Demystifying Video over IP

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@EvertzTV

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Topics Covered

- SMPTE 2022-6, SMPTE RDD 37 (ASPEN), VSF TR-03, and SMPTE 2110
- Ultra HD over IP
- 10/25/100GbE Infrastructure
- SDVN Orchestration and Control
- Big Data Analytics

IP in the Facility

What’s out there

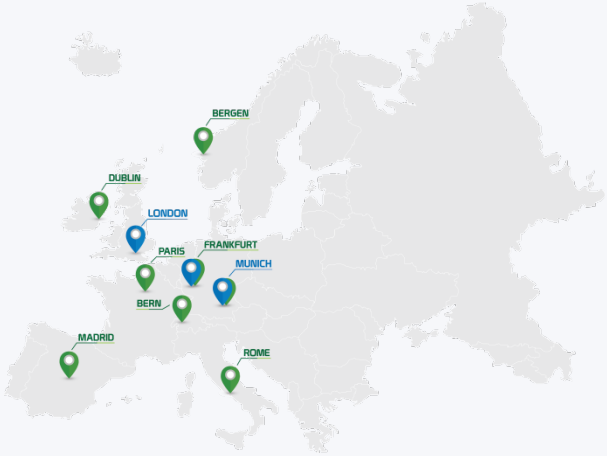
IP. Here and Now.

Key Messages

- Today
  - 40 EXE-VSRs globally
- Rio 2016 Games
  - NBC used EXE at it’s core

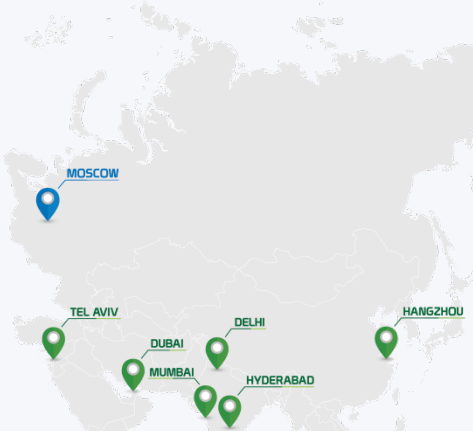
NORTH AMERICA

EUROPE

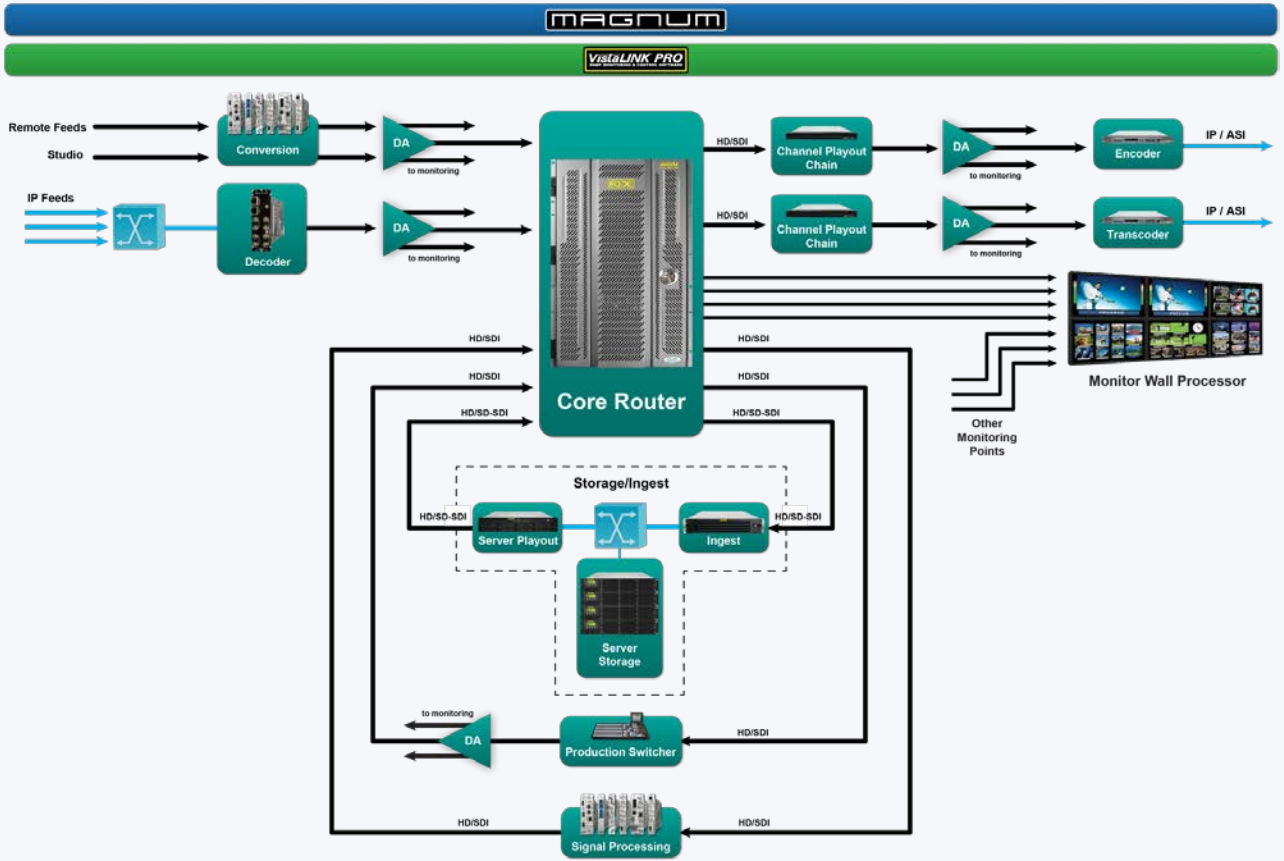


SOUTH AMERICA

ASIA



Traditional SDI Workflows



Why we like baseband ?

- ✓One signal, one cable
- ✓Simple control system
- ✓Discrete and deterministic switching
- ✓Extremely low level of jitter and latency
- ✓Easy to manage and use

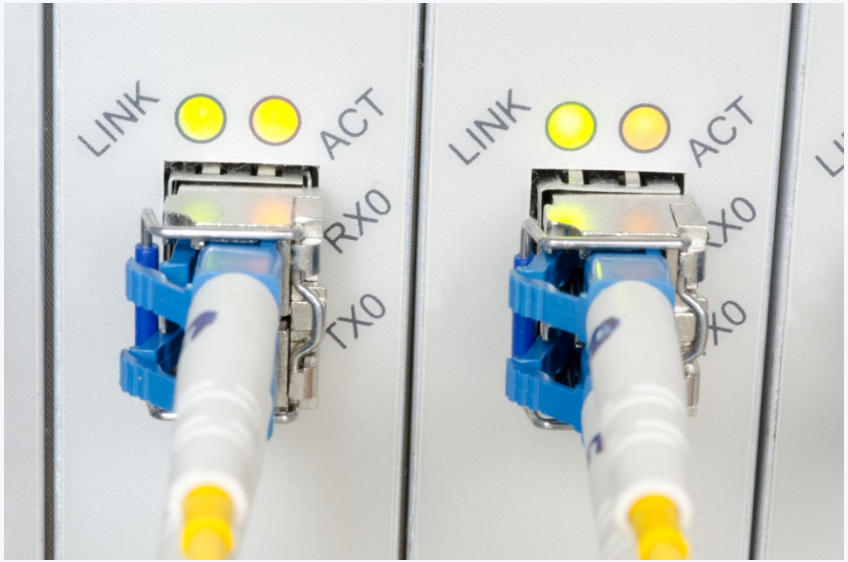
What are the new challenges ?

- ✓More HD services, multi screen (OTT)
- ✓Ultra HD and Beyond
- ✓OPEX/CAPEX
- ✓Future Proofing Facility

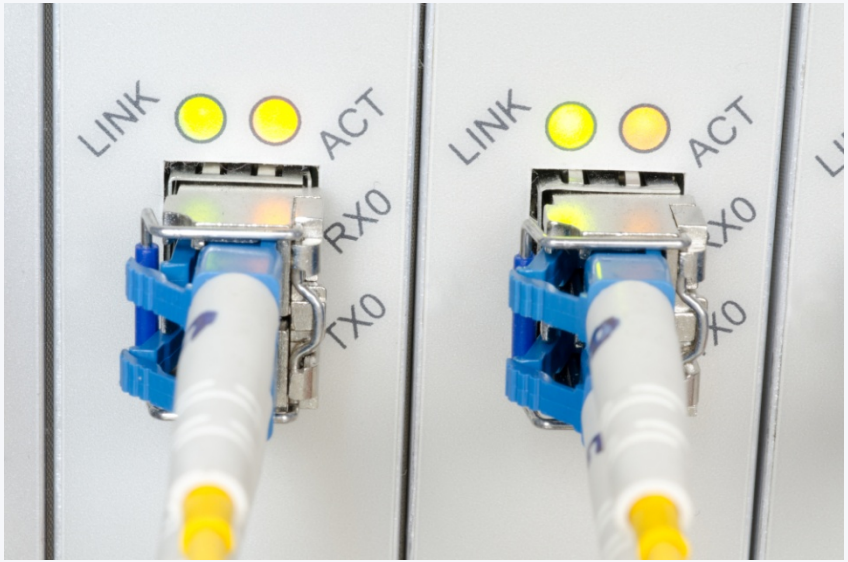
IP in the facility

John Footen says “One of the good things about using IP is that the IP stack itself is not something we have to spend time specifying.
This is a huge advantage, and the reason why the media industry is moving in this direction.
We need to use the basic foundation, so engineers can work on making sure the underlying media is right, without worrying about transport.

