SMPTE ST 2110 – The Basics

Phil Myers, Product Manager

Monday 23rd October 2017
Birmingham City University
A Thoroughbred Company with Real Pedigree

- Long Heritage
  ...since 1970s:
  PAL/NTSC Analog
  Analog to SDI
  Now SDI to IP

- Over 5 years
  ...developing
  IP strategy & systems

- Released 3rd Gen. IP products

- Delivering IP solutions

SAM
Started ahead..

Staying ahead!

2015: One of five founding members of

Alliance for IP Media Solutions

Close working alliances with:

ARISTA  CISCO
JUNIPER
SAM – A Voice in IP Standards

- Member of all relevant Standards organizations
- One of five Founding members of AIMS*
- One of ten Principal members of AMWA*

**AIMS Roadmap**

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<th>Baseline for Interoperability</th>
<th>Enable IP Streaming of Audio</th>
<th>Support Split Video and Audio Routing</th>
<th>Add Video Bandwidth Efficiency to Split Video, Audio and ANC Data Routing</th>
<th>Enable Discovery and Registration of Compliant Streams</th>
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**The Role of AIMS**

To foster the adoption of the work of these organizations with regard to IP interoperability

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*AIMS – Alliance for IP Media Solutions  *AMWA – Advanced Media Workflow Association

www.s-a-m.com
JT-NM Roadmap of Networked Media Open Interoperability*

**Legend:**
- Standard / Specification: Published, Widely available, Study / Activity or other.

**II. Elementary flows**
- SDI over IP
  - SMPTE ST 2059
  - AES-67
  - SMPTE ST 2022-6
- Audio
- Timing
- ST 2110: Transport of uncompressed essence

**III. Auto-Provisioning**
- AMWA IS-04: Discovery & Registration
- AMWA IS-05: Connection management
- AMWA IS-06: Network Control

**IV. Dematerialized facilities**
- EBU R146: Cloud Security for Media Companies
- EBU - Investigating models/workflows: e.g. Identify Best Practices
- AMWA Labs Findings: e.g. AMWA Specs/Best Practices

**Cloud-fit**
- Open, secure, public/private cloud solutions
- Non-media-specific IT
- Self-describing, open APIs suitable for virtualization

**Automated resource management**
- for more flexible and sharable infrastructure at scale

**More flexible and efficient workflows**
- New formats supported like UHD and mezzanine compression

**Current and mature technology**

**See Dematerialized Facilities FAQ at JT-NM.org for more information. * JT-NM assumption as of August 2017 and will evolve over time. Visit JT-NM.org for the latest update. Feedback to info@videoservicesforum.org.**
Industry Drivers

Chart 16: Of the products / solution that you plan to purchase over the next 12 months, which is the most important priority (only large broadcasters)

- Multi-platform content delivery (broadcast, web, mobile etc.)
- IP networking & content delivery
- 4K (UHD)
- File-based / tapeless workflows
- Cloud computing / Virtualization
- Video on demand
- Improvements in video compression efficiency
- Move to automated workflows
- Targeted advertising
- Remote production
- Transition to HDTV operations
- Centralized operations (playout, transmission etc.)
- Virtual Reality
- Analog switch-off
- Outsourced operations (playout, transmission etc.)
- Transition to 3Gbps (1080p) operations
- Transition to 5.1 channel audio
- Reduction in carbon emissions / other green initiatives

* Source – IABM, May 2017 Digest

Why IP Routing?

• Ubiquity of IP Networks & Infrastructure
  $10B+ invested each year compared with 10’s of millions in baseband SDI

• Massive IT industry means resources & expertise more readily available
  Recruiting easier / less specialist training requirements / Younger generation IT literate

• Universality of IP Infrastructure equipment
  Better investment case re: Redeployment and change of use

• Much larger component supplier base
  Wider choice & better availability

• Size…IP Router equivalents much smaller!
  Sirius 840 576² = 31U
  **Juniper** QFX 10008 & **ARISTA** 7508E, 1152 10GbE Ports = 13U
  …that’s a massive 5760² @ HD SDI Uncompressed
Traditional Broadcast & Media routing

Connectivity

Copper
- BNC
  - HD-BNC
- Multi-way ‘D’ type for Analog & AES Digital.
- BNC for MADI

