You don’t have to throw your SDI baby away with the bathwater.

End-user case studies on deployments of all sizes, as well as post-deployment considerations

Kevin Salvidge – Leader Europe Limited

IP SHOWCASE™

Leader

Audio Engineering Society · AIMS Alliance for IP Media Solutions · AMWA Networked Media. Working. · EBU · SMPTE · VSF Video Services Forum

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Disclaimer

The following presentations features real life events.

No customer have been named, to prevent any potential embracement.

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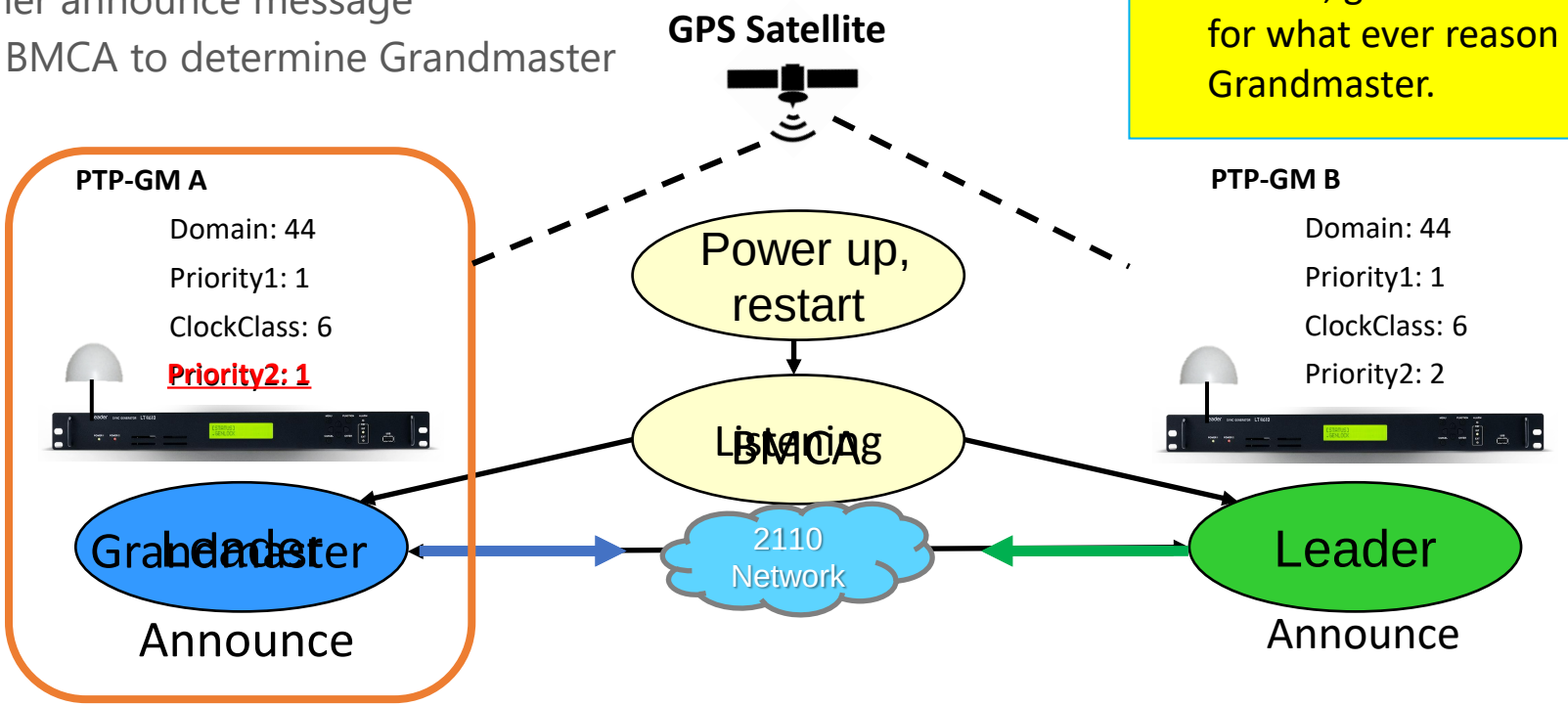
Reference Source

Unlike BB/TLS in the SDI world, PTP comes with a number parameters, that if incorrect configured, can result in unexpected an unpleasant affects to your IP operations.

Leader Best Master Clock Algorithm

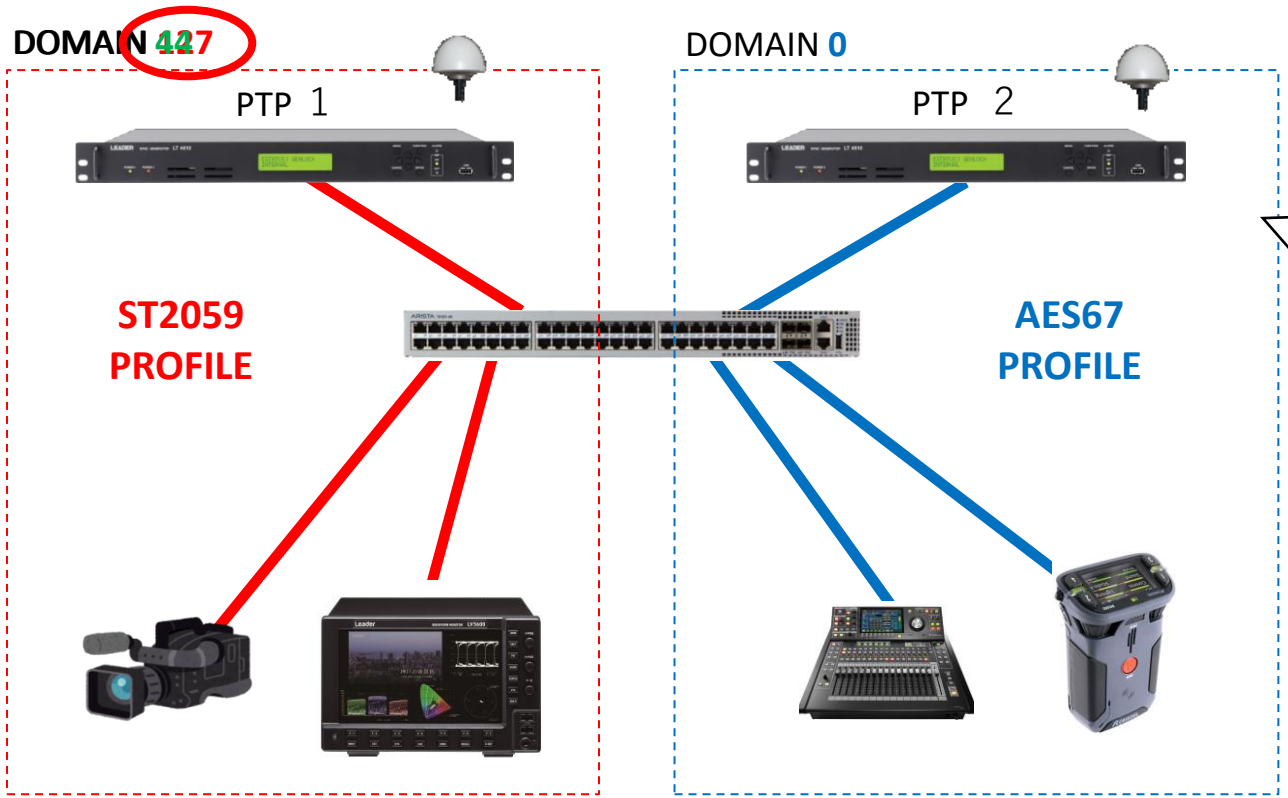
- BMCA（Best Master Clock Algorithm）
  - Who is Grandmaster?
  - When devices powered on
  - PTP Devices Listen
  - Gather announce message
  - Use BMCA to determine Grandmaster

- A key to the resiliency of the PTP is the BMCA.
- The BMCA allows a Leader to automatically become the Grandmaster or take over the duties of Grandmaster when the previous Grandmaster loses its GPS, gets disconnected due to a switch fault, or for what ever reason is unable to continue as Grandmaster.



PTP Domains

- System configuration with Domain divided
  - Some audio equipment only supports the profile of AES 67



Domains are for use of multiple PTP services simultaneously with one physical Ethernet connection.

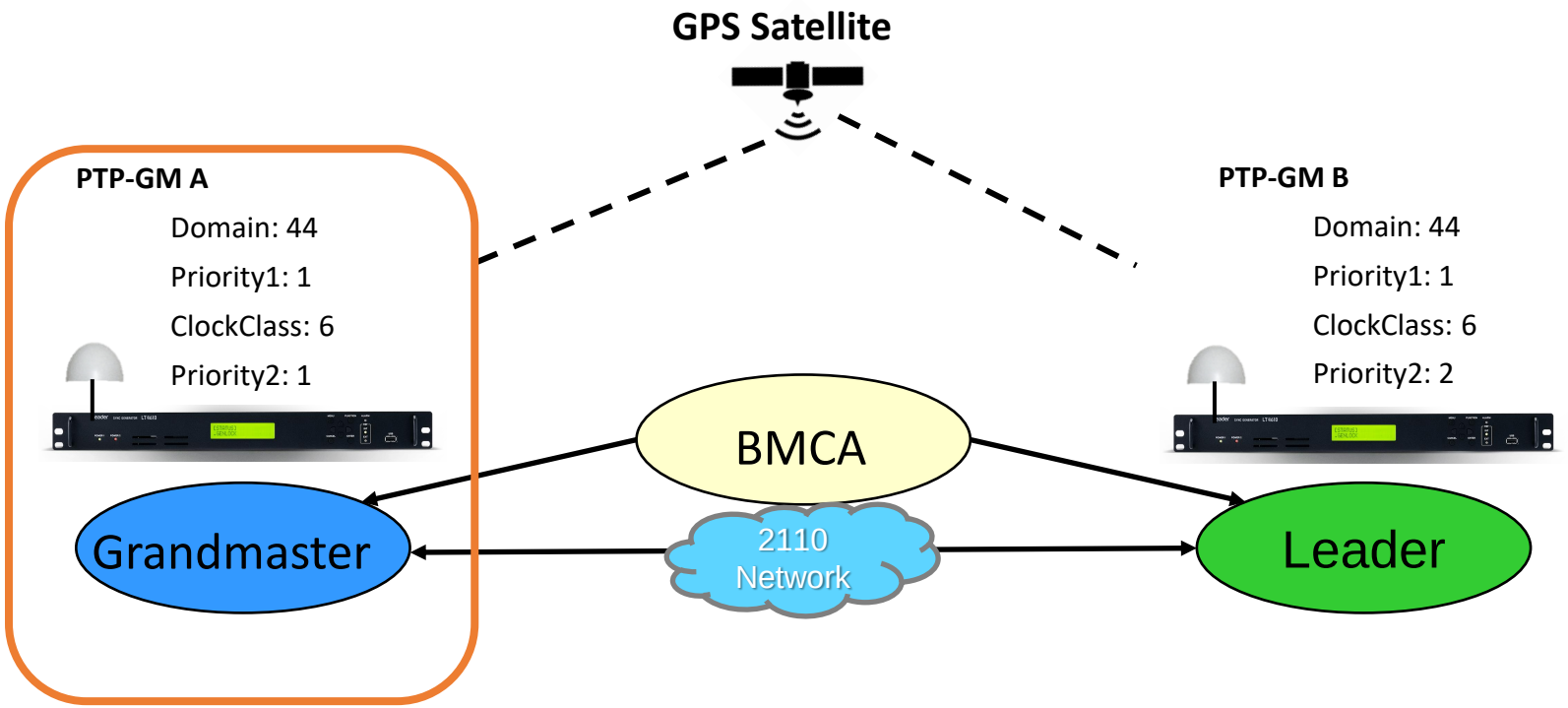
PTP operation is performed between devices having the same DOMAIN.