Benefits of IP



- Less cables (6HD in 10GE)
- Bi-Directional
- Direct Optical Interfaces
- Simple WAN interconnects



Benefits of IP Facility

Using 10GbE, 25GbE, 40GbE, or 100GbE

- Format Agnostic (Future Proof)
- Scalable and Flexible
- Efficient Workflows
- Path to Virtualization

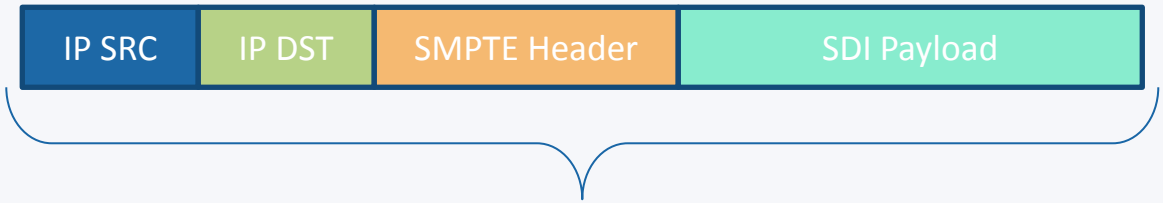
Uncompressed over IP

What’s out there

SDI to IP Encapsulation Standards

SMPTE 2022-6

“Transport of High Bit Rate Media Signals over IP Networks (HBRMT)”



One Multicast IP Stream

SMPTE ST 2022-6 HBR MEDIA PAYLOAD HEADER

OFFSET	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	EXT				F	VSID			FRCOUNT								R		S		FEC				CF			RESERVED				
32	MAP				**FRAME**												**FRATE**								SAMPLE			FMT-RESERVED				
64	*VIDEO TIMESTAMP*																															
96	*HEADER EXTENSION*																															

SMPTE ST 2022-6 HBR MEDIA PAYLOAD HEADER EXTENSION EXAMPLE

OFFSET	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
96	*FIRST TAG (0x01)*								*FIRST VALUE LENGTH (0x03)*								*FIRST VALUE* ⤵															
128	↳ *FIRST VALUE*								*SECOND TAG (0x02)*								*SECOND VALUE LENGTH (0x02)*								*SECOND VALUE* ⤵							
160	↳ *SECOND VALUE*								*STUFFING (0x00)*								*STUFFING (0x00)*								*STUFFING (0x00)*							

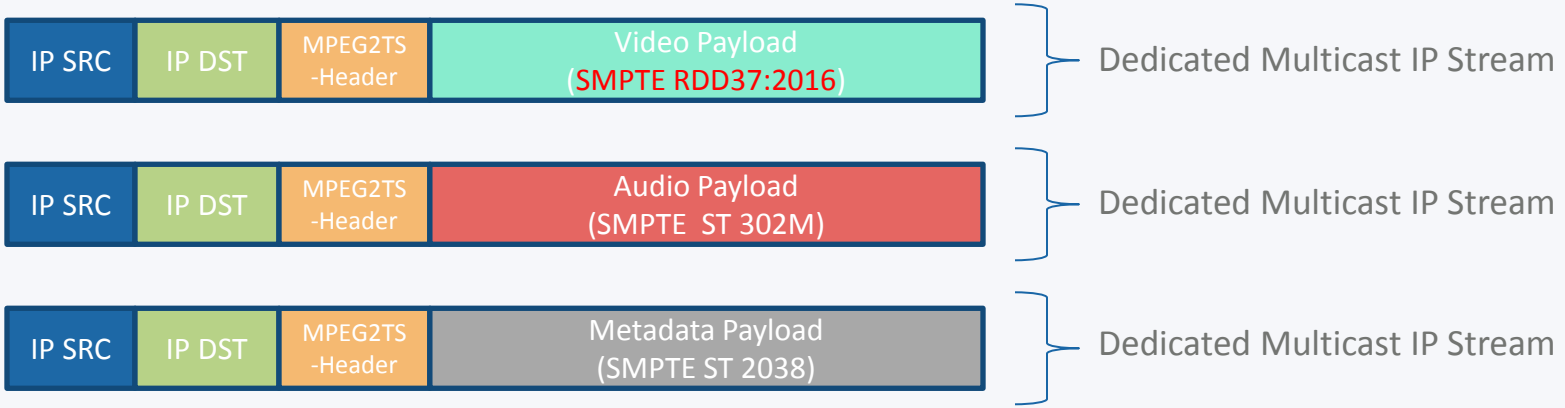
- Frame
  - Identifies raster size and sampling structure. Doesn't support anything higher than 2048x1080p (yet).
- Frate
  - Identifies frame rate. Doesn't support anything higher than 60Hz (yet).

Source: Francois Legrand, CBC presentation VSF 2/16.

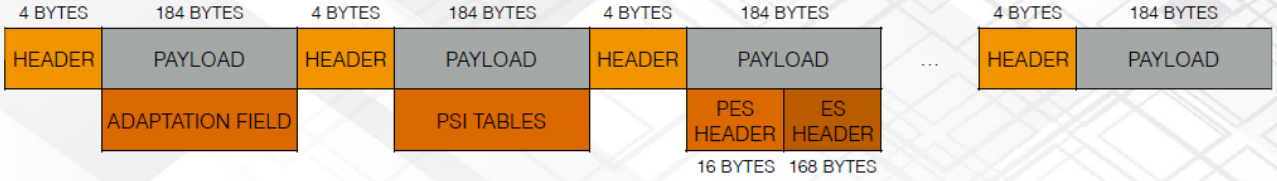
SDI to IP Encapsulation Standards

ASPEN (Open format that expands on ISO/IEC 13818-1)

“Open Framework to Transport Video, Audio, and Metadata over IP”



RDD37:2016 – Published by SMPTE in March 2016



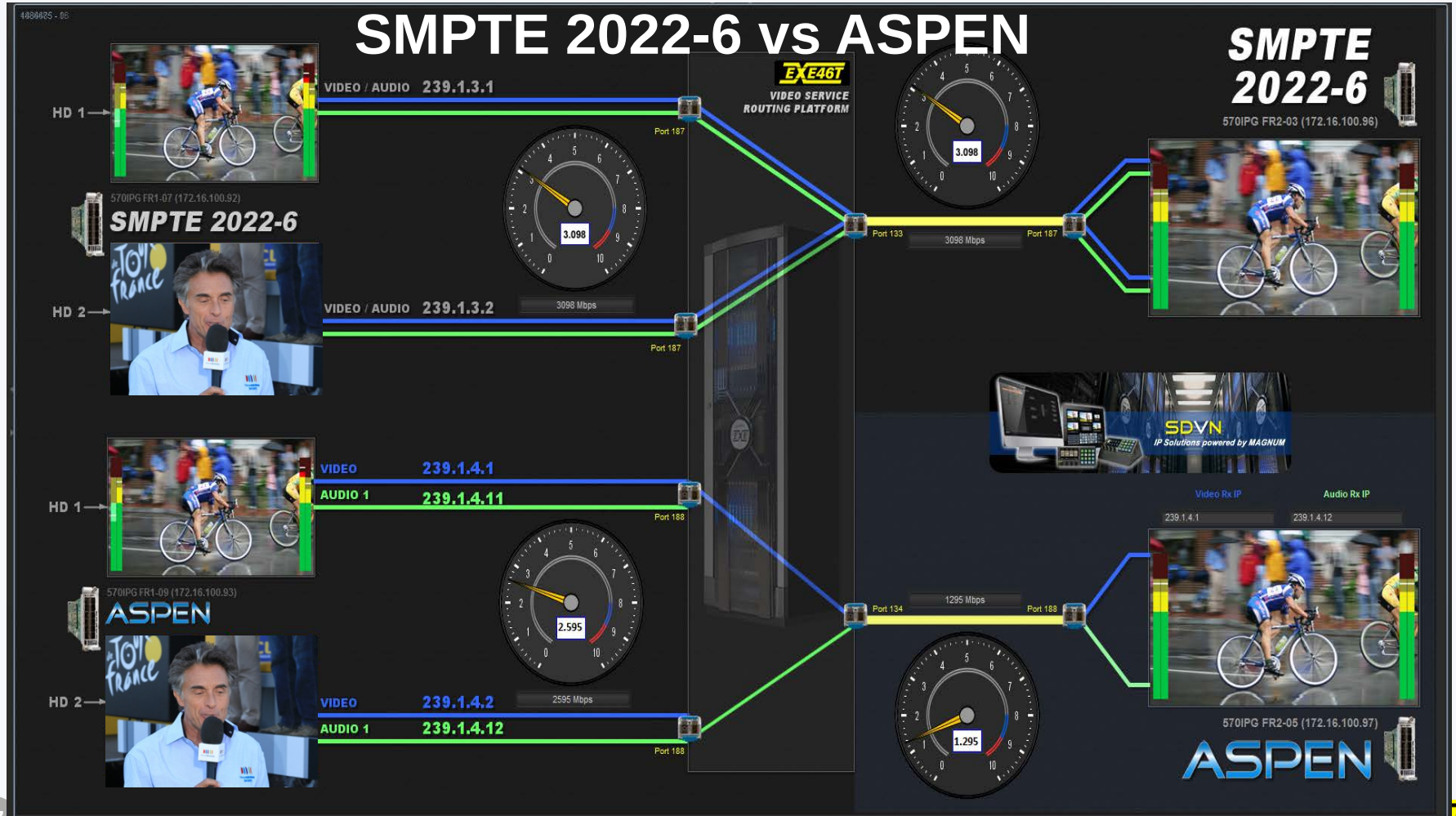
PROPOSED MODIFICATIONS TO ISO/IEC 13818-1:2013 ES HEADER (ASPEN)