Fiber (SM/MM)
- SFP*
  - 3G/HD/SD-SDI
  - Dual Transmitters (2x Tx)
  - Dual Receiver (2x Rx)
  - Transceiver (Tx/Rx)
  - AES MADI 100Mb/s (Tx/Rx)

Video + Audio + Data

Video
- SDI Video
  - Video + Embedded Audio (x16)
  - + User data (270Mb/s, 1.5/3Gb/s)

Audio
- AES Digital Audio
  - (3Mb/s – 48kHz sampling)
  - Balanced - Differential
  - Unbalanced - Single Ended

Data
- RS485 Serial - Older systems!
  - (Separate or integrated)
  - Currently more likely separate
  - 100MbE or GbE IP Switch

www.s-a-m.com

SFP* – ‘Small Form-factor Pluggable’
A little about COTS* IP Video Routers

- **Very large bandwidth**  Up to 115 Tbits/s, Up to 51 Bpkts/s
- **Non-Blocking**  Router internal bandwidth can handle all the port bandwidths at the same time & at full capacity
- **IGMPv3**  Internet Group Management Protocol
  Communications protocol used by clients & adjacent routers on IPv4 networks to establish multicast group memberships
- **PIM-SSM**  Protocol Independent Multicast - Source Specific Multicast
  Between routers & subnets. Essentially allows a client to receive multicast traffic directly from the source

*RTP – Real-Time Protocol  *COTS – Commercial Off The Shelf
The Basics – the building blocks

Design considerations for an IP infrastructure

- **Standards** – Which ones? Do we care?
- **IP Conversion (to/from SDI)** – Amount? Formats?
- **IP Conversion (to/from MADI)** - Amount? Formats? Processing?
- **Native IP Devices** – Amount? Format? Control?
- **Signal Processing** – Video? Audio? Transportation?
- **Multi-viewers** – Amount? Formats? Layouts? Tally? Control?
- **Connectivity** – 1.5, 3 or 12Gbps? 10, 25, 40, 50 or 100Gbps?
- **Network Design** – Singular switch? Spine/Leaf? Modular? L2 or L3?
- **Control & Monitoring System** – Topology? Performance? Licensing? SNMP?
- **System redundancy** – All or Core Components?
The Basics – the building blocks

Design considerations for an IP infrastructure

• **Standards** – Which ones ? Do we care ?
• IP Conversion (to/from SDI) – Amount ? Formats ?
• IP Conversion (to/from MADI) - Amount ? Formats ? Processing ?
• Native IP Devices – Amount ? Format ? Control ?
• Signal Processing – Video ? Audio ? Transportation ?
• Multi-viewers – Amount ? Formats ? Layouts ? Tally ? Control ?
• Connectivity – 1.5, 3 or 12Gbps ? 10, 25, 40, 50 or 100Gbps ?
• Network Design – Singular switch ? Spine/Leaf ? Modular ? L2 or L3 ?
• Control & Monitoring System – Topology ? **Performance** ? Licensing ? SNMP ?
• System **redundancy** – All or Core Components ?
Redundant Network Infrastructure – 10/40GbE or 25/50/100GbE Connectivity

Why? – Required to build an IP system!
The Basics – the building blocks

Existing standards

**SMPTE ST 2022-2** (Compressed Transport Streams)

**SMPTE ST 2022-5** (Forward Error Correction)

**SMPTE ST 2022-6** (High Bit Rate Media Transport)

**SMPTE ST 2022-7** (Seamless Protection Switching)

**SMPTE ST 2059-1** (Generation of PTP Signals, Epoch)

**SMPTE ST 2059-2** (SMPTE Profile for IEEE1588 PTP)

**SMPTE ST 2042** (VC2 compression)

Well aligned to support legacy SDI infrastructure in an IP domain

Defined with the future in mind, an all IP future!
SMPTE ST 2022-6 (Multiplexed streams)
SMPTE ST 2022-7 (Redundancy)

- **SMPTE ST 2022-7** Seamless protection of ST 2022 IP Datagrams
- Originally for **SMPTE ST 2022-6** streams. Good for **ST 2110 RTP** Video, Audio & Metadata streams
- Requires copy of Multicast Source
- Two identical network interfaces
- Two IP Routers or two IP Router cards
- Packets received / joined at Host
- Packet-by-packet merging / arbitration
- Works for individual packet or full stream loss
The Basics – the building blocks

Standards – approved and ready for deployment today!