Domain 0 is used by Audio services for audio reference.

Domain 127 is the default for PTP, so any new equipment that is added to the network could be a Grandmaster via BMCA on Domain 127, so it is possible to have the new equipment take over without you knowing it.

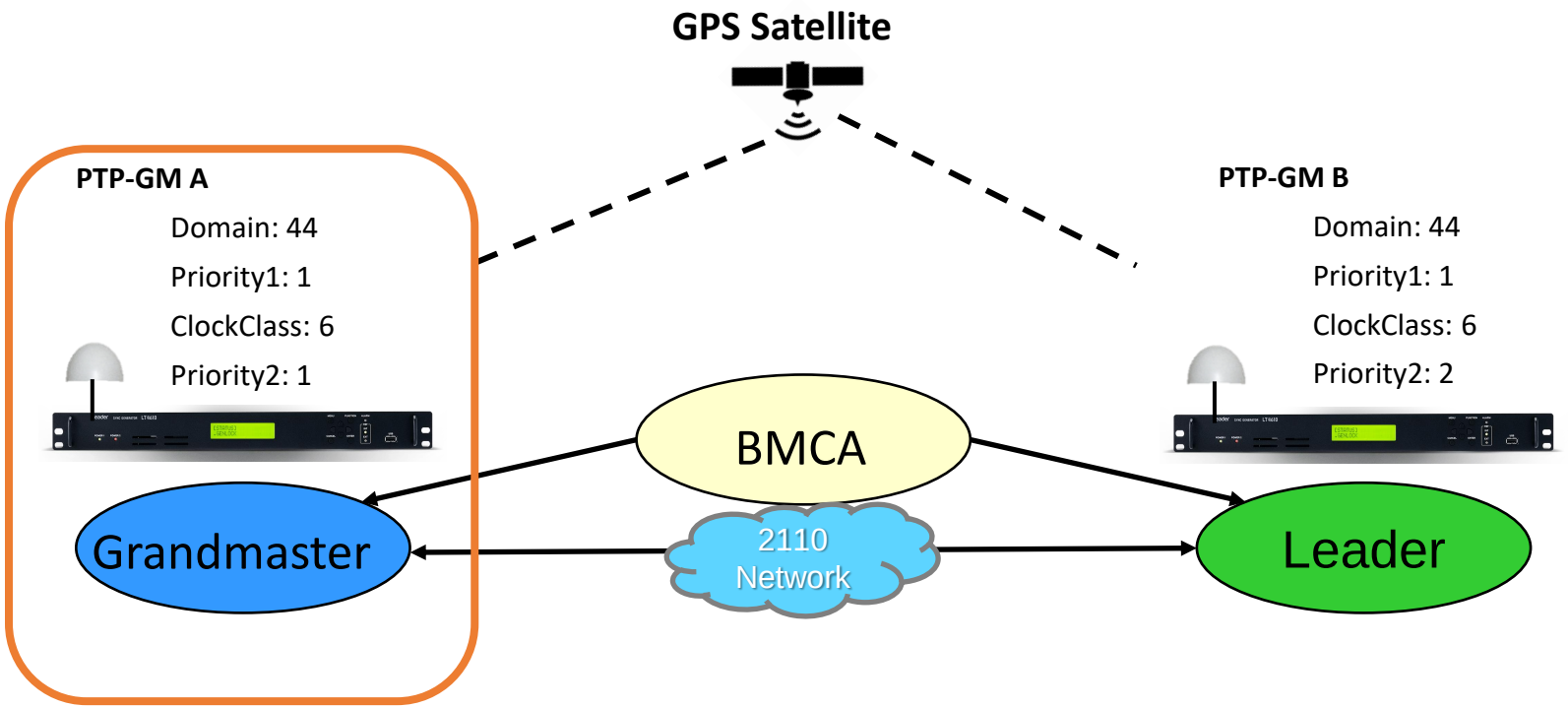
Best Master Clock Algorithm

- If the Leader does not see an Announce message from a better clock within the Announce Time Out Interval, then it takes over the role of Grandmaster.



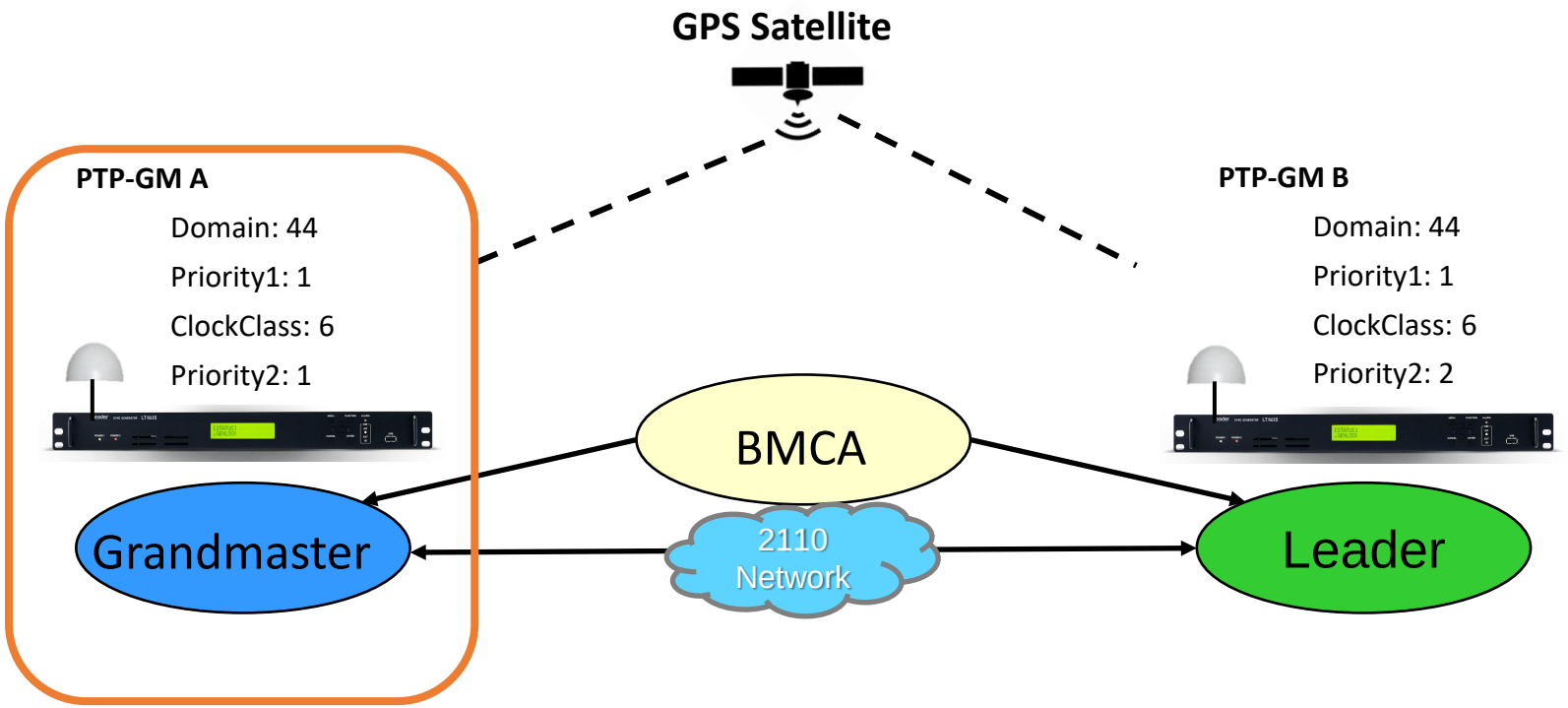
Best Master Clock Algorithm

- This runs continuously so Leader capable devices are constantly on the look out for the possible loss of the current Grandmaster.



