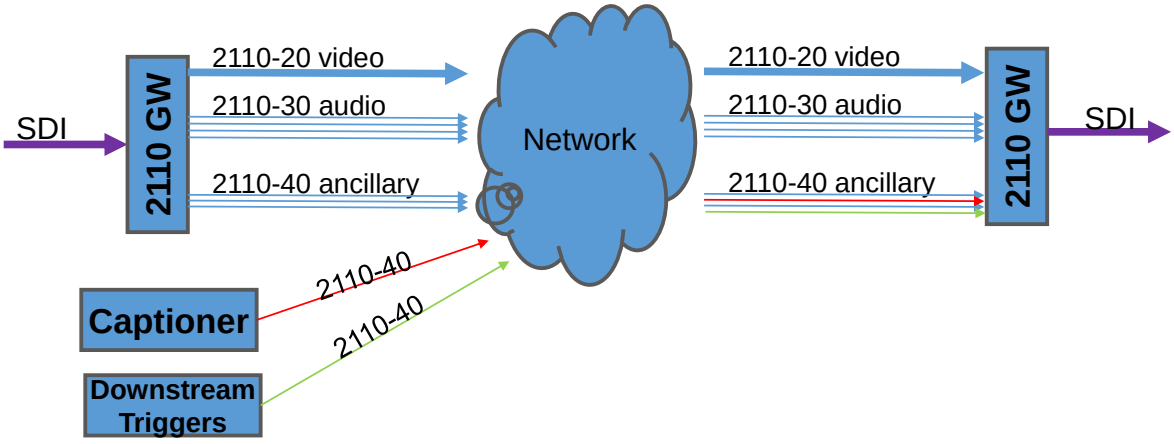
VANC Data Routing – Just Like Audio?



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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

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Questions

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