OFFSET	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	FRAME COUNTER								TOTAL HORIZONTAL SIZE																ACTIVE HORIZONTAL SIZE							
32	ACTIVE HORIZONTAL SIZE								FIRST ACTIVE PIXEL																TOTAL VERTICAL SIZE (FIELD 0)							
64	TOTAL VERTICAL SIZE (FIELD 0)								ACTIVE VERTICAL SIZE (FIELD 0)																FIRST ACTIVE LINE (FIELD 0)							
96	FIRST ACTIVE LINE (FIELD 0)								FIRST EXTENDED ACTIVE LINE (FIELD 0)																TOTAL VERTICAL SIZE (FIELD 1)							
128	TOTAL VERTICAL SIZE (FIELD 1)								ACTIVE VERTICAL SIZE (FIELD 1)																FIRST ACTIVE LINE (FIELD 1)							
160	FIRST ACTIVE LINE (FIELD 1)								FIRST EXTENDED ACTIVE LINE (FIELD 1)																FRAME RATE DENOMINATOR							
192	FRAME RATE DENOMINATOR								FRAME RATE NUMERATOR																COLOR SPECIFICATION							
224	0	0	0	0	COMP SIZE				0	0	0	0	0	0	SS		HORIZONTAL SYNC START															
256	HORIZONTAL SYNC STOP																VERTICAL SYNC START (FIELD 0)														
288	VERTICAL SYNC STOP (FIELD 0)																VERTICAL SYNC HORIZONTAL POSITION (FIELD 0)														
320	VERTICAL SYNC HORIZONTAL POSITION (FIELD 0)																VERTICAL SYNC START (FIELD 1)														
352	VERTICAL SYNC STOP (FIELD 1)																VERTICAL SYNC HORIZONTAL POSITION (FIELD 1)														
384	HS	VS	RESERVED																													
...																																
LAST	RESERVED																PES/ES HEADER CRC														

- ES Header is flexible enough to allow the mapping of private data.
- ASPEN encapsulation uses it to store video metadata.
- Overhead of TS is <5%.

Source: Francois Legrand, CBC presentation VSF 2/16.

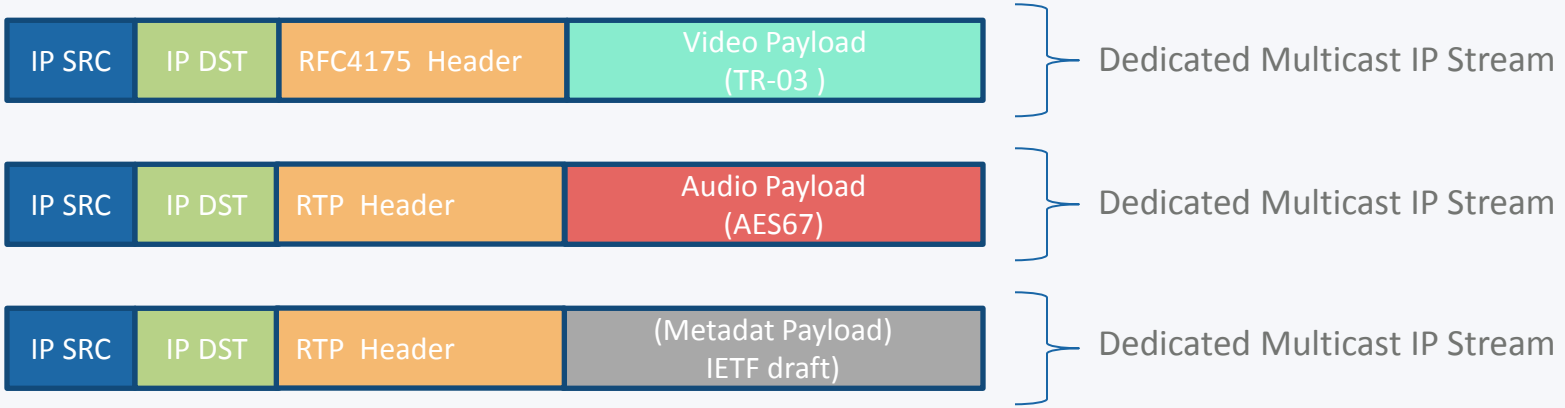
SMPTE 2022-6 vs ASPEN



SDI to IP Encapsulation Standards

VSF TR-03

“Another way to carry multiple streams”



What is TR-03?

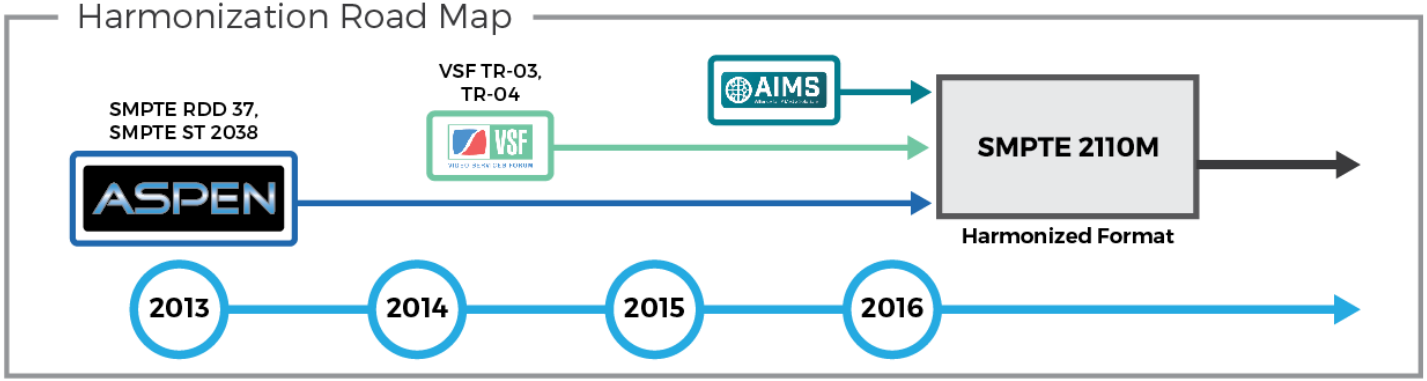
Explanation

- Proposed as a **T**echnical **R**ecommendation by Video Services Forum (VSF)
    - Evertz a member already (with 70 others)
- RFC4175 for uncompressed video (3G/HD/SD)
- AES67 for audio
- Undefined for metadata, Internet draft based on SMPTE 2038
- SMPTE 2059-2 (PTP) for timing
- SDP (Session Description Protocol) for essence association is proposed for registration of flows

IP Here & Now

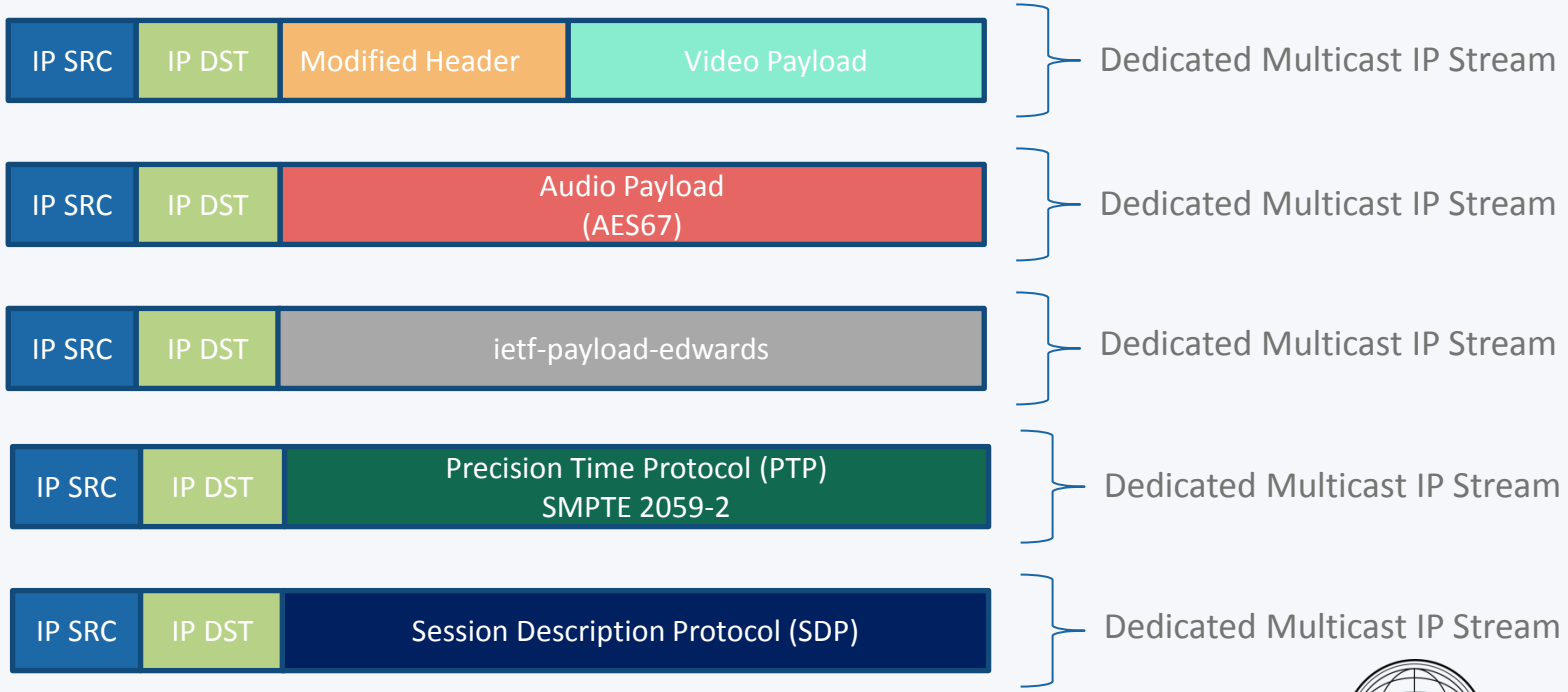
Software Defined Video Networking Solutions

evertz



Video, Audio, & Metadata to IP Encapsulation

Future Standard SMPTE 2110



Standards Update

SMPTE 2110 Family

- ST2110 family consists of 4 main parts
  - ST2110-10 System Overview (**working draft**)
  - ST2110-20 Uncompressed Video (**draft submission**)
  - ST2110-30 PCM Audio (**working draft**)
  - ST2110-40 Ancillary Data (**in development**)
- ST2110 standards completion
  - NAB 2018 (AIMS roadmap)