**SMPTE ST 2110 – 10 (System – RTP, SMPTE ST 2059, SDP)**

Engineering criteria that defines an extensible system of RTP-based essence streams referenced to a common reference clock, in a manner which specifies their timing relationships. This standard specifies the system timing model and the requirements common to of all of the essence streams

- RTP (Real-time Transport Protocol – RFC 3550) ➔ proven technology for transporting time-critical data over UDP packets (RFC 768)

- SMPTE ST 2059 ➔ based on IEEE 1588 standard, greater technology maturity

- PTP utilised in many other mission critical applications ➔ high frequency trading, energy infrastructure and robotics to name a few

- SDP (Session Description Protocol – RFC 4566) ➔ metadata exposed by the senders, tells the receiver what it needs to know – distributed by the control system (not covered in ST 2110-10)
**ST 2110-10 (System Timing)**

**SMPTE ST 2059-1 and -2**

1. **Multicast to Edge Devices**
   * Reduces multicast traffic, protects edge devices

2. **Unicast to PTP Grandmaster**

**Multi-format SDI references**
1 x PTP (RJ45), 1 x PTP (SFP)
Free-run or Genlock
GPS option

**Modular (No SDI)**
Up to 4 PTP ports/modules
Free-run or Genlock
GPS option

*M1000 can be slaved to SPG8000A to circumvent high client count issues

**Target ΔT between all devices:**
≤ 1.0 microsecond (Lock time < 5s)

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**Devices:**
- **Tektronix SPG8000A**
- **Meinberg LANTIME M1000**
- **Production Switcher**
- **IP Gateways**
- **Camera**
- **BB / TL Slave**

**Connections:**
- PTP Grandmaster
- PTP Slave
- Multi-format SDI references
- GPS option
**Break-before-Make**  Clean, Very fast & Visibly undetectable (One frame repeat)
Good for 95%+ of applications!

Break!

Make!

**Make-before-Break**  Clean’ (Switches on frame boundary)
Bandwidth burden for switch duration

Break!

Make!
ST 2110-10 (Session Description Protocol)

Flow Metadata

Should include the following metadata:

- Sender description
- Video and/or audio essence
- Raster size (in pixels)
- Frame-rate (video)
- Channel count (audio)
- Sampling structure (audio/video)
- Bit depth (audio/video)
- Colourimetry
- Source IP address and port
- RTP payload ID (audio/video)
- PTP grandmaster source and domain

v=0
o=- 243362948900865 0 IN IP4 192.168.20.112
s=Snell IQMIX
t=0 0
a=ts-refclk:ptp=IEEE1588-2008:ec-46-70-ff-fe-00-bf-60:0
a=mediaclk:direct=0
a=clock-domain:PTPv2 0
m=audio 50000 RTP/AVP 97
i=RAVENNA Audio-strm0/0,RAVENNA Audio-strm0/1
a=source-filter: incl IN IP4 239.31.112.1/31
a=rtpmap:97 L24/48000/2
a=framerate:480
a=rtpmap:97 L24/48000/2
a=framerate:48
a=recvonly
a=sync-time:0
The Basics – the building blocks

Standards – approved and ready for deployment today!

**SMPTE ST 2110 – 20** (Uncompressed Video – RFC 4175)

Specifies the real-time, RTP-based transport of uncompressed active video essence over IP networks. An SDP-based signalling method is defined for image technical metadata necessary to receive and interpret the stream

- Raster size independent ➔ up to 32K x 32K pixels
- Agnostic
  - Colour sampling ➔ 4:1:1 to 4:4:4+
  - Bit depth ➔ 8 to 16-Bit+
  - Frame-rate ➔ 23.98 to 120 fps+
- Support for HDR ➔ PQ & HLG
- Significant bandwidth efficiency ➔ 1080p50 @ ST 2022-6 = 3.074Gbps vs 1080p50 @ ST 2110-20 = 2.143Gbps
SMPTE ST 2110 (Essence streams)
ST 2022-6

ST 2110-30 (8 ch.)

