SMPTE ST-2110

In Real World Applications

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Agenda

- Moving to IT, IP and cloud
- Heritage of standards
- SMPTE ST 2110 essentials
- Design considerations for fixed facilities
- Design considerations for WAN
Flexible Building Blocks

IT outpaces Broadcast in scale, investment and developments.

Transport layer scales beyond broadcast bitrates and routing technology scales beyond broadcast routers

IT environments provide high utilization (multi-purpose hw) and open for moving workloads to public cloud

Using software components makes workflows easier to automate.

Connectors and cables are multi-purpose
 Comes with new challenges...

<table>
<thead>
<tr>
<th>Reliability</th>
<th>Timing</th>
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| - New mechanisms for recovery from glitches, faults and failures  
- Guarantee bandwidth  
- Isolation to protect against faulty configuration / faulty equipment flooding | Synchronize all sources feeding into the same production |

<table>
<thead>
<tr>
<th>Multicast</th>
<th>Security and separation</th>
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<tbody>
<tr>
<td>IP infrastructure supports multicast, but was never designed for broadcast requirements.</td>
<td>Avoid malicious attacks, faults and misconfiguration</td>
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<tr>
<th>Cost of ownership</th>
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| It is not always the right choice  
- Smaller scale (sub 500² systems) |
• The Ethernet Alliance roadmap is based on input from users
• It represents current capability and future expectations
• Component manufacturers target the roadmap, working hard to deliver the necessary router chips and optical components
• NIC cards, IP Routers and Optics are developed in parallel
• The entire eco-system moves forward in unison
• Funded for the Global IT Market $3.7 Trillion 2018 (gartner.com)
Broadcast Market $3.3 Billion
Heritage of IP Standards

User Requirements

Reference Architecture

Market-based Advocacy & Feedback

EBU

IEEE 1588

SMPTE ST 2059

IETF RFC 4175

AES67

AMWA IS-04

SMPTE ST 2110

AIMS
ST-2110 Essentials
### SMPTE ST 2110 Key points

#### SMPTE ST 2110 – 10
**System** – RTP, SMPTE ST 2059, SDP
- RTP stream over UDP
- Multicast (IGMPv2/3) or Unicast
- One SDP per RTP Stream
- PTP - SMPTE ST 2059-1&-2

#### SMPTE ST 2110 – 20
**Video** - Based on RFC 4175
- Raster size up to 32x32
- Format agnostic (frame, colour space, bit depth, TCS)
- Saves bandwidth

#### SMPTE ST 2110 – 40
**Ancillary Data** – RFC 8331 which is based on SMPTE ST 2038
- Not strictly “SDI abstracted data” - no audio (HANC)
- VANC data - CC, SCTE, VITC, AF, VChip)
- RTP time stamps for sync with video

#### SMPTE ST 2110 – 30
**Audio** - Based on AES67 & RFC 3190
- Uncompressed PCM Audio
- 48KHz Sampling
- 16 - 24 bit depth
- Channel count & timing defined in levels
- A - C

#### SMPTE ST 2110 – 31
**Future** - Compressed Audio

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Paul
SMPTE ST 2110 – 21 (Traffic Shaping and Delivery Timing)

Specifies the packet emission timing and other network traffic parameters to ensure error free data transmission through an IP network. It provides for 3 traffic profiles: N, NL and W which are suitable for different devices such as pure software senders or FPGA based senders. It sets basic parameters for bandwidth overhead in a network segment and memory capacity in a router.

- **Type N Senders →** Distribute the pixels of the video raster during the active portion of the frame with nearly zero latency and packet delay variation.
- **Type NL Senders →** Distribute the pixels of the video raster across the entire duration of the frame with nearly zero latency and packet delay variation
- **Type W Senders →** Allow for increased variation, or bursts, in packet emission. Care should be taken to ensure that traffic design supports simultaneous peak bursts without packet loss in the router.
- **Beta, or Bandwidth overhead is recommend to be 1.1 (10%)**
- **Cmax, varies by type, and sets the peak rate for packet burst duration**
### SMPTE ST 2110 – 30 (Uncompressed Audio – RFC 3190)