Standards Update

SMPTE 2110 Goals

- Ensure the right thing is being done
- Looks at all applications (Live, cloud, etc.)
- Provides early IP adopters with future-proof solution

Interop Update

- Numerous Interops have/will be held in US/Europe
  - Identify issues with proposed standards and formats
  - Test out vendor interoperability
- Largest to date at Fox Houston (26 Vendors)
  - Aug 2016
  - ST2022-6, RFC4175, AES67, ST2059 (PTP), TR-03

Supported IP Formats

- SMPTE 2022-6
- TR-03
- RFC4175
- AES67
- PTP
- ASPEN

Interop

- AJA Video Systems
- Arista
- Artel
- Avid
- Cobalt
- Coveloz
- Deltacast
- Embrionix
- EVS
- Belden - Grass Valley
- Harmonic
- Ikegami
- Imagine Communications
- Lawo
- LiveU
- Macnica
- Matrox
- Media Global Links
- Nevion
- Panasonic
- Riedel
- Rohde & Schwarz
- Ross Video
- SAM
- SonoVTS
- Sony
- Tektronix
- TVU
- Utah Scientific
- Vizrt
- Wheatstone

Interop & Community

- Abekas
- AJA Video Systems
- AMV
- Broadcast Pix
- ChryonHego
- Cinegy
- Comprehensive Technical Group (CTG)
- CSP Inc.
- Deltacast
- Discovery
- Dome Productions
- Edit Share
- Embrionix
- Evertz
- FOR-A
- FSUE "TTC" Ostankino"
- Game Creek Video
- Guitammer
- Hitachi Kokusai
- Electric Limited Inc.
- I-MOVIX
- Ikegami
- LEADER Electronics Corp.
- LiveU
- Macnica America Inc.
- Matrox Electronic Systems Ltd.
- Media 5
- NBC Sports Group
- NEP Group Inc.
- Neutrik
- NewTek
- Nextera
- PacketStorm
- Phabrix
- Pixel Power
- Providius Corp,
- Rohde & Schwarz
- Ross Video
- SolidState Logic
- Sony
- Streampunk Media
- Tektronix
- The Weather Channel
- Time Warner Cable SportsNet
- TV2
- TVU
- Velocity Broadcast
- Vizrt

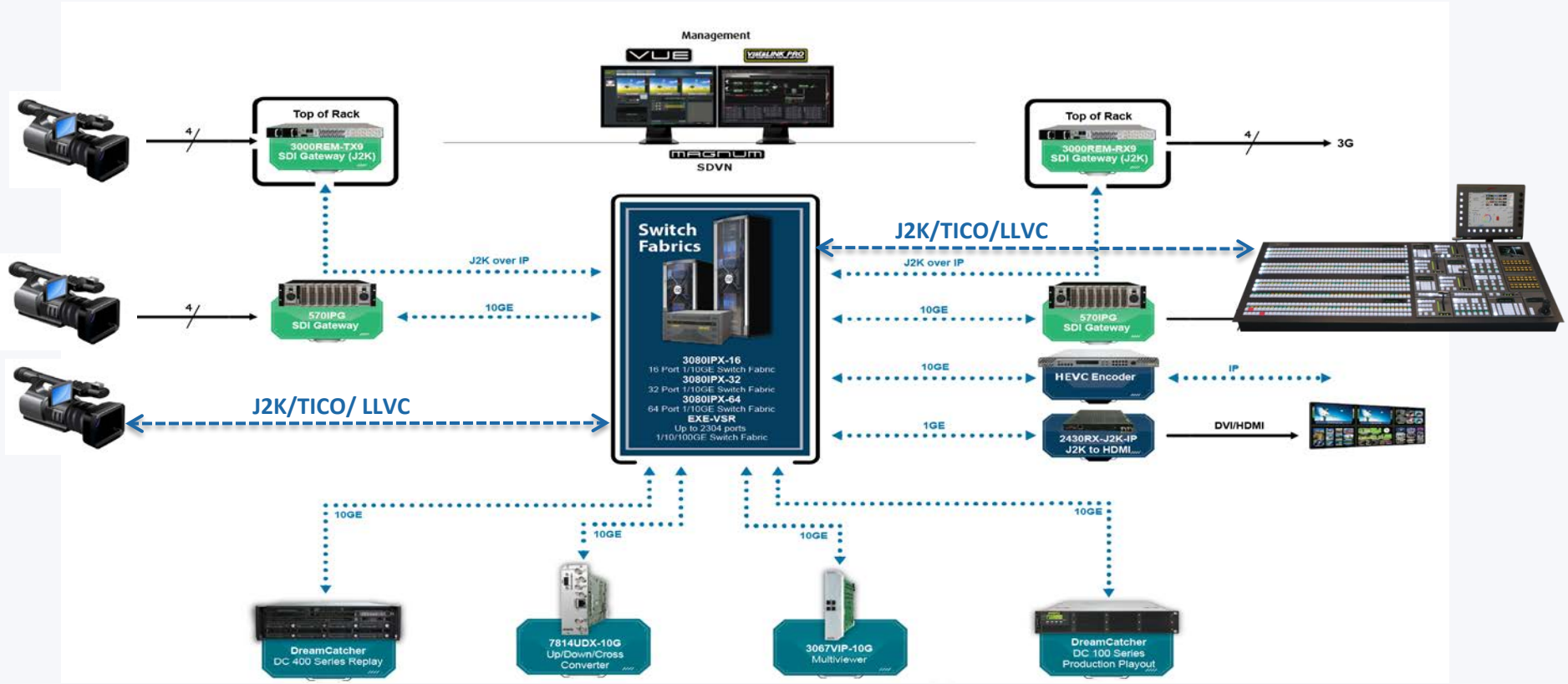
Ultra HD over IP

How?

Compressed 4K

- ✓ JPEG2000
  - ✓ Open format (VSF TR01) with interoperability
  - ✓ Uses TS
- ✓ Sony LLVC
  - ✓ Published as RDD
  - ✓ Must use for 4K over NMI
- ✓ TICO
  - ✓ Published as RDD
  - ✓ Can map to 3G-SDI payload and use SMPTE 2022-6
- ✓ VC-2
  - ✓ Published as SMPTE