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

ST 2110-20

ST 2110-30 (8 ch.)

SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms

ST 2110-20 & 30 (Uncompressed Audio & Video)

Migration from ST 2022-6 to ST 2110

SDI

ST 2022-6

ST 2110-30 (8 ch.)

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

ST 2110-20

ST 2110-30 (8 ch.)

SDI

SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms
ST 2022-6

ST 2110-30
(8 ch.)

Rx

25G

Tx

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

SDI

SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms

ST 2022-6

ST 2110-30
(8 ch.)

Rx

25G

Tx

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

SDI

SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms

ST 2110-20 & 30 (Uncompressed Audio & Video)

Migration from ST 2022-6 to ST 2110

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

ST 2022-6

ST 2110-30
(8 ch.)

Rx

25G

Tx

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

SDI

SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms
ST 2110-20 & 30 (Uncompressed Audio & Video)

Migration from ST 2022-6 to ST 2110

SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms
SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms

ST 2110-20 & 30 (Uncompressed Audio & Video)

Migration from ST 2022-6 to ST 2110

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms
The Basics – the building blocks

Standards – approved and ready for deployment today!

SMPTE ST 2110 – 30 (Uncompressed Audio – AES67)

Specifies the real-time, RTP-based transport of PCM digital audio streams over IP networks by reference to AES67. An SDP-based signalling method is defined for metadata necessary to receive and interpret the stream

- Uncompressed Linear PCM Audio only
- Relatively flexible
  - 48kHz sampling
  - 16 and 24-Bit depth
  - Variable packet timing ➔ 125us to 1ms
  - Channel count based on packet timing ➔ 8 channels @ 1ms vs 64 channels @ 125us
- Low bandwidth consumption ➔ 8 channels x 24 bits x 48,000 samples x 1.5 (RTP) = 9.7Mbits/sec
ST 2110-20 & 30 (Uncompressed Audio & Video)

Advanced Hybrid Audio Workflows

**SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms**

**ST 2022-6**
- Rx

**ST 2110-30 (8 ch.)**
- Tx

**IQMIX (IP Gateway – SDI)**
- 8 x SDI to IP and 8 x IP to SDI

**IQAMD (IP Gateway – MADI)**
- 8 x MADI to IP and 8 x IP to MADI

**MADI**
- ST 2110-30 (64 ch.)
- Rx

**ST 2110-30 (64 ch.)**
- Tx

**IQMIX (IP Gateway – SDI)**
- 8 x SDI to IP and 8 x IP to SDI

**ST 2022-6**
- Rx

**ST 2110-30 (8 ch.)**
- Tx

**MADI generated ST 2110-30 audio stream configured as 64 ch. @ 125us**

**25G**
SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms

MADI generated ST 2110-30 audio stream configured as 64 ch. @ 125us

Edge Device receiver will only take first 8 channels of ST 2110-30 stream (if more channels are present, they are ignored)

Only a single ST 2110-30 stream can be connected to the Edge Device receiver at any given time

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

IQAMD (IP Gateway – MADI)
8 x MADI to IP and 8 x IP to MADI

ST 2110-20 & 30 (Uncompressed Audio & Video)
Advanced Hybrid Audio Workflows

ST 2022-6
ST 2110-30 (8 ch.)
Rx
25G
Tx

ST 2110-30 (64 ch.)
Rx
10G
Tx
ST 2110-20 & 30 (Uncompressed Audio & Video)

Advanced Hybrid Audio Workflows

SDI generated ST 2110-30 audio stream configured as 8 ch. @ 1ms

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

IQAMD (IP Gateway – MADI)
8 x MADI to IP and 8 x IP to MADI

MADI generated ST 2110-30 audio stream configured as 64 ch. @ 125µs

ST 2110-30 (8 ch.)

ST 2110-30 (64 ch.)

3 x ST 2110-30 Receivers (144 ch.)

Audio XS (Audio Routing & Processing)
64 x ST 2110-30 receivers (2048 ch.)
64 x ST 2110-30 transmitters (2048 ch.)

Audio “shuffled” in Audio XS

1 x ST 2110-30 Transmitter (8 ch.)