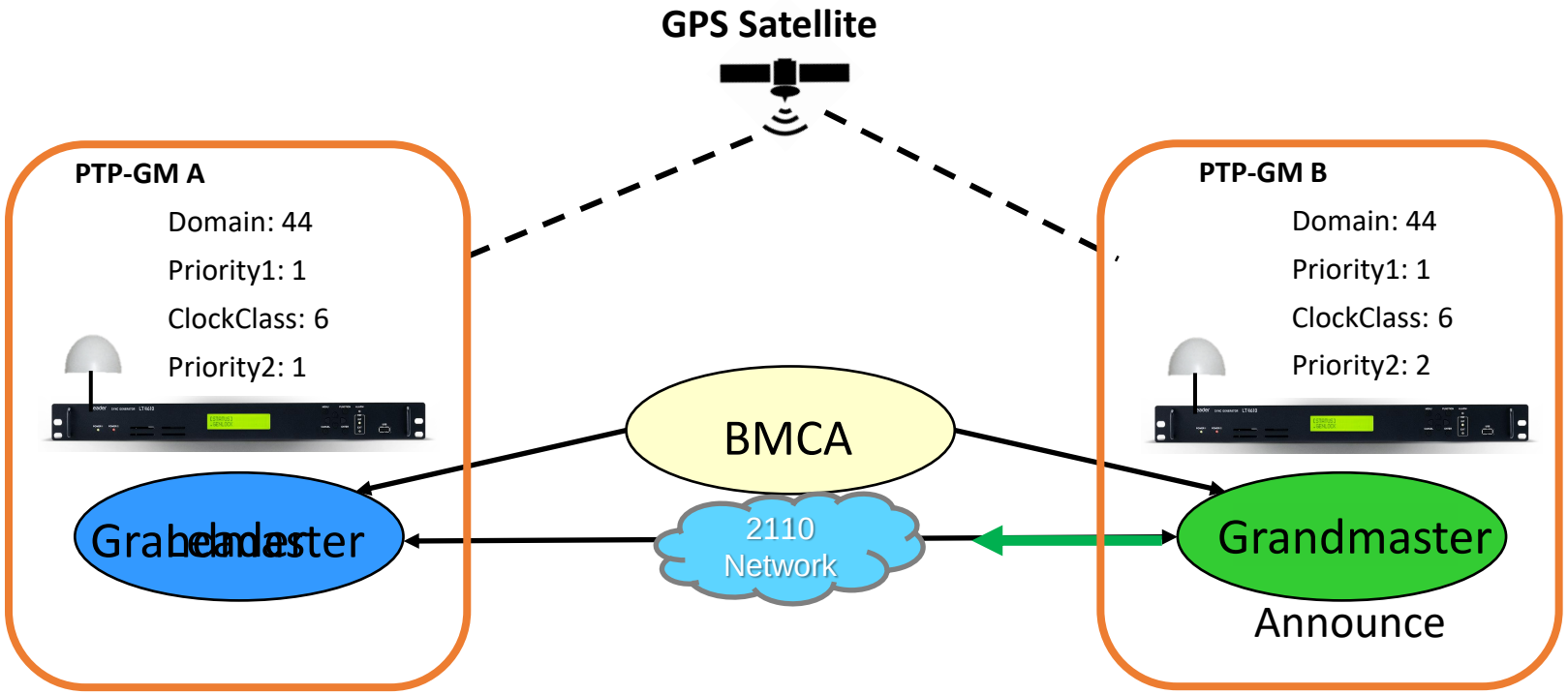
Best Master Clock Algorithm

- For this reason, **you want the network detection timeout to be longer that the Time out interval of the BMCA (Grandmaster / Leader)**



Best Master Clock Algorithm

- If you don't, then the Leader capable devices will keep jumping to the conclusion that the Grandmaster has gone away and they need to take over.



Larger 2110 Leaf and Spine

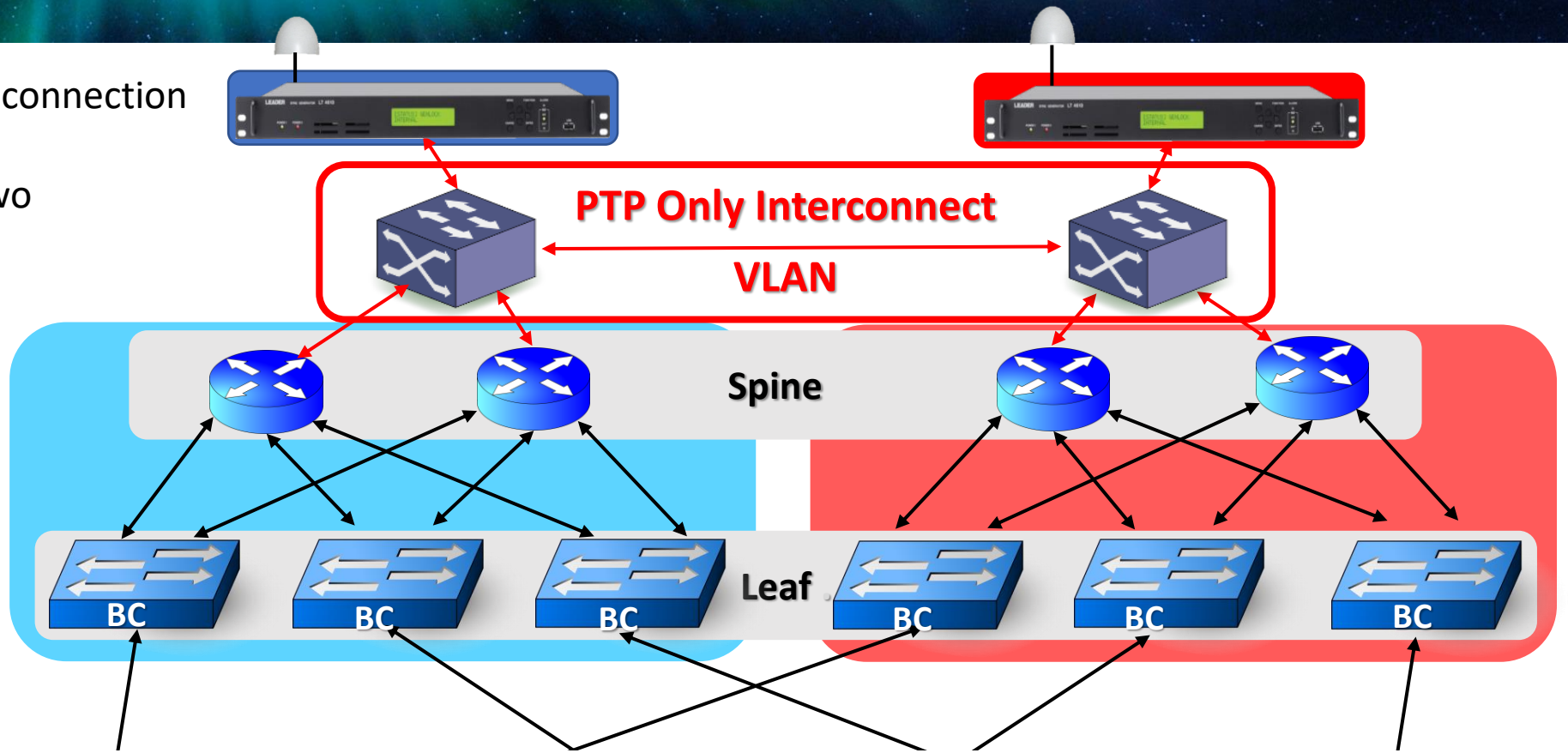
In an Air Gap Network the only connection between networks is the PTP communication between the two Grandmaster and the Leader

Each Leaf connects to every Spine in it own network

Each South bound Leaf Port is a Boundary Clock

Need more Devices add more Leafs

Need more Bandwidth add more Spines



Ensure the BMCA elections take place at the feeder switch level not lower down the media network

NOTE: For Spine / Leaf network architectures the Leaf ports connected to PTP follower endpoints should always stay in Master state.

Configure this CLI to ensure they will always stay as masters, even if the Follower is misconfigured or a GM is accidently connected under this port.

Best Master Clock Algorithm

1920x1080/50I YCbCr(422) 10bit IP A TIME: 17:05:44

EVENT LOG LIST SAMPLE No.874 << NOW LOGGING >>

874: 2022/06/22 17:04:17	IP2	LINK UP	
873: 2022/06/22 17:04:17	IP2	LINK UP	GMID:00-09-0d-ff-fe-01-0a-c2,PTP Cloc…
872: 2022/06/22 17:04:13	IP2	LINK UP	
871: 2022/06/22 17:04:13	IP2	LINK UP	GMID:28-af-fd-ff-fe-d9-9d-9b,PTP Clock…
870: 2022/06/22 17:04:07	IP1	LINK UP	GMID:00-09-0d-ff-fe-01-0a-c2,
869: 2022/06/22 17:00:29	IP2	LINK UP	
868: 2022/06/22 17:00:29	IP1	LINK UP	
867: 2022/06/22 17:00:29	B	1920x1080/50I	
866: 2022/06/22 17:00:28	B	NO SIGNAL	
865: 2022/06/22 17:00:23	B	1920x1080/50I	

FCS	IP CS	UDP CS	
Video1 RTP Sequence	Video2 RTP Sequence	Video3 RTP Sequence	Video4 RTP Sequence
Mbit Stream1	Mbit Stream2	Mbit Stream3	Mbit Stream4
Interval Variation1	Interval Variation2	Interval Variation3	Interval Variation4
PTP Unlock	PTP GMID	PTP ClockClass	
Video1 RTP Timing	Video2 RTP Timing	Video3 RTP Timing	Video4 RTP Timing
Audio1 RTP Timing	Audio2 RTP Timing	Audio3 RTP Timing	Audio4 RTP Timing
ANC1 RTP Timing	ANC2 RTP Timing	ANC3 RTP Timing	ANC4 RTP Timing
Video1 CMAX	Video2 CMAX	Video3 CMAX	Video4 CMAX
Video1 VRX	Video2 VRX	Video3 VRX	Video4 VRX

Leader

Sync Pulse Generators (SPG's)