Ultra HD Production Using IP

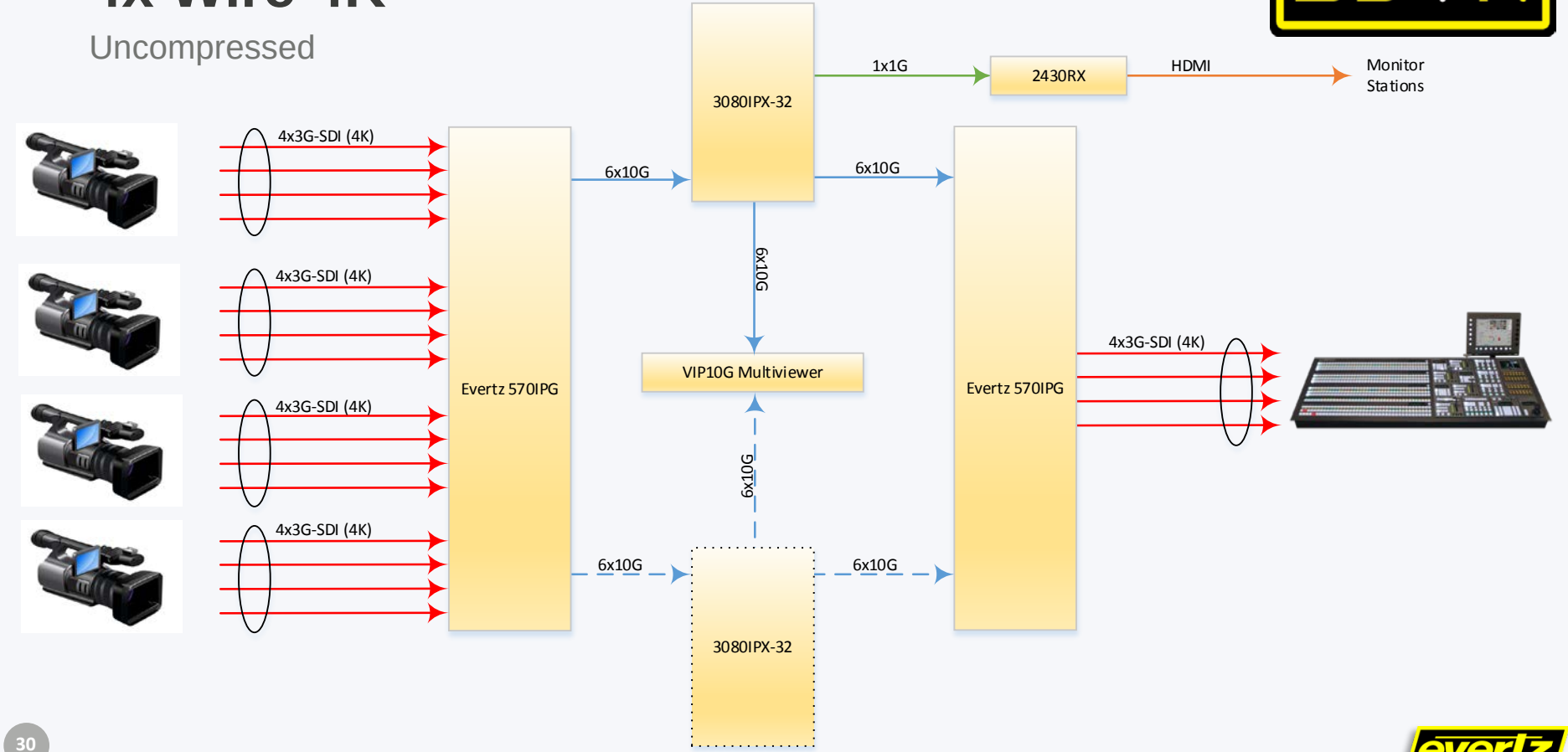


Uncompressed 4K (or 8K)

- SMPTE 2022-6
  - No provisions for uncompressed UHD (4K or 8K)
  - Standard only for 10GbE links
  - No support for higher frame rates
- Sony NMI
  - Cannot carry uncompressed UHD 4K
- RFC4175
  - Uncompressed UHD (4K or 8K) not supported yet

4x Wire 4K

Uncompressed



Why 25GbE?

Benefits

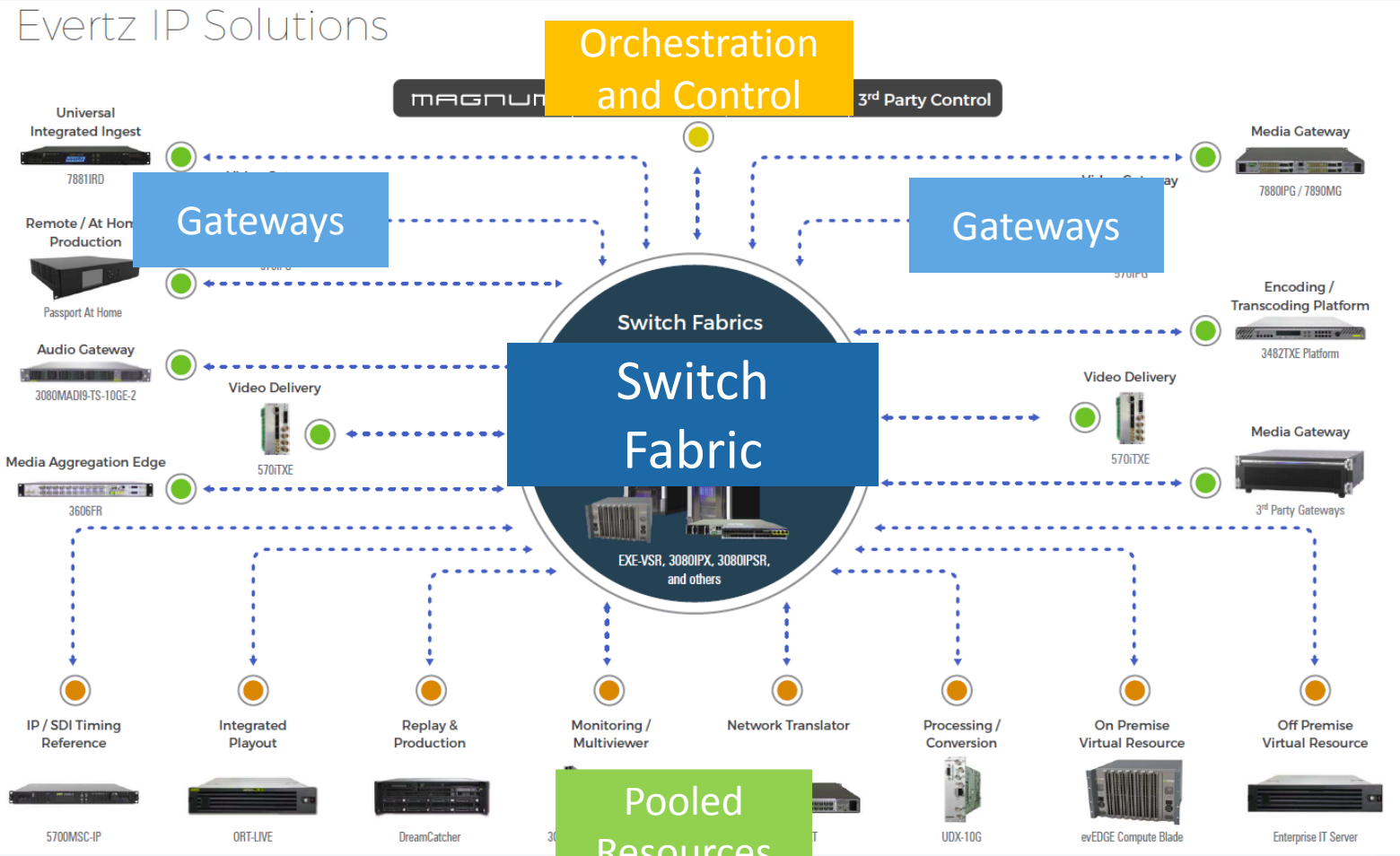
- Up to 8 Uncompressed 3G-SDI over a single interface
- Up to 2 Uncompressed 12G-SDI (for UHD) over a single interface (or 1 uncompressed UHD/4K 120p)
- 2.5 times more density then 10GbE
- Less cables
- Ideal for aggregation

25GbE vs 40GbE

Differences

- 25GbE
  - SFP28+
  - Single Duplex interconnection
  - Full 25Gb/s bandwidth
- 40GbE
  - QSPF
  - Quad Duplex
  - Four independent 10GbE pairs

Evertz IP Solutions



Switch Fabrics

What to consider…

Purpose Built IP Switch Fabric

- Utilize SDN on “White Box” switch fabric
- Google, Facebook, Amazon utilizing this approach
- Evertz using SDN on EXE IP switch Fabric
- Deterministic Switching with constant latency
- Fully non-blocking – No oversubscription for Video Traffic
- Fully redundant – No convergence issues
- Simple config & management – Looks like video router
- End to End Management with MAGNUM SDVN
- Super scalable –Modular, build as grow, 1000’s of streams

Switch Fabric

Requirements for Live Video

High Capacity

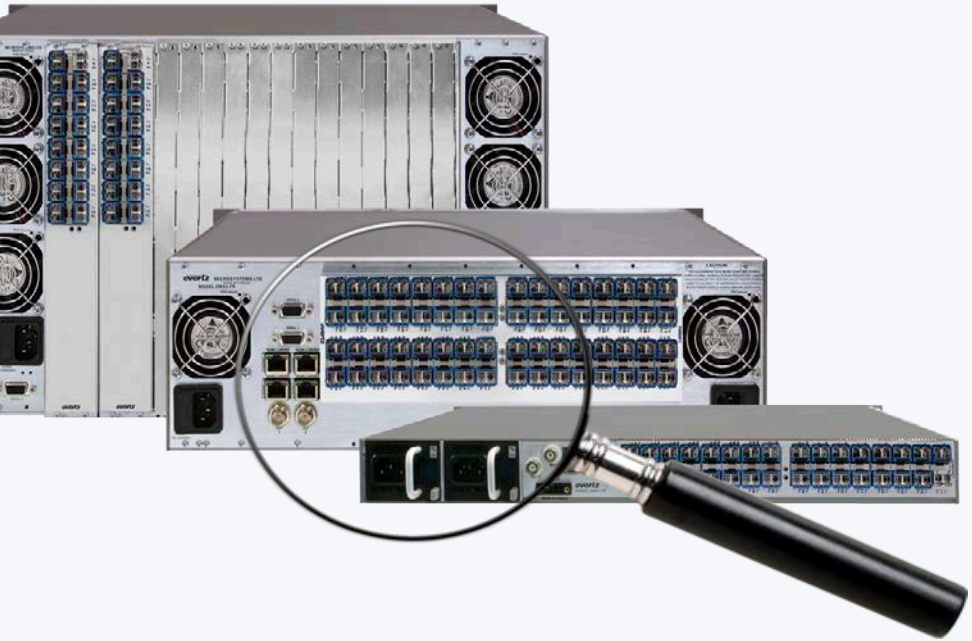
What's the equivalent of 1152 x 1152 3G-SDI

Non-blocking

No congestion or packet drops/queues

Ultra low latency

No processing in the fabric



Switch Fabric

Requirements for Live Video

Visibility

Where the video is going

Full Control of path

Path is chosen by operator not switch

Guarantee flow

Need to deterministic switching

Timing

Frame / VBI Switching

Switch Fabric

Requirements for Live Video

Redundancy

Network based

Path Redundancy

Within switch fabric

Hardware

Physical chassis

Advanced Security

No unknown packet forwarding through the switch.