IQMIX (IP Gateway – SDI)
8 x SDI to IP and 8 x IP to SDI

ST 2022-6

25G

10G

SDI

MADI

MADI

ST 2022-6

ST 2110-30 (8 ch.)

ST 2110-30 (64 ch.)

ST 2110-30 (64 ch.)

SDI

MADI

MADI
The Basics – the building blocks

Standards in final ballot draft / in progress – coming soon!

**SMPTE ST 2110 – 21** (Performance of transmitters – packet pacing, bursts, gaps)

**SMPTE ST 2110 – 40** (Ancillary Data – VANC based on IETF ANC 291)

**SMPTE ST 2110 – 31** (Compressed Audio – non-PCM/AES3, Guardband aware, stereo)

**SMPTE ST 2110 – 50** (Support for legacy SMPTE ST 2022-6 infrastructure)

... hot discussion at the moment, ST 2110-2x (Compressed Video)
The Basics – the building blocks

The SMPTE ST 2110 suite of standards!

**SMPTE ST 2110 – 10** (System – RTP, SMPTE ST 2059, SDP)

**SMPTE ST 2110 – 20** (Uncompressed Video – RFC 4175)

**SMPTE ST 2110 – 21** (Performance of transmitters – packet pacing, bursts, gaps)

**SMPTE ST 2110 – 30** (Uncompressed Audio – AES67)

**SMPTE ST 2110 – 31** (Compressed Audio – AES3)

**SMPTE ST 2110 – 40** (Ancillary Data - IETF ANC 291)

**SMPTE ST 2110 – 50** (SMPTE ST 2022-6 Essence)

- **Approved (September 2017)**
- **Final draft ballot (Target: late 2017 / early 2018)**
- **In progress (Target: 2018)**
The Basics – the building blocks

But, don’t get confused - technical recommendations or standards?

NMOS IS-04 - (Device Discovery and Registration) Specification by AMWA
NMOS IS-05 - (Connection Management) Specification by AMWA
NMOS IS-06 - (Network Control) Specification by AMWA
VSF TR04 - (2022-6 & AES67) Technical recommendation by Video Services Forum
VSF TR03 - (RFC4175 & AES67) Technical recommendation by Video Services Forum
SMPTE RDD 34 - (Sony LLVC compression) Registered Disclosure Document
SMPTE RDD 35 - (IntoPIX Tico compression) Registered Disclosure Document
SMPTE RDD 37 - (Evertz ASPEN) Registered Disclosure Document
In summary – why are we doing this again?

**Flexibility** ➔ upgradeability and future expansion

Format **agnostic** ➔ 1080p, UHD, HDR, HFR and beyond

Cost saving and **efficiency** ➔ less cabling, quicker installation, easier to maintain

**Agility** – Building a platform for the enabling of virtualised services

Highest **reliability** – can be no less than what has come before (SDI served us well)

No limitation on a single vendor ➔ highest level of **interoperability**, breeds best in class products

... **lastly**, these are exciting times for the broadcast industry, a chance to leverage technological change. Change is happening – it’s an opportunity, don’t dwell on the past, embrace the future – SMPTE ST 2110 greatly aids this evolution in the broadcast industry and it’s here today!
Multi-vendor interoperability with over 50+ vendors
Focused on live production, contribution and playout workflows
Real-world customer deployments presented
Real-world Deployment

SMPTE ST 2110
2,000+ Signal Flows @ ST 2110-20 and ST 2110-30
Critical path redundancy – ST 2022-7
Award winning, industry first, great example - SMPTE ST 2110 delivered!
Introduction to Timeline TV

Established in 2006

Market leading provider of broadcast technology and services – across the globe. Broadcast Anywhere!

Portfolio includes:

• Outside Broadcasts (all 4K capable)
• Post-production facilities in Soho, Ealing Studios, BT Sport and MediaCityUK
• RF and Satellite
• Managed services
• System integration
Introduction to Timeline TV

Trusted supplier to the biggest brands in both UK and International television markets – including: BBC, ITV, Channel 4 and BT Sport

Broadcast centres built and managed for clients such as BT Sport, Manchester City FC TV and Racing UK

Technical and creative facilities for a diverse range of programmes, such as live music and award shows, political conferences, global sporting competitions, light entertainment and current affairs

Key events covered for clients – Wimbledon, Americas Cup, UEFA Europa League, Dubai World Cup, Artic Live for BBC and Henley Royal Regatta
The challenge

Current OB fleet includes a mid-sized UHD baseband truck which was purpose built back in 2015 (UHD-1). UHD-1 contains: SAM Sirius S840 Router, Kahuna 4ME Production Switcher, Sony HDC-4300 cameras, EVS UHD replay servers and a Calrec Artemis audio console.