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Primary SPG

Analog BB

Analog Tri-Level Sync

SD/HD SDI Black

Digital Audio AES/EBU Reference

ECO

To Distribution Amplifiers

Analog BB

Analog Tri-Level Sync

SD/HD SDI Black

Digital Audio AES/EBU Reference

Backup SPG

Leader Sync Pulse Generators (SPG's) + PTP

IP SHOWCASE

Primary SPG

PTP – SMPE ST 2059 / AES67 / General

To Network Switch

Analog BB

Analog Tri-Level Sync

SD/HD SDI Black

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To Distribution Amplifiers

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Backup SPG

To Network Switch

PTP – SMPE ST 2059 / AES67 / General

Leader Sync Pulse Generators (SPG's) + PTP

IP SHOWCASE

Primary SPG

X

PTP – SMPE ST 2059 / AES67 / General

To Network Switch

Analog BB

Analog Tri-Level Sync

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Backup SPG

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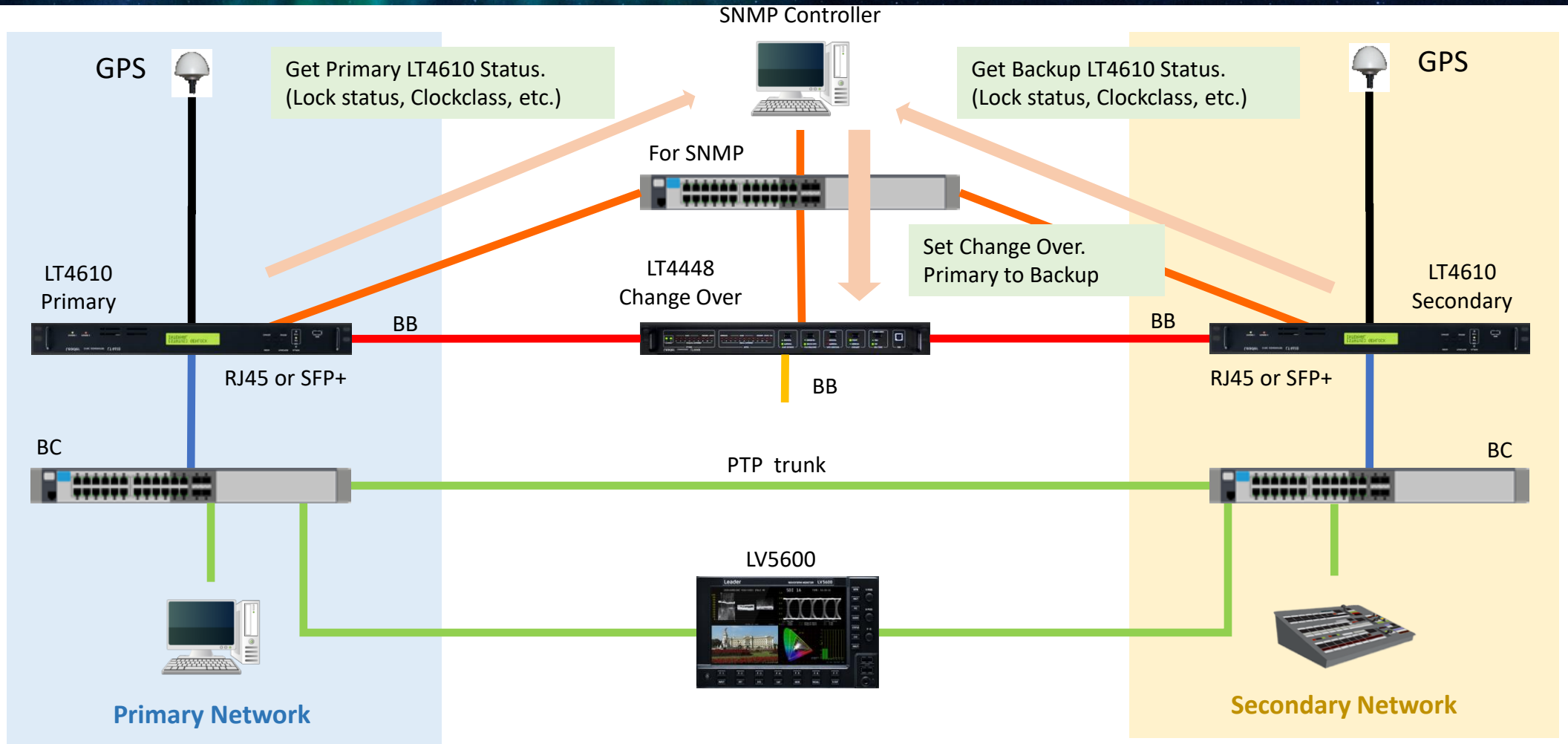
Leader Sync Pulse Generators (SPG's) + PTP

IP SHOWCASE



Leader Sync Pulse Generators (SPG's) + PTP

IP SHOWCASE

Primary SPG

X

PTP – SMPE ST 2059 / AES67 / General

To Network Switch

Analog BB

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SD/HD SDI Black

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Backup SPG

To Network Switch

PTP – SMPE ST 2059 / AES67 / General

You don’t have to ……

- Ancillary Data

- Over the years, the SDI “Ancillary Data” system has become the home for lots of things.

  - Some are intrinsic to the video signal
  - Some are independent essences
  - And some have ended up there because it seemed like a good place to put it at the time.

You don’t have to …….

Video Payload ID (VPID) Codes

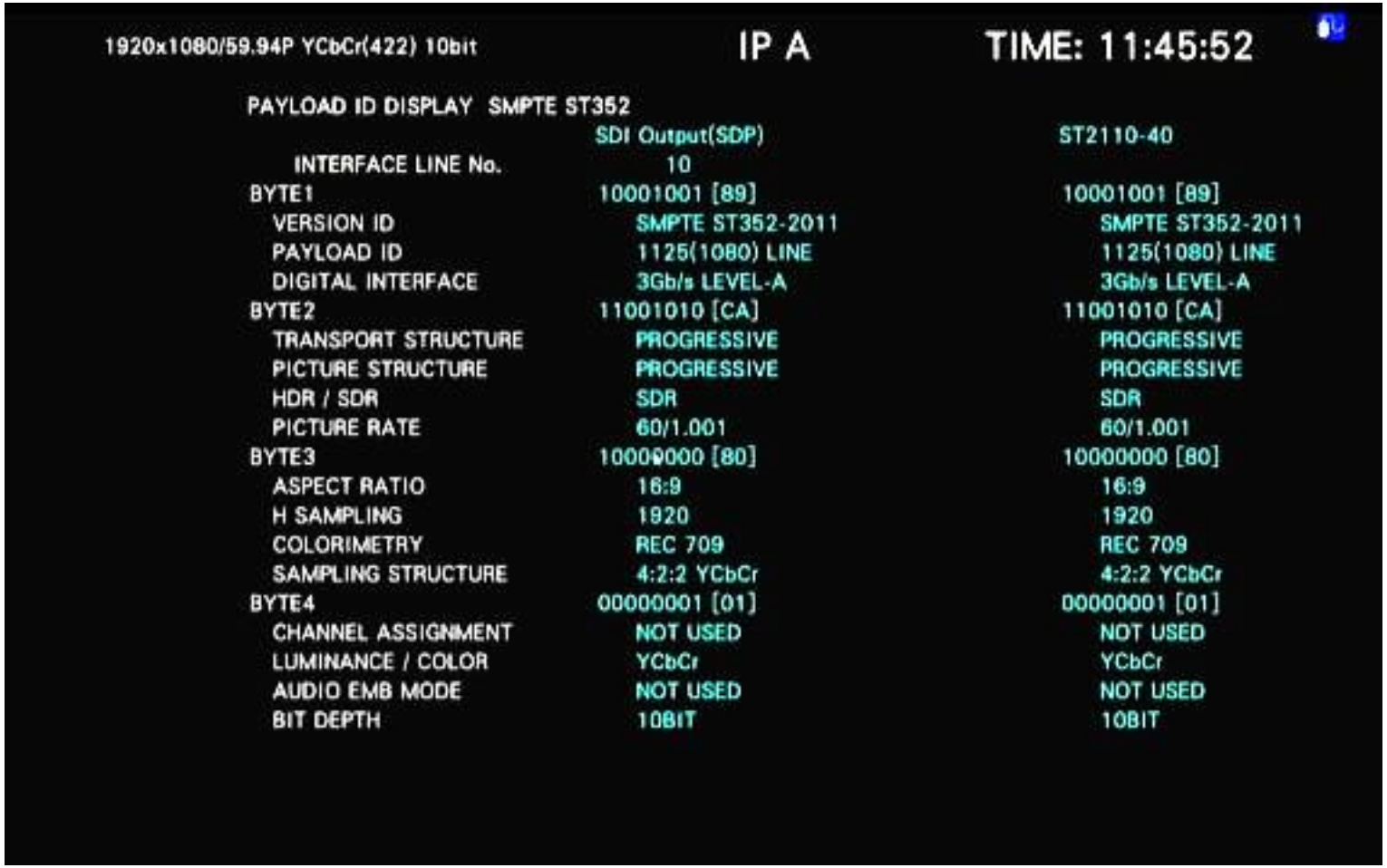
SMPTE ST352

Is carried within the Ancillary data space to assist a device in quickly decoding the video signal.

SMPTE ST2110-20 specifies the transport of uncompressed active video

The Ancillary Data is managed as part of SMPT ST2110-40

Leader Video Payload ID



You don’t have to ……

- **And now for a new challenge !**

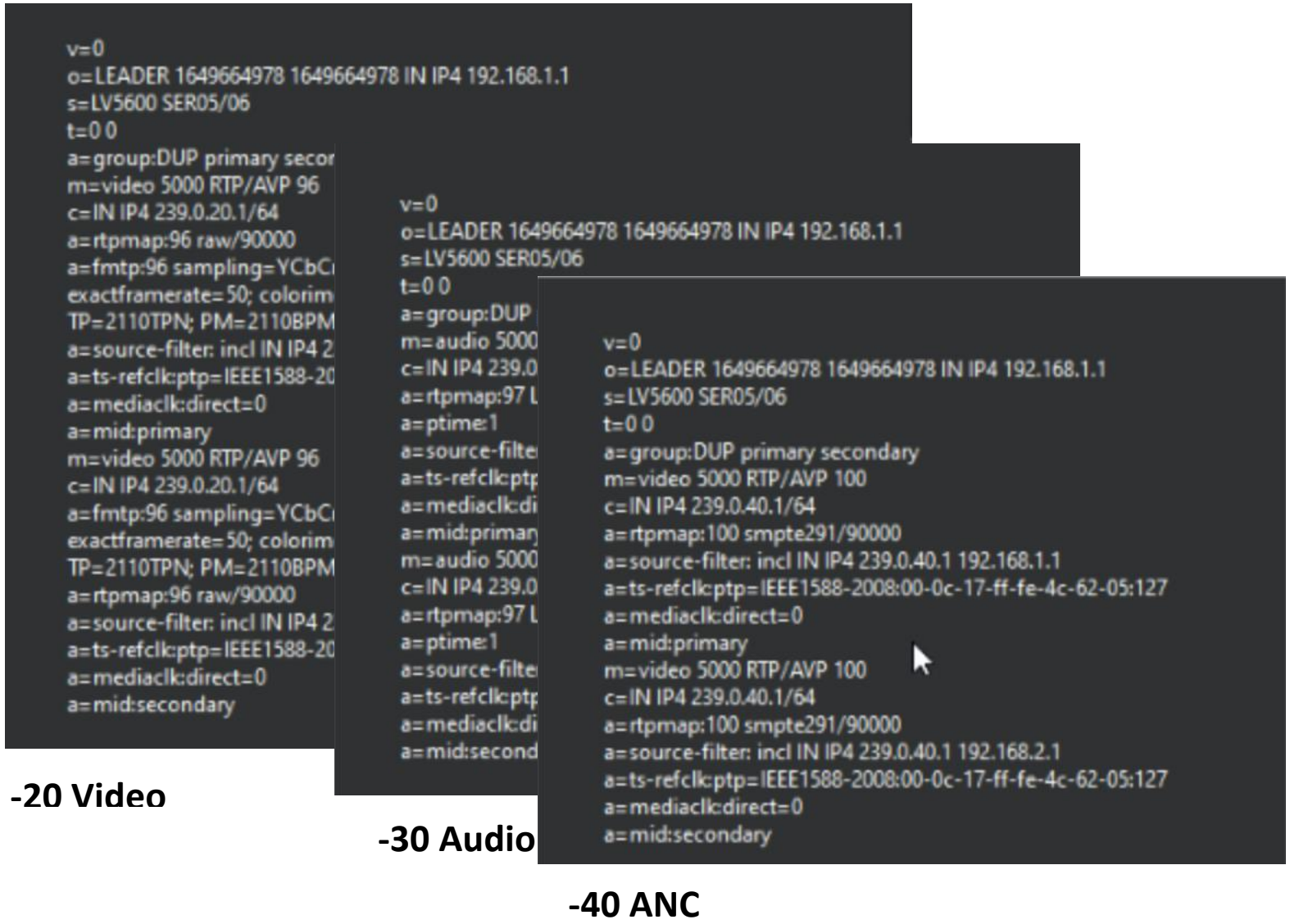
- To assist in the control and switching of IP multicast flows within a broadcast facilities broadcasters are using NMOS Orchestration systems to configure IP receivers.