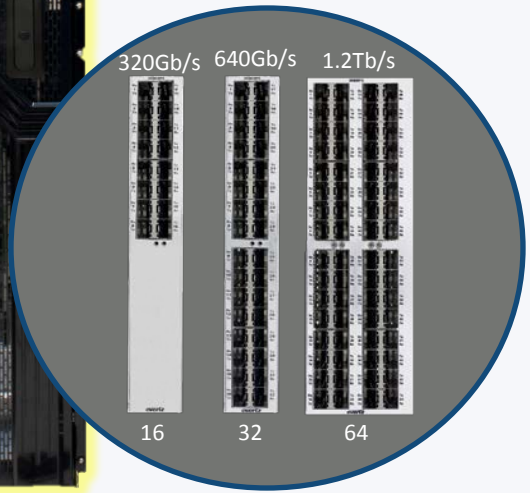
Switch Fabrics

What does Evertz offer…

EXE-40RU (2304x10GE)

EXE-28RU (1152x10GE)

EXE-16 RU(576x10GE)



EXE-VSR and 3080IPX

High Capacity Packet Switches

High Capacity

Up to 46 Tb/s Switching Capacity with non-blocking architecture

Scalable

Grow from 96 to 138000 Uncompressed HD-SDI

Format Agnostic

ST 2022-6 or SONY NMI or ASPEN or TR-03 or ST 2110

Support for 10/25/100GbE

Up to 2304 10GbE SFP+ and support for 100GbE CXP

evEDGE

Software Defined Compute and Routing platform

Redundant Switching

16/32/64/128 Port IPX Switch Fabrics

Double Density IPG

Next Gen Uncompressed IPG Platform (ASPEN, SMPTE 2022-6, NDI, RFC4175, and AES67

Edge Compute Blades

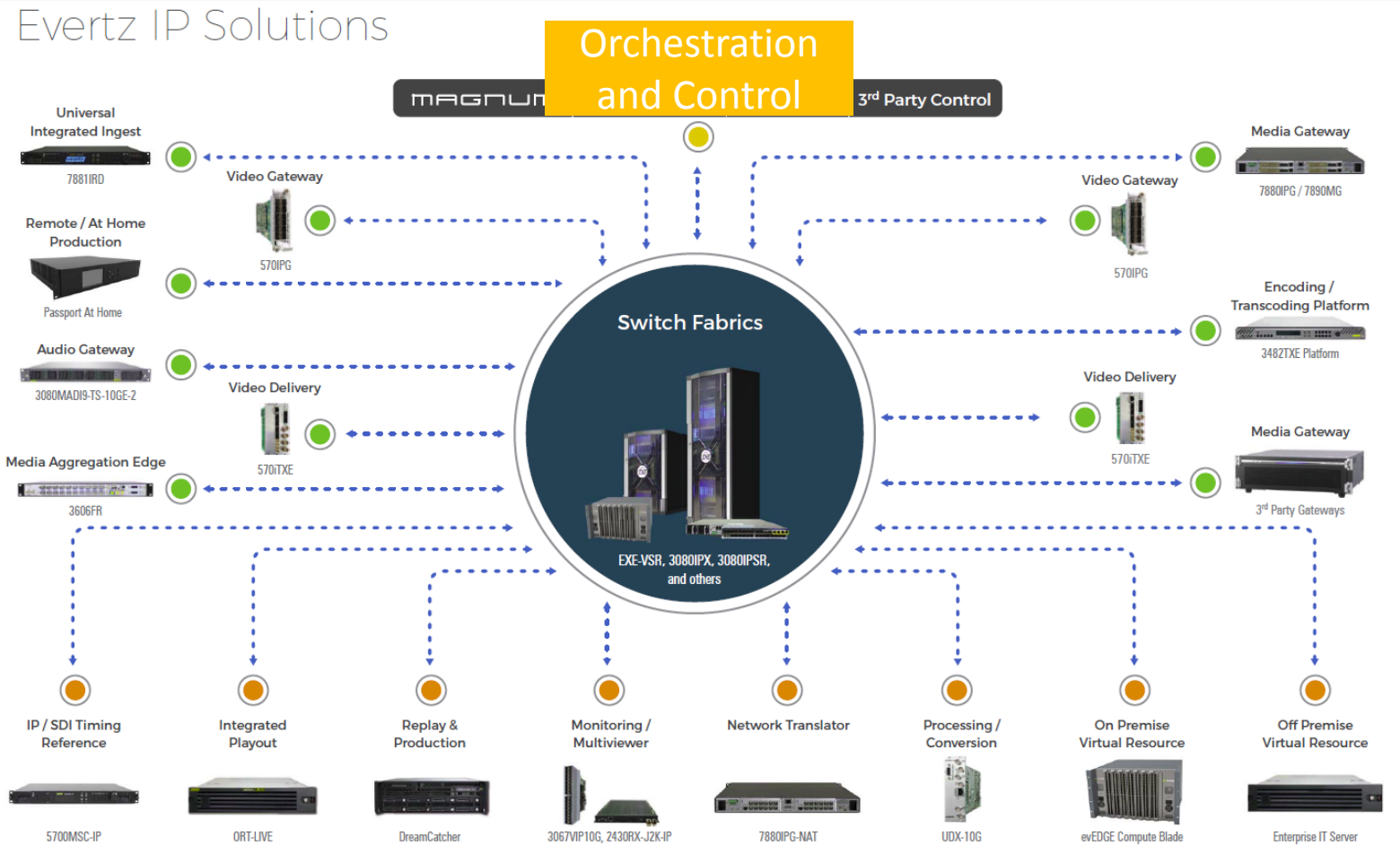
Firmware Specific Process FPGA Engine

.

Elasticity and Agility

Build, stack standalone or Core

Evertz IP Solutions



Software Defined Video Networking

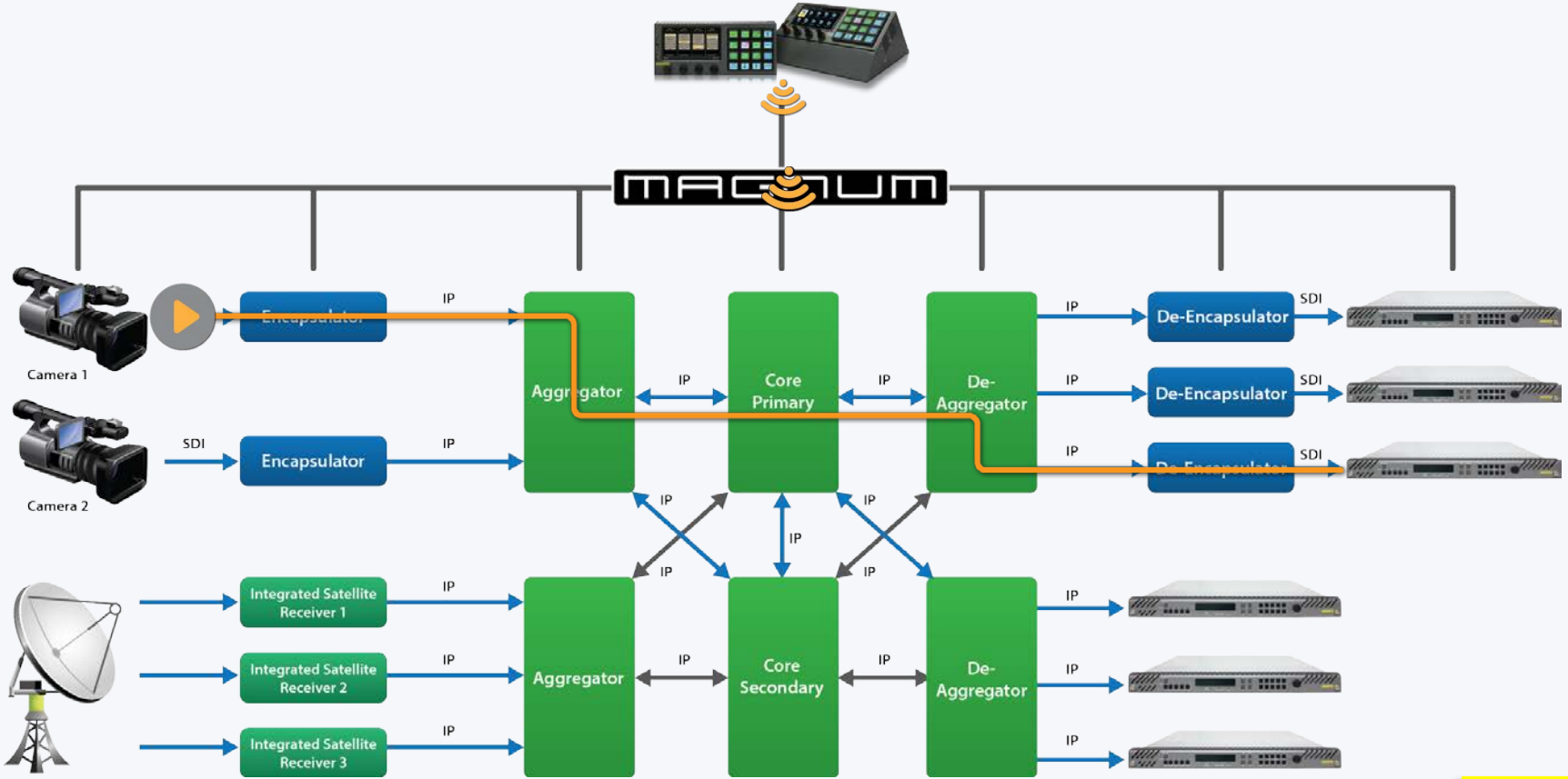
The key is software orchestration

SDVN Orchestration/ Control

- ✓ Full Control
  - ✓ End-to-end control
- ✓ Familiar interface for operators
- ✓ Bandwidth Management
- ✓ Hybrid (SDI and IP)
- ✓ Manages and Schedules Resources