During 2016, Timeline identified a gap in the market for a larger OB truck to provide UHD coverage of live events where a greater number of camera and replay devices were required ➔ as well as to cover additional audio requirements!

Key driver ➔ to provide the same client experience of a large modern HD truck but in UHD.

After visiting many broadcast suppliers at IBC 2016, IP technology was identified as the only viable way by Timeline to achieve their technical and commercial requirements for “UHD-2”.

Based on these findings, Timeline commissioned their second UHD OB Truck to be built in early 2017 (UHD-2) – with a target on air date of early May 2017.
Project requirements

Timeline’s core technical requirements for “UHD-2”:

• Support for up to 32 x UHD cameras

• Connectivity for 12 x UHD replay servers and 2 x UHD archive servers

• Core IP Infrastructure – COTS based with 25, 50 and 100G connectivity

• Signal agnostic IP fabric - uncompressed UHD 2160p video with support for multiple resolutions (i.e. 3G 1080p, HD 1080i, etc.)

• Industry standards based approach throughout – SMPTE ST 2110 (RFC 4175 & AES67) and SMPTE ST 2022-6 today

• Support for newer technologies such as high dynamic range (HDR) and high frame rate (HFR)

• Expectation – overall reduction in cabling and equipment (i.e. weight and accessibility)
Objectives and concept

Expandability and flexibility to cope with all production scenarios

Support for complex and enhanced audio workflows

Decentralisation of equipment ➔ cost effective for large events that currently only scale by using more than one OB vehicle

Produce simultaneous UHD 2160p HDR & SDR, 3G 1080p HDR & SDR and HD1080i content

Cutting edge technology ➔ agile, not locked into a single vendor or specific IP format (i.e. intoPIX TICO, VC2, etc.)

Most importantly, enables Timeline to offer new services, attract new clients and be more competitive
Core technology installed in “UHD-2” (Triple Expander):

- SAM Kahuna IP Production Switchers – HDR 6ME and SDR 6ME
- SAM IQMIX (SDI) and IQAMD (MADI) IP Gateways – embed/de-embed on all I/O
- SAM Audio XS Audio Routing and Processing System
- SAM MV-820 IP Multi-viewers
- SAM Orbit IP Routing and Monitoring System
- Arista 7504R Modular COTS network switch with up to four 100G line-cards (up to 14.4Tbps)
- Tektronix SPG8000A and Meinberg LANTIME M1000 PTP/TL/BB Solution
- Sony HDC-4300 UHD / HDR Cameras
- EVS XT4K UHD Replay Servers
- Sony PWS-4400 UHD Archive Servers
- Calrec Apollo Audio Console – 56 faders
- Axon Cerebrum Control System

Flexible tailboard providing both SDI and IP (100G) connectivity – TX with Dolby Atmos
SAM is providing IP routing layer
- SAM is responsible for overall IP system performance
- SAM is providing 3rd party edge device drivers where required – i.e. Sony Cameras, EVS, etc.
Summary

An OB vehicle of this size and complexity is a huge investment

Adopting a future proof standard increases operational lifespan

Provides significant client benefits:

- Full production capability on large scale OB events in uncompressed UHD
- Ultimate flexibility ➔ Efficiently add multiple adhoc production areas
- Any source or destination is de-embeddable / embeddable ➔ reduced processing requirements
- Viewing anywhere ➔ Scalable distributed IP multi-viewer architecture
- Faster set up ➔ Less external cabling ➔ Labour saving

Connectivity to almost any IP, SDI format ➔ challenging in an SDI world

Unparalleled level of system wide redundancy

Commissioned and on-air as of 29th April 2017. However no rest, continual innovation with IP technology ➔ IP Remote production and Flypack solutions to follow…
Q & A

THANK YOU!

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