- They configure receivers by means of **Session Description Protocol (SDP).**

- **Session Description Protocol** does not deliver any media streams itself but is used between endpoints for negotiating on network metrics, media types and other associated properties.

Leader You don't have to .....

IP SHOWCASE



- Session Description Protocol
  - Video
  - Audio
  - ANC Data

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source address

```
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=source-filter:incl IN IP4 239.100.9.10 192.168.100.2
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=mediaclk:direct=0
a=mid:primary
m=video 50020 RTP/AVP 112
c=IN IP4 239.101.9.10/32
a=source-filter:incl IN IP4 239.101.9.10 192.168.101.2
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=mediaclk:direct=0
a=mid:secondary
```

o : session ID:123456 Ver:11
s : session name
i : additional session information
t = 0 0 : permanent session
a = group:dup : Duplication

Multicast 224.0.0.0 – 239.255.255.255

Video format

Grandmaster ID

PTP domain number

- Session Description Protocol

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NMOS CONNECTION LIST (IS-05) NMOS ON

Receiver/Sender	Time	Input	Source	Destination	Response
Audio3 G4	---	-	---	---	---
Audio4 G1	---	-	---	---	---
Audio4 G2	---	-	---	---	---
Audio4 G3	---	-	---	---	---
Audio4 G4	---	-	---	---	---
ANC1	2022/09/02 01:19:27	A	192.168.100.115	239.0.40.1	HTTP/1.1 200 OK

```
s=LV5600 SER05/06
t=0 0
a=group:DUP primary secondary
m=video 5000 RTP/AVP 100
c=IN IP4 239.0.40.1/64
a=rtpmap:100 smpte291/90000
a=source-filter: incl IN IP4 239.0.40.1 192.168.100.115
a=ts-refclk:ptp=IEEE1588-2008:00-0C-17-FF-FE-4C-62-05:44
a=mediaclk:direct=0
a=mid:primary
m=video 5000 RTP/AVP 100
c=IN IP4 239.0.40.1/64
a=rtpmap:100 smpte291/90000
a=source-filter: incl IN IP4 239.0.40.1 192.168.100.120
a=ts-refclk:ptp=IEEE1588-2008:00-0C-17-FF-FE-4C-62-05:44
a=mediaclk:direct=0
a=mid:secondary
```

SDP - ANC

- Session Description Protocol
- Being able to analysis the SDP is vital if an error has occurred in its creation and receivers on the network are unable to connect or display the IP stream.
- The SDP can be copied and exported as a text tile for remote analysis.

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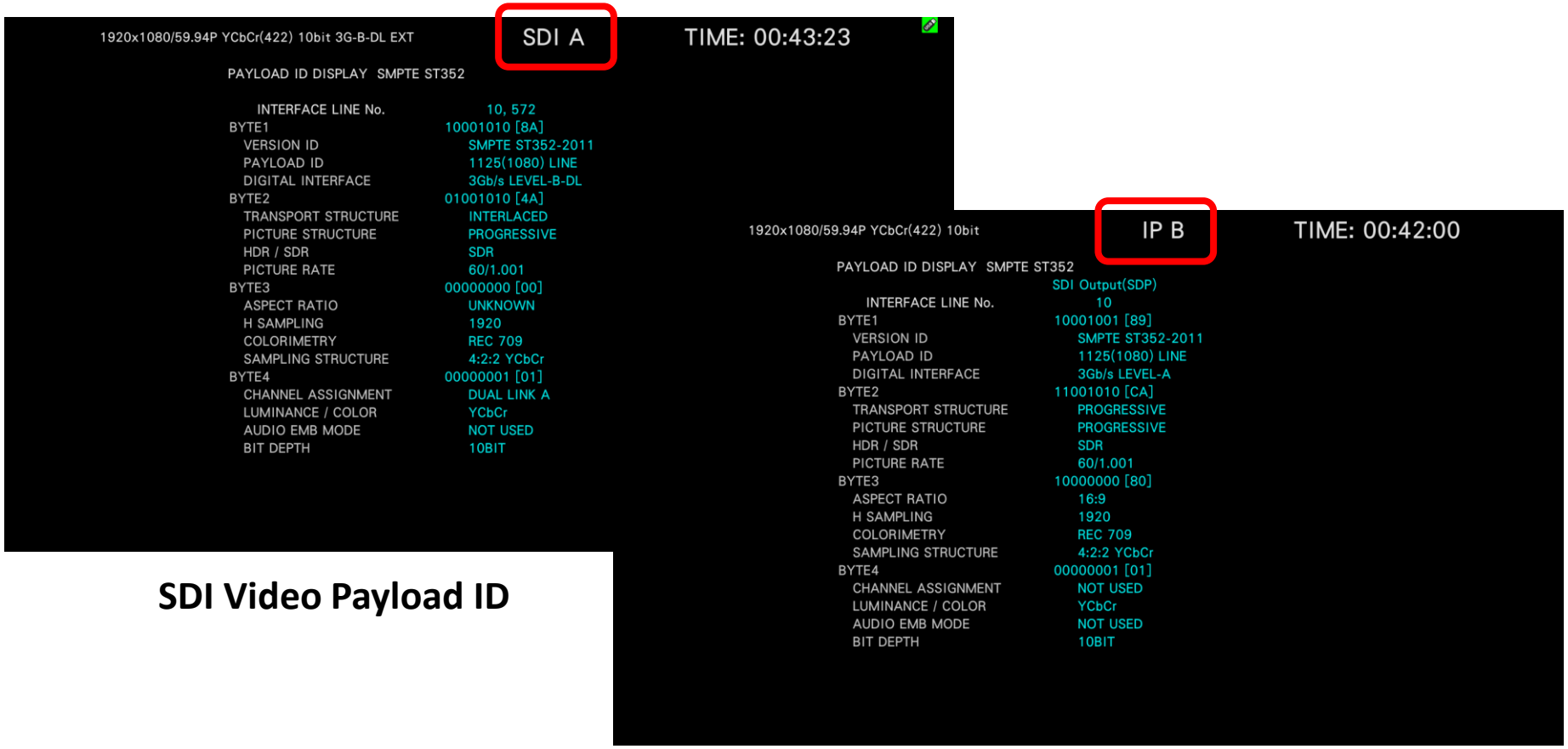

SDI Video Payload ID

SDP Video Payload ID

- Session Description Protocol
- In ‘True Hybrid’ operation, the Leader can display both the SDI Payload ID and the SDP to allow easy comparisons.

Leader

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PAYLOAD ID DISPLAY SMPTE ST352	
INTERFACE LINE No.	10
BYTE1	10001001 [89]
VERSION ID	SMPTE ST352-2011
PAYLOAD ID	1125(1080) LINE
DIGITAL INTERFACE	3Gb/s LEVEL-A
BYTE2	11001010 [CA]
TRANSPORT STRUCTURE	PROGRESSIVE
PICTURE STRUCTURE	PROGRESSIVE
HDR / SDR	SDR
PICTURE RATE	60/1.001
BYTE3	00000000 [00]
ASPECT RATIO	UNKNOWN
H SAMPLING	1920
COLORIMETRY	REC 709
SAMPLING STRUCTURE	4:2:2 YCbCr
BYTE4	00000001 [01]
CHANNEL ASSIGNMENT	NOT USED
LUMINANCE / COLOR	YCbCr
AUDIO EMB MODE	NOT USED
BIT DEPTH	10BIT

PAYLOAD ID DISPLAY SMPTE ST352	
INTERFACE LINE No.	10
BYTE1	10000101 [85]
VERSION ID	SMPTE ST352-2011
PAYLOAD ID	1125(1080) LINE
DIGITAL INTERFACE	1.485Gb/s
BYTE2	00001010 [0A]
TRANSPORT STRUCTURE	INTERLACED
PICTURE STRUCTURE	INTERLACED
HDR / SDR	SDR
PICTURE RATE	60/1.001
BYTE3	00100000 [20]
ASPECT RATIO	16:9
H SAMPLING	1920
COLORIMETRY	REC 709
SAMPLING STRUCTURE	4:2:2 YCbCr
BYTE4	00000001 [01]
CHANNEL ASSIGNMENT	NOT USED
LUMINANCE / COLOR	YCbCr
AUDIO EMB MODE	NOT USED
BIT DEPTH	10BIT

- Session Description Protocol
- The same applies to ANC Data Analysis of -40 ANC Data stream and SDI embedded audio

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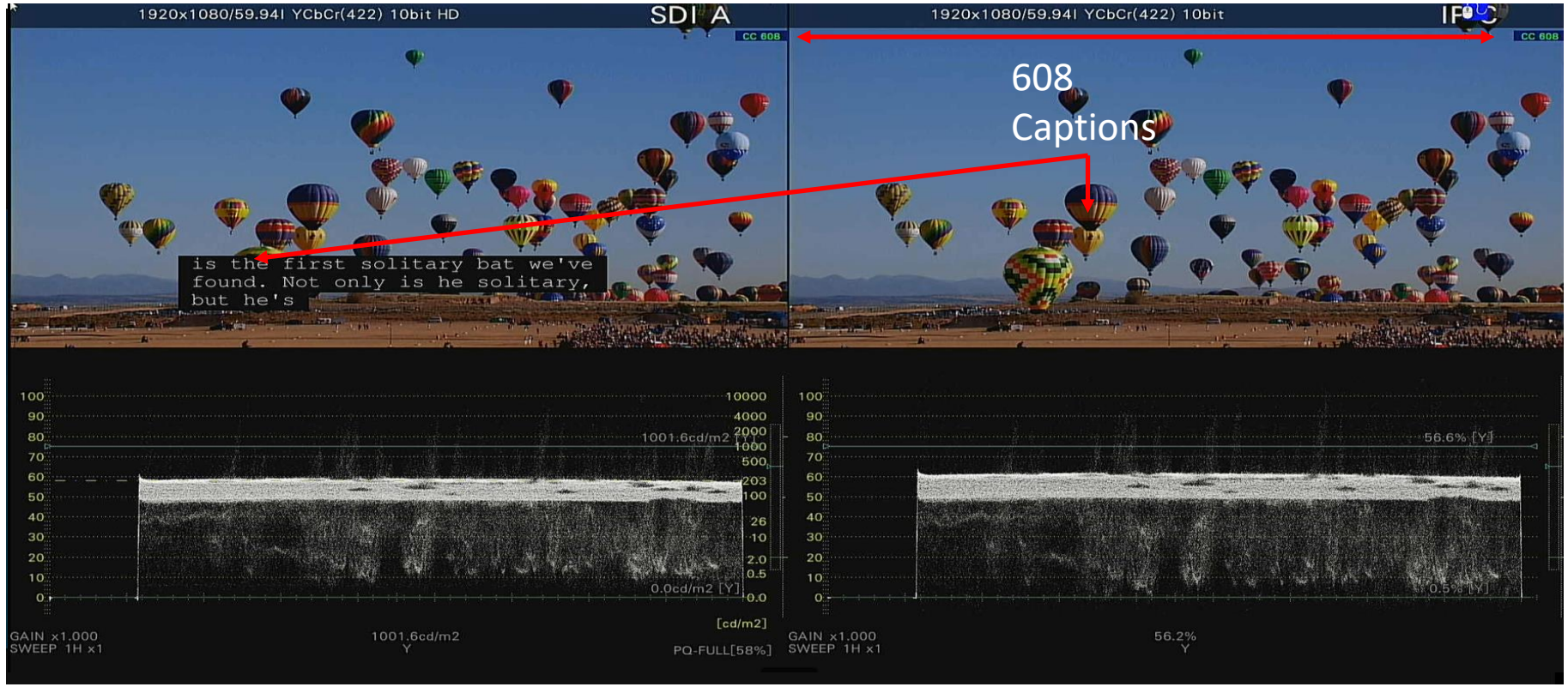