everlz

SDVN IP Workflows

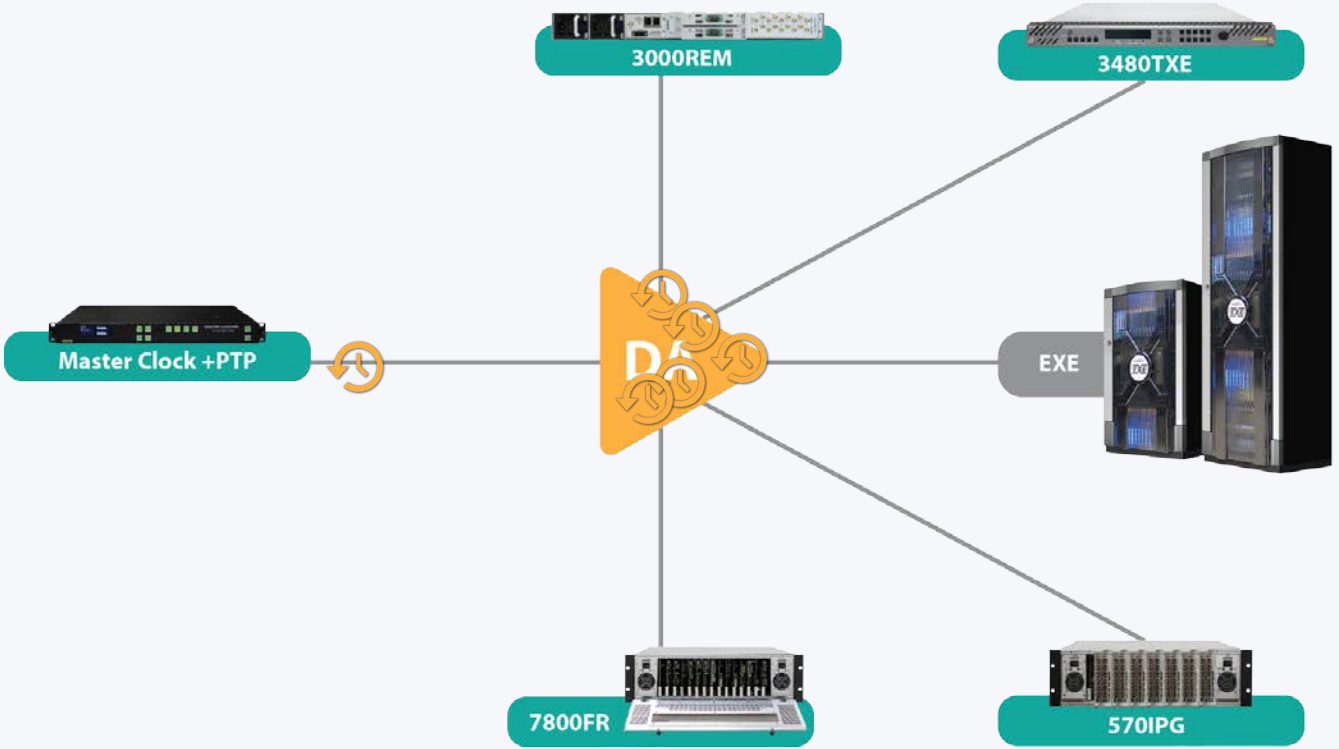


Timing

How to time

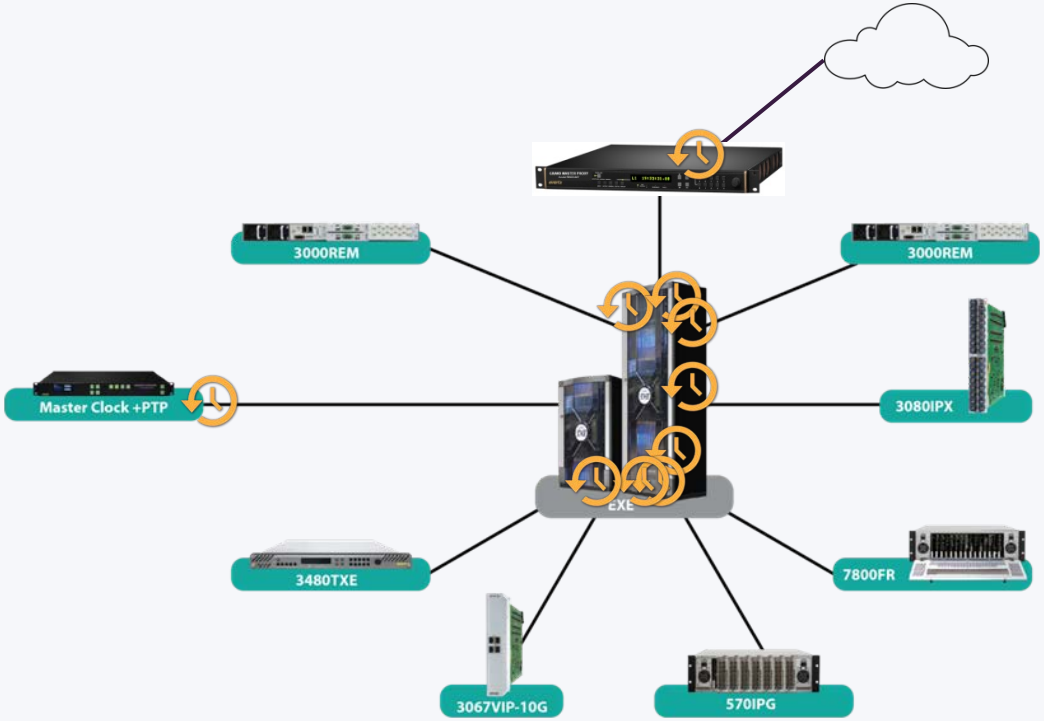
Synchronizing the IP facility

Legacy Reference: Analog Black Burst



Synchronizing the IP facility

IEEE 1588 – PTP over UDP/IP Multicast Transport



Evertz Operational Intelligence
Big Data Analytics

Functional Overview

Edge Devices
Terminal Gear

Core Routers

Compression

Playout
File-based

overture RT LIVE

MEDIATOR·X

Orchestration / Ctrl
Monitoring

3rd Party

Syslog | SNMP | Unstructured Data | JSON | Custom IP (EXE)

inSITE

Big Data Analytics info store

User Queries
Reports

Troubleshooting
(Customer & Evertz)

Utilization
Trending

Data Graphs
Visualizations

Machine Learning
Prediction

Custom
Development

evertz

VistaLINK PRO GFX v12.0.0.2066

File Tree Alarm Configuration Audit Preset inSITE Tools Window Help

Tree Views Mode Identify History 1.0 Apply Status Started Logger

EXE Monitor

Settings

Live | inSITE

Connection Status

Connect Disconect

Active Payload: Fri Apr 01 16:26:42 EDT 2016

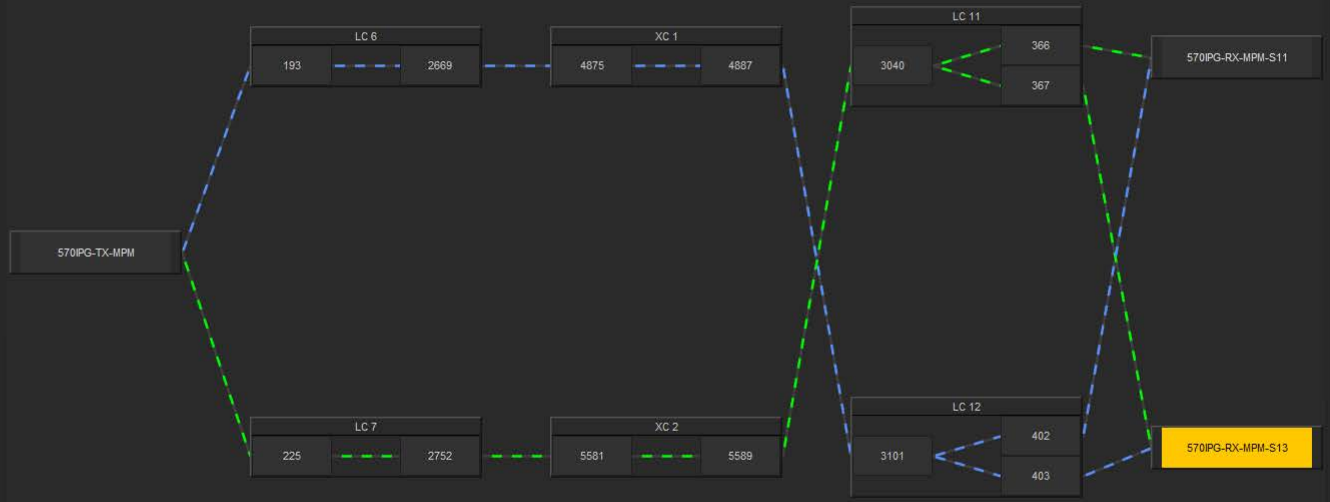
Active Data

Flows Ports

Multicast D...	Bandwidth	Source Port	Destination ...	Alias
239.1.2.4	1,364,013	189	375	
239.10.4.1	7,522	189	375	
239.10.4.2	7,521	189	375	
239.10.4.3	7,521	189	375	
239.10.4.4	7,521	189	375	
239.1.7.3	1,375,842	368	373	
239.1.7.4	1,375,834	368	373	
239.1.7.5	1,375,845	368	373	
239.1.7.6	1,375,834	368	373	
239.1.1.3	2,727,306	181	374	
239.1.1.4	2,727,281	182	375	
236.1.2.9	3	401	251	
236.1.2.10	3	402	251	
236.1.2.11	3	403	251	
236.1.1.14	3	404	215	
236.1.2.14	3	405	251	
236.1.2.13	3	406	251	
239.1.4.101	1,375,839	225	366	MPM-1a
239.1.4.102	1,375,839	225	366,367	MPM-2a
239.1.4.2	1,375,863	193	402,403	MPM-2b
239.1.4.103	1,375,845	225	366,367	MPM-3a
239.1.4.3	1,375,849	193	402,403	MPM-3b
239.1.4.104	1,375,839	225	366,367	MPM-4a
239.1.4.4	1,375,851	193	402,403	MPM-4b
239.1.4.105	1,375,839	225	366,367	MPM-5a
239.1.4.5	1,375,874	193	402,403	MPM-5b
239.1.4.106	1,375,840	225	366,367	MPM-6a
239.1.4.6	1,375,896	193	402,403	MPM-6b