<table>
<thead>
<tr>
<th>Level(s)</th>
<th>Supported by the Receiver</th>
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<tbody>
<tr>
<td>A</td>
<td>Reception of 48 kHz streams with from 1 to 8 channels at packet times of 1 ms</td>
</tr>
<tr>
<td>AX</td>
<td>Reception of 48 kHz streams with from 1 to 8 audio channels at packet times of 1 ms. Reception of 96 kHz streams with from 1 to 4 channels at packet times of 1ms</td>
</tr>
<tr>
<td>B</td>
<td>Reception of 48 kHz streams with from 1 to 8 channels at packet times of 1 ms or 1 to 8 channels at packet times of 125 µs</td>
</tr>
<tr>
<td>BX</td>
<td>Reception of 48 kHz streams with from 1 to 8 channels at packet times of 1 ms or 1 to 8 channels at packet times of 125 µs. Reception of 96 kHz streams with from 1 to 4 channels at packet times of 1ms or 1 to 8 channels at packet times of 125 µs</td>
</tr>
<tr>
<td>C</td>
<td>Reception of 48 kHz streams with from 1 to 8 channels at packet times of 1 ms or 1 to 64 channels at packet times of 125 µs</td>
</tr>
<tr>
<td>CX</td>
<td>Reception of 48 kHz streams with from 1 to 8 channels at packet times of 1 ms or 1 to 64 channels at packet times of 125 µs. Reception of 96 kHz streams with from 1 to 4 channels at packet times of 1ms or 1 to 32 channels at packet times of 125 µs</td>
</tr>
</tbody>
</table>
Network & Resource Control

AMWA NMOS

Broadcast Controller

SDN Controller

Network equipment

Media endpoints

IS-04: Discovery & Registration
IS-05: Connection Management

IS-06: Network Control

IS-04: Discovery & Registration
IS-05: Connection Management
Design Considerations for Fixed Facilities
Common Topologies

Leaf

Spine

Monolithic Switch

Gateways & IP Native Devices

PTP Grand Master

2022-7 Seamless Switching
IP Switching Options

Break-before-Make (BBM)  Clean, fast, visibly undetectable (One frame buffer & repeat)

Make-before-Break (MBB)  ‘Clean’ (Switches on frame boundary)
Design Considerations

The following considerations apply to any facility switching to IP, these are questions that need to be considered before moving into the design stage.

General
• Scale of system - 500x500 plus?
• Redundancy on all devices?
• Amount of devices?
• Number of clean and dirty switching routes?
• Blocking or non-blocking?

Devices
• Devices Traffic shaping compatibility (N/NL/W)?
• Confirm Audio Levels agreed (A,B,C or Mix)?
• Timing, calculate jitter in signal flow vs receive level A/B/C?
• 2022-7 compatibility on NIC?
• Control - In-bound or Out?

Switch
• Leaf and Spine vs Single Chassis Switch?
• Single Sided or 2022-7?
• Port Speeds - 10G, 25G, 40G, 50G, 100G, 400G?
• Switch Boundary PTP or Transparent?
• Distance between switches and devices?

Control & Monitoring
• Integration with existing systems?
• Switches Managed or Unmanaged (L2/L3 SDN)
• IGMPv2 or v3?
• SNMP, API?
• Hierarchical Software solution or Single Application?
Design Considerations for WAN
The shift to SMPTE 2110 is driven by the transformation of live production. A transformation that is making the WAN the center piece of every single production workflow.
How is ST-2110 improving distributed production?

- **Format Agnostic**: Support for future production formats. All services on one common infrastructure.
- **Essence Streams**: Separation of audio, video and data production workflows.
- **Agility & Virtualization**: Improve flexibility with software, COTS & Cloud resources.
And what are the challenges of introducing ST-2110 in the WAN?

- Retain essence streams
  - Keep audio, video, data separate

- Control traffic
  - Isolate traffic
  - Reserve bandwidth
  - Manage bursts

- Manage timing
  - Transport sync

ON ANY INFRASTRUCTURE
Workflow consistency no matter the

- Distance
- Mix of traffic
- Network load

And no matter the type of connection

- Dedicated Fiber or OTN
- Leased Carrier Ethernet/IP services
- Public infrastructure (internet)
- Wireless (4G/5G/radio links)
- Cloud direct connect services
Hybrid Alternatives

#1 - Convert at the edges to synchronous transport
   • IS 04/05 signaling at edge of WAN.
   • Conversion of signals to SDI at edge.

#2 - Migrate to broadcast quality Ethernet transport
   • IS 04/05 signaling at conversion to legacy.
   • Signals are converted to ST 2110 at the edge.
   • All transport consolidated to broadcast quality Ethernet with support for strict BW reservation and essence stream transport.
Thank you!