Day-to-Day Operations

- ‘True Hybrid’ operation allows you to ensure ancillary data like closed captions are present.
- Multiple analysis tools like PIC and WFM can be displayed in both IP and SDI.

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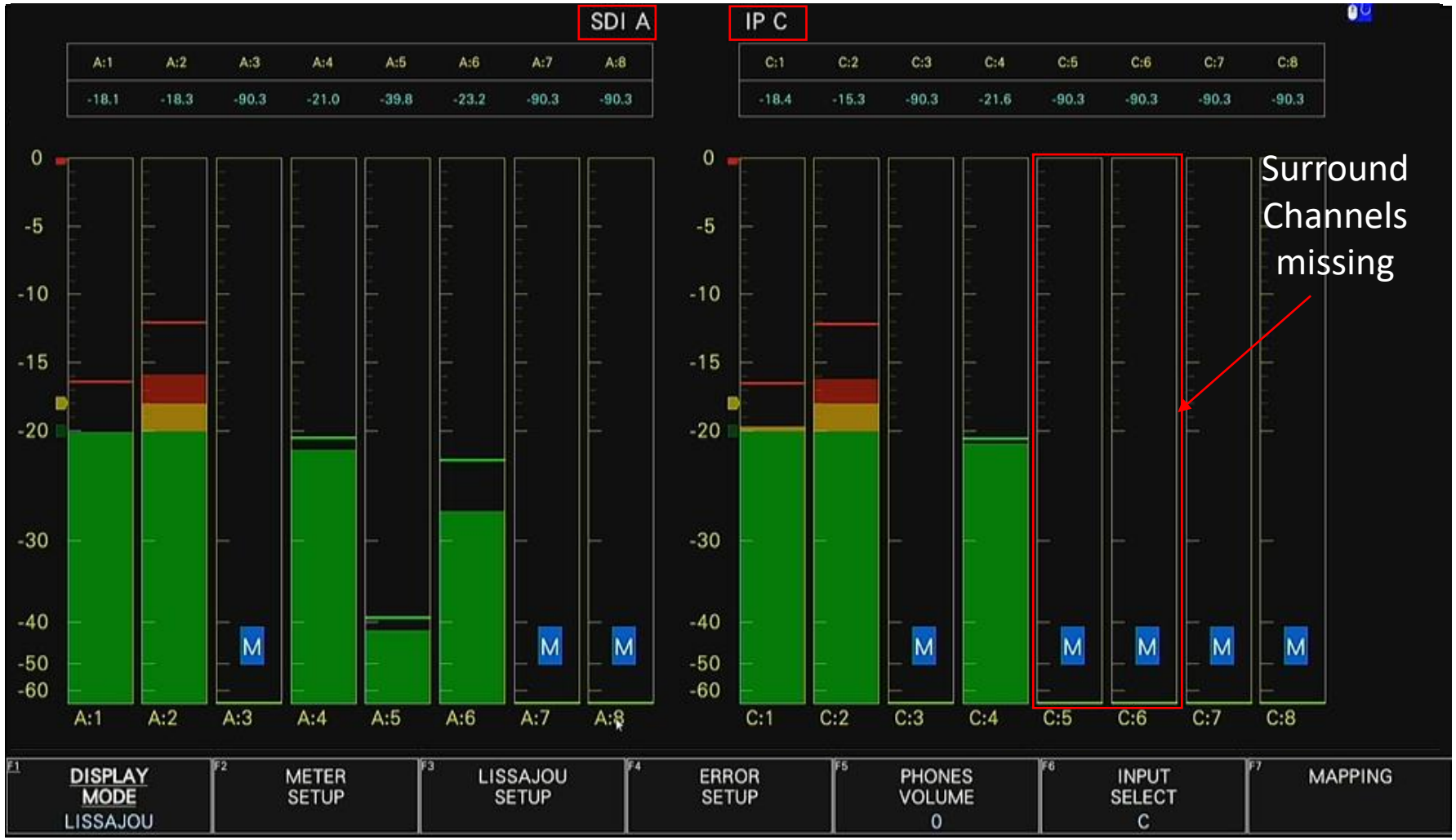
IP SHOWCASE



Day-to-Day Operations

- The same applies to Audio Analysis of -30 or -31 audio stream and SDI embedded audio.

You don’t have to ……

IP to SDI Gateways

Test and Measurement products have always acted as gateways in broadcasters’ facilities.

Now, with the introduction of IP, they are continuing to fulfil this role.

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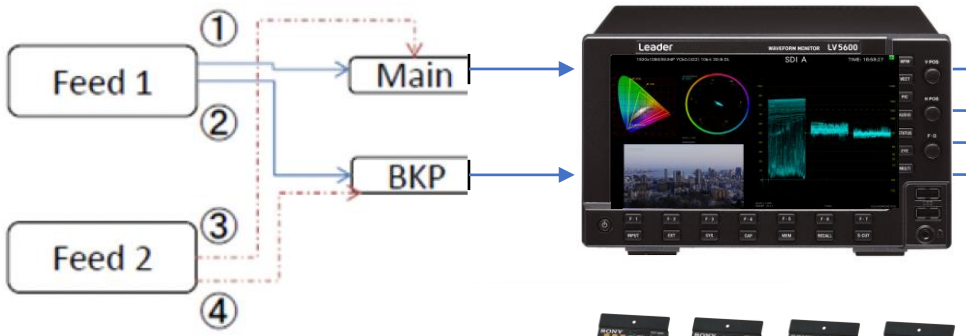
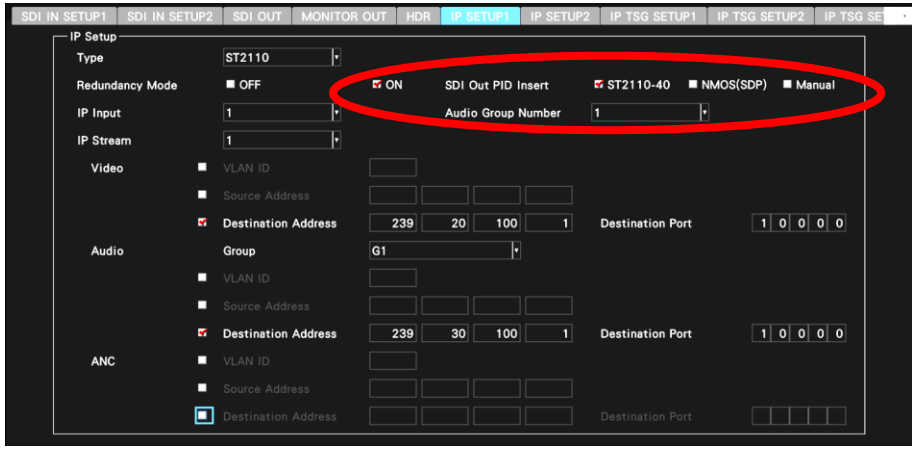
2022-7



Link - 1

VPID

4x 3G-SDI Output



Professional Broadcast Monitor

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Vision Engineer in an IP World

It’s not uncommon for Vision Engineers to have to control multiple cameras and this involves rapidly switching between cameras sources.

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Day-to-Day Operations

- Vision Engineers expect the same performance from IP test and measurement products, as they previously enjoyed with SDI.
- They also don’t care if the video source is IP or SDI, their job is to match the images, irrespective of underlying infrastructure.

You don’t have to …….

Audio-to-Video Synchronization

Also known as lip sync refers to the relative timing of audio (sound) and video (image) parts during playout.