Generate Path Clear Path

Flow Path



MPM-2a MPM-2b

Search Windows

4:26 PM 4/1/2016

VistaLINK PRO GFX v12.0.0.2066

File Tree Alarm Configuration Audit Preset inSITE Tools Window Help

Tree Views Mode Identify History 1.0 Apply Status Started Logger

EXE Monitor

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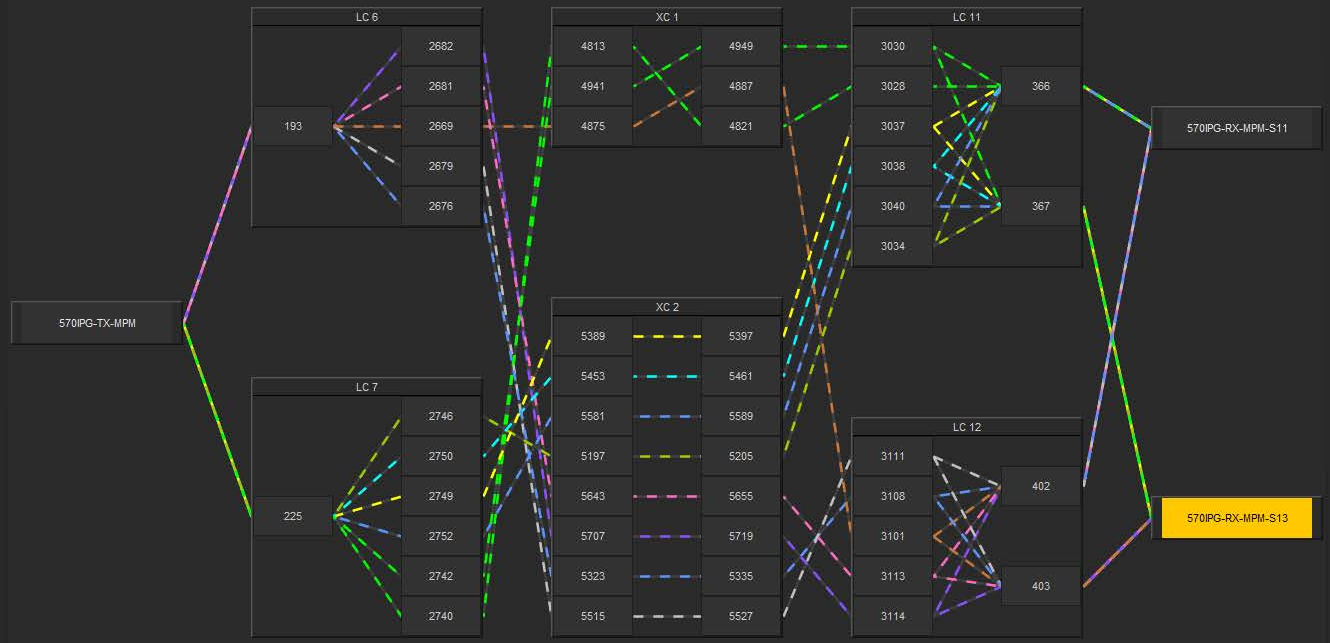
239.1.7.2	1,375,952	368	373	
239.10.3.4	7,523	189	375	
239.1.2.4	1,364,014	189	375	
239.10.4.1	7,521	189	375	
239.10.4.2	7,521	189	375	
239.10.4.3	7,521	189	375	
239.10.4.4	7,521	189	375	
239.1.7.3	1,375,830	368	373	
239.1.7.4	1,375,841	368	373	
239.1.7.5	1,375,852	368	373	
239.1.7.6	1,375,952	368	373	
239.1.1.3	2,727,264	181	374	
239.1.1.4	2,727,270	182	375	
236.1.1.4	3	192	215	
236.1.1.5	1,363,980	193	215	
236.1.2.2	3	186	251	
236.1.1.3	3	189	215	
236.1.2.3	3	190	251	
236.1.2.15	3	428	251	
239.1.4.101	1,375,840	225	366	MPM-1a
239.1.4.102	1,375,847	225	366,367	MPM-2a
239.1.4.2	1,375,857	193	402,403	MPM-2b
239.1.4.103	1,375,836	225	366,367	MPM-3a
239.1.4.3	1,375,862	193	402,403	MPM-3b
239.1.4.104	1,375,929	225	366,367	MPM-4a
239.1.4.4	1,375,856	193	402,403	MPM-4b
239.1.4.105	1,375,836	225	366,367	MPM-5a

Generate Path Clear Path

Flow Path

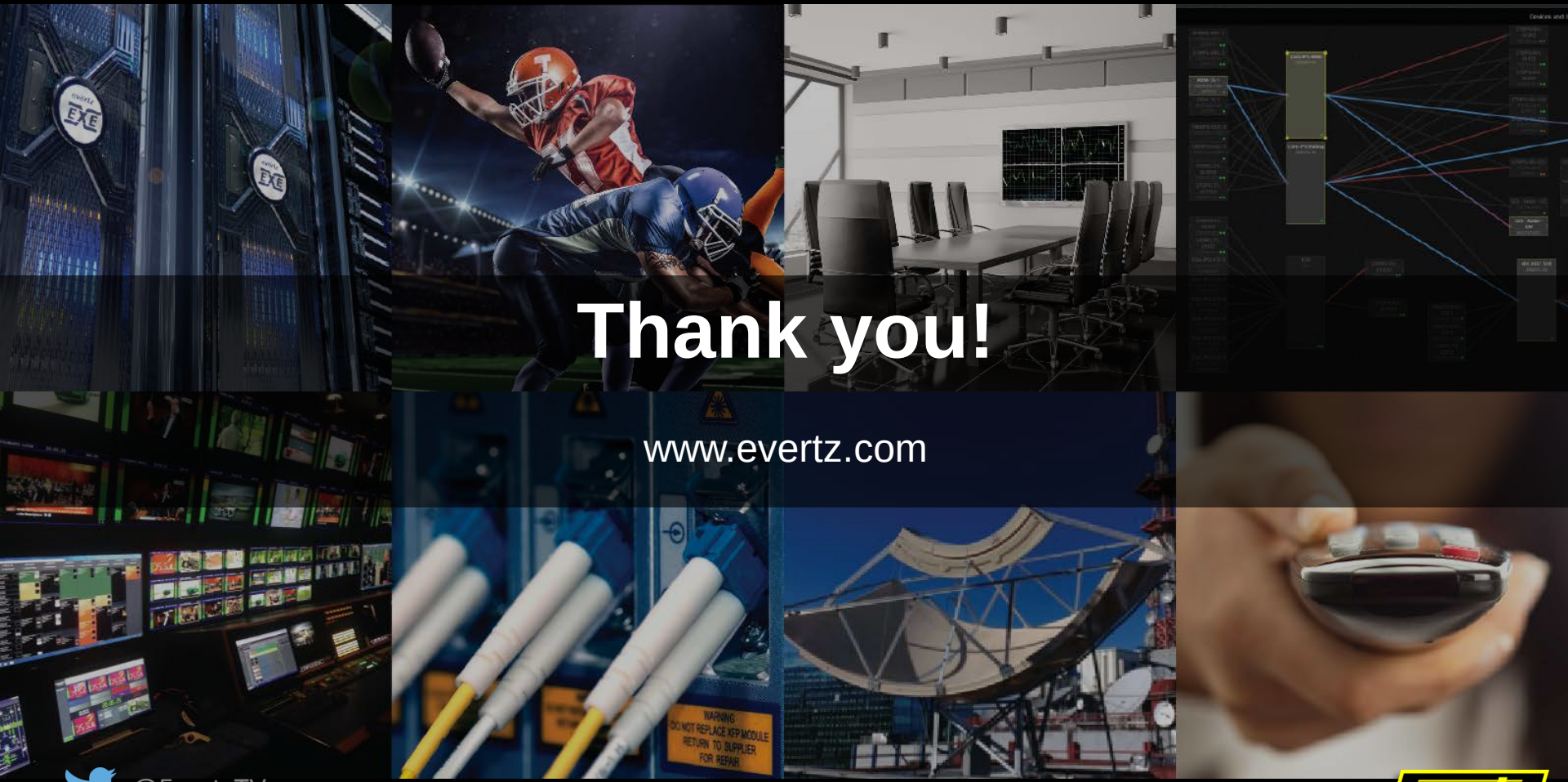


MPM-4a MPM-3a MPM-1a MPM-2a MPM-2b MPM-4b MPM-3b MPM-5a MPM-6b

Search Windows

4:27 PM
4/1/2016

Who’s deployed so far…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