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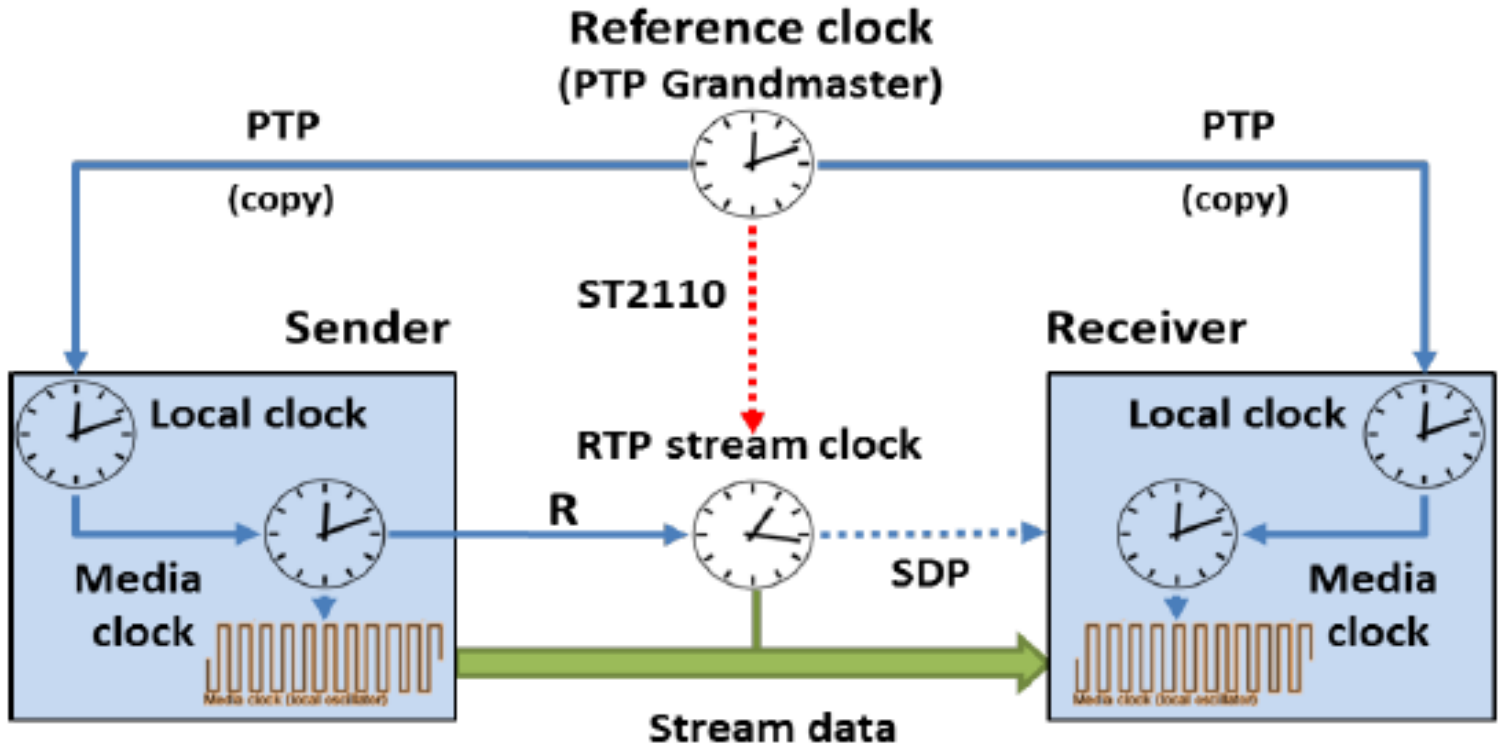

Day-to-Day Operations

- It can be confirmed whether video, audio and ANC essences are synchronized with PTP by comparing the timing information of the PTP and the RTP timestamp.
- The transmitting side transmits the stream according to the time of the PTP and the receiving side reproduces in accordance with the time of PTP.

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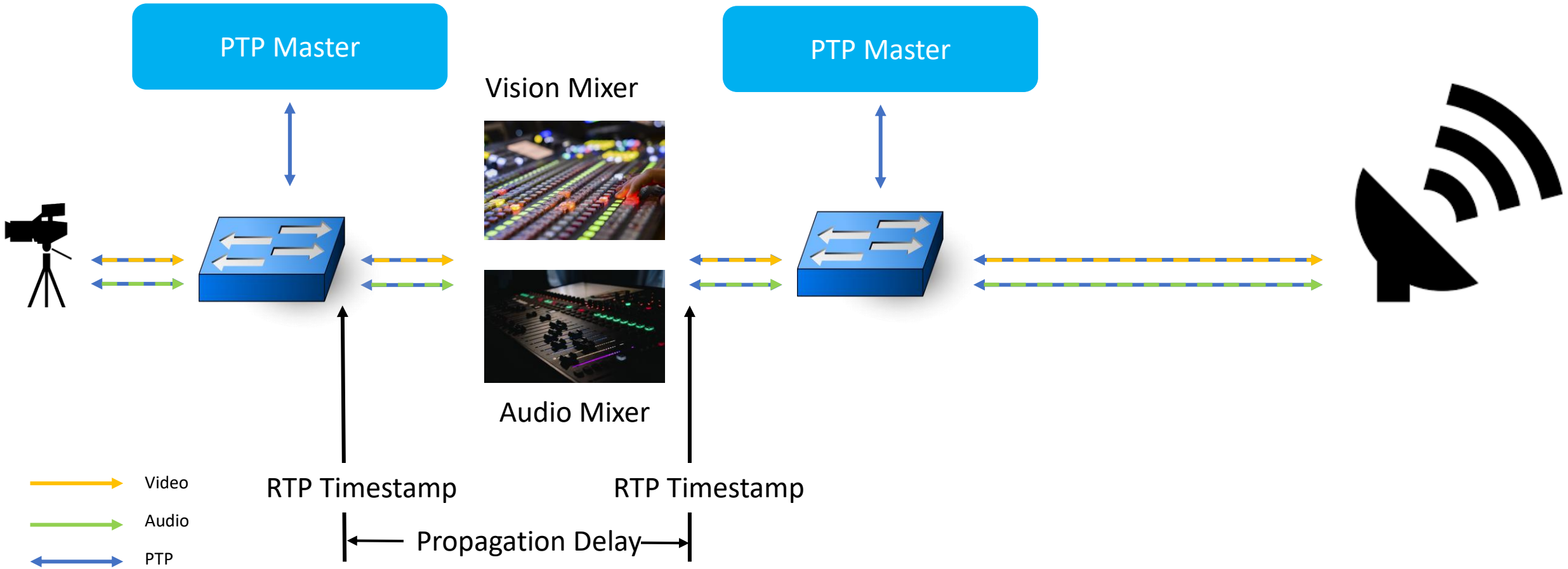

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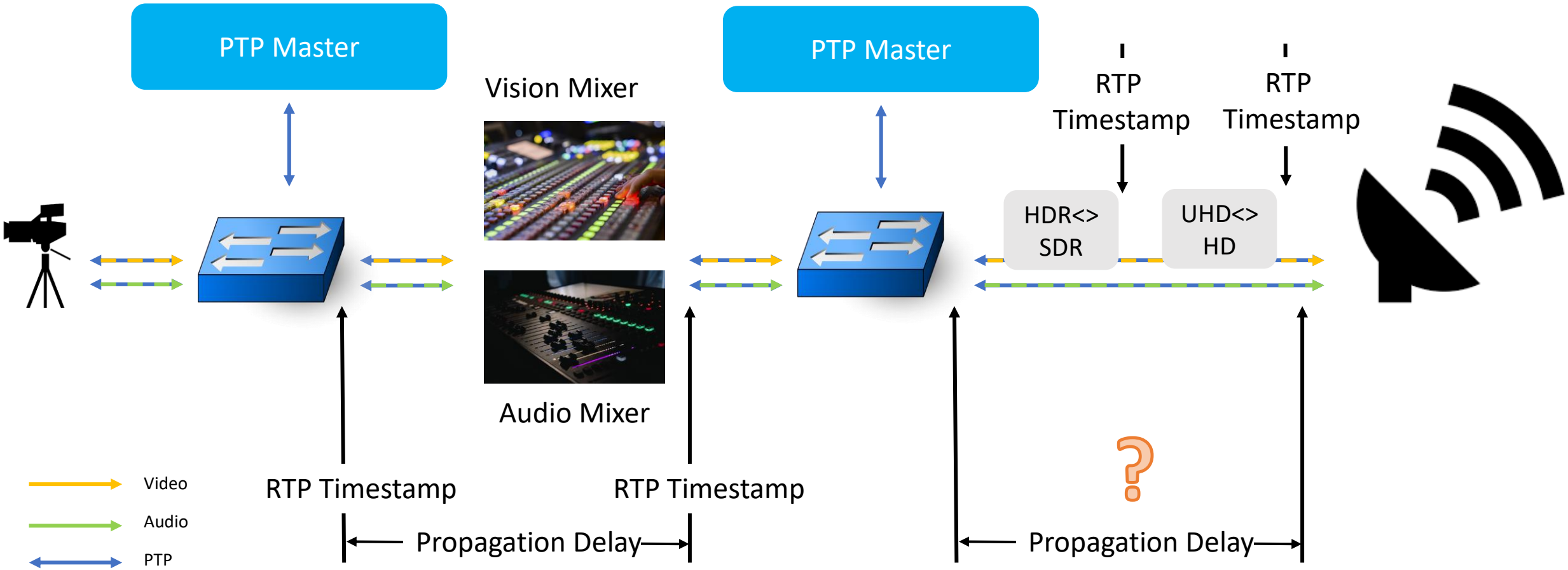

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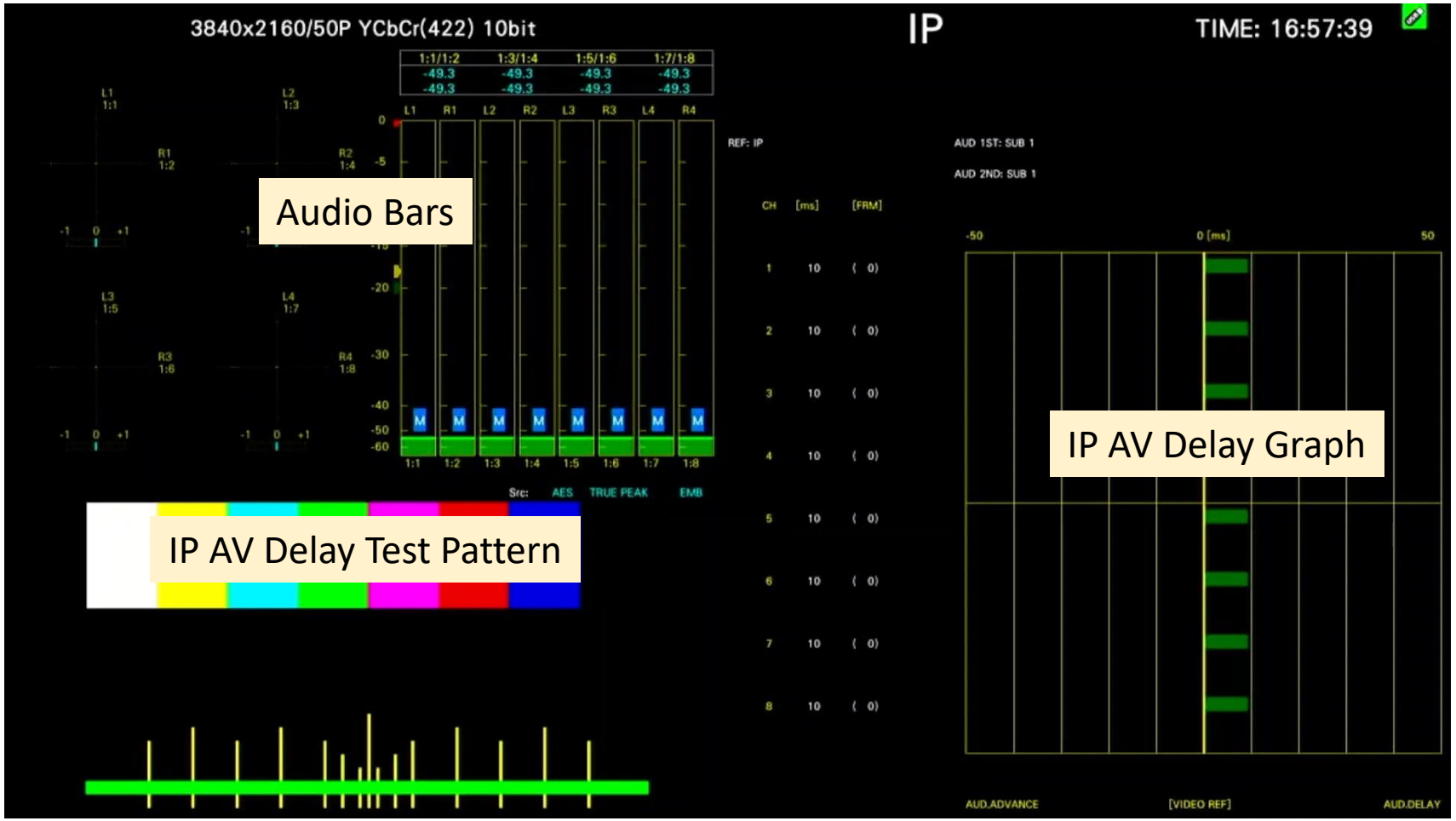

Day-to-Day Operations

- Using an IP AV Delay test pattern allows broadcasters to accurately identify the AV Delay.
- The IP AV Delay Graph displays the Audio Lead/Lag for each individual audio channel.

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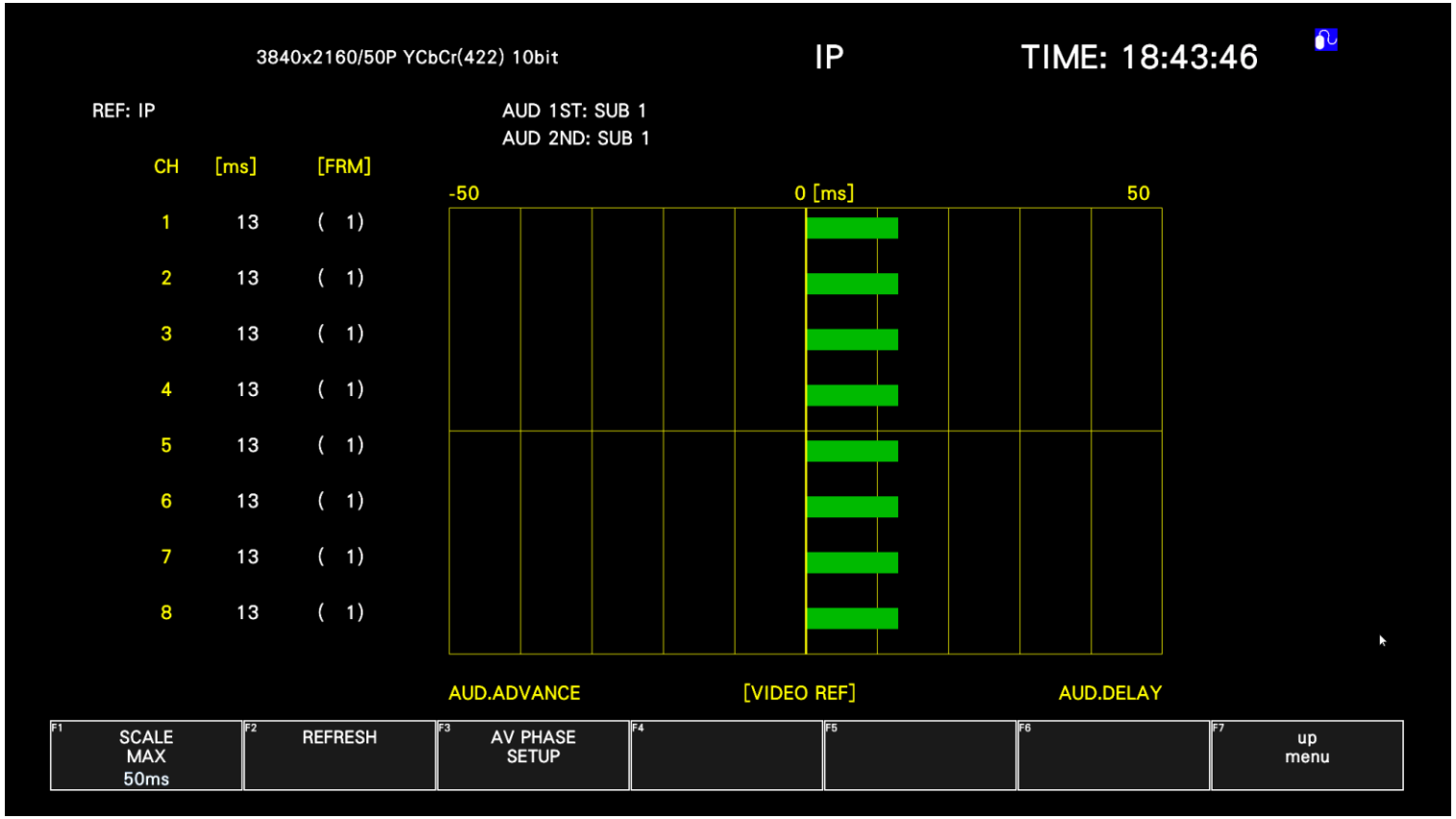

AV Delay

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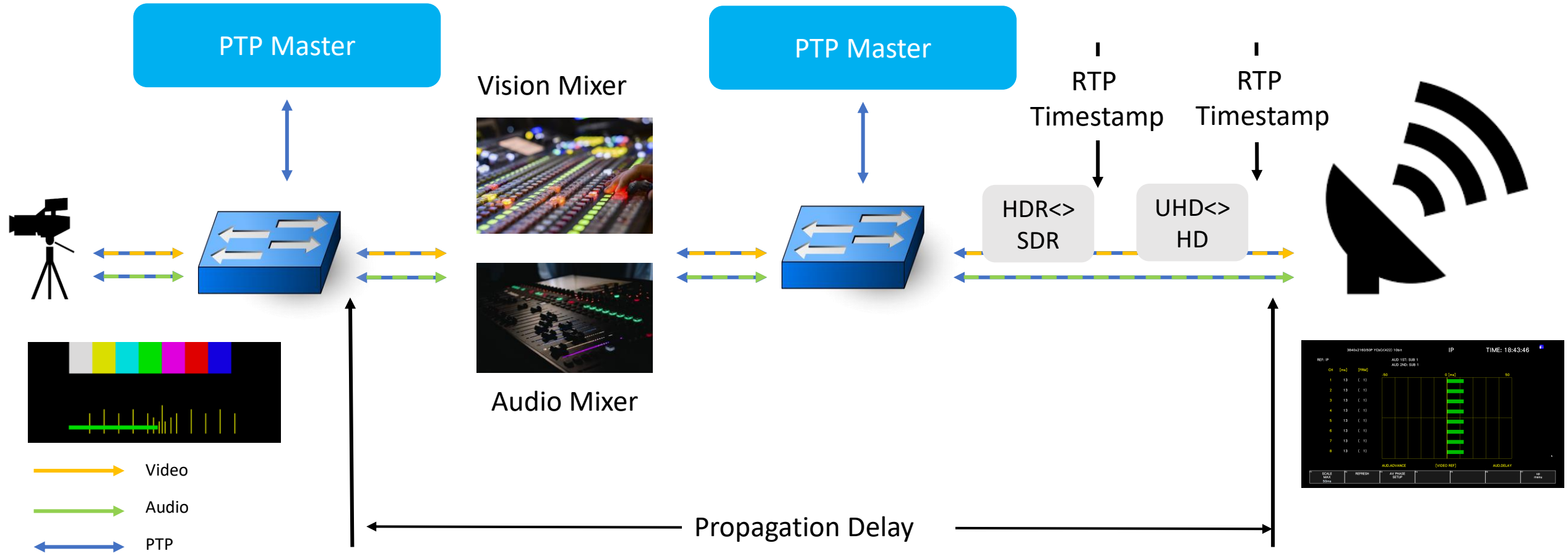

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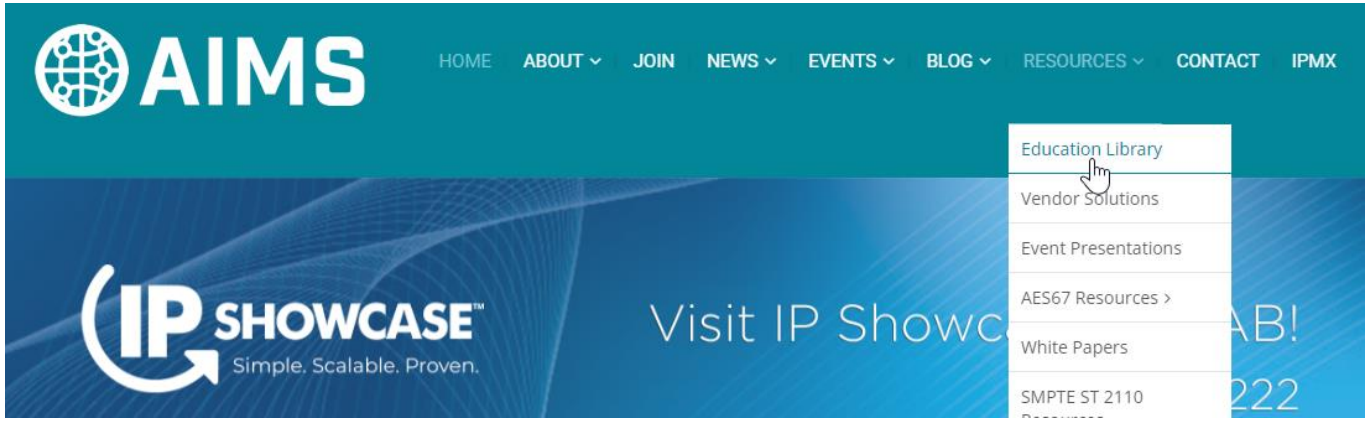
Leader AIMS Education Working Group

Building a foundation of shared knowledge and practical experience in the area of IP media networking

Visit the Education Library at AIMSAlliance.org



Let us know what training and learning opportunities you'd like to see in the field of IP Media Networking

info@aimsalliance.org

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- **Kevin Salvidge**
  - Sales Engineering Manager
  - Email : salvidge@leadereurope.com
  - Tel : +44 7826 178 752

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- If you would like more information including a copy of this presentation.

Any Questions?

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Audio Engineering Society

AIMS Alliance for IP Media Solutions

AMWA Networked Media. Working.

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SMPTE

VSF VIDEO SERVICES FORUM