Camera Training Center
Breda The Netherlands

August 2017

grass valley

A BELDEN BRAND

Jan Paul Campman

- **Your Host for this session**
- *Training Manager*
- *Trainer*
- *Acceptance Engineer*
- *Demo specialist*
- *Web master*

- your guide for this **INTERACTIVE** session.
- **Welcome to the LDX Series WEB-Training**

grass valley

A **BELDEN** BRAND

IP XCU 10G Fiber (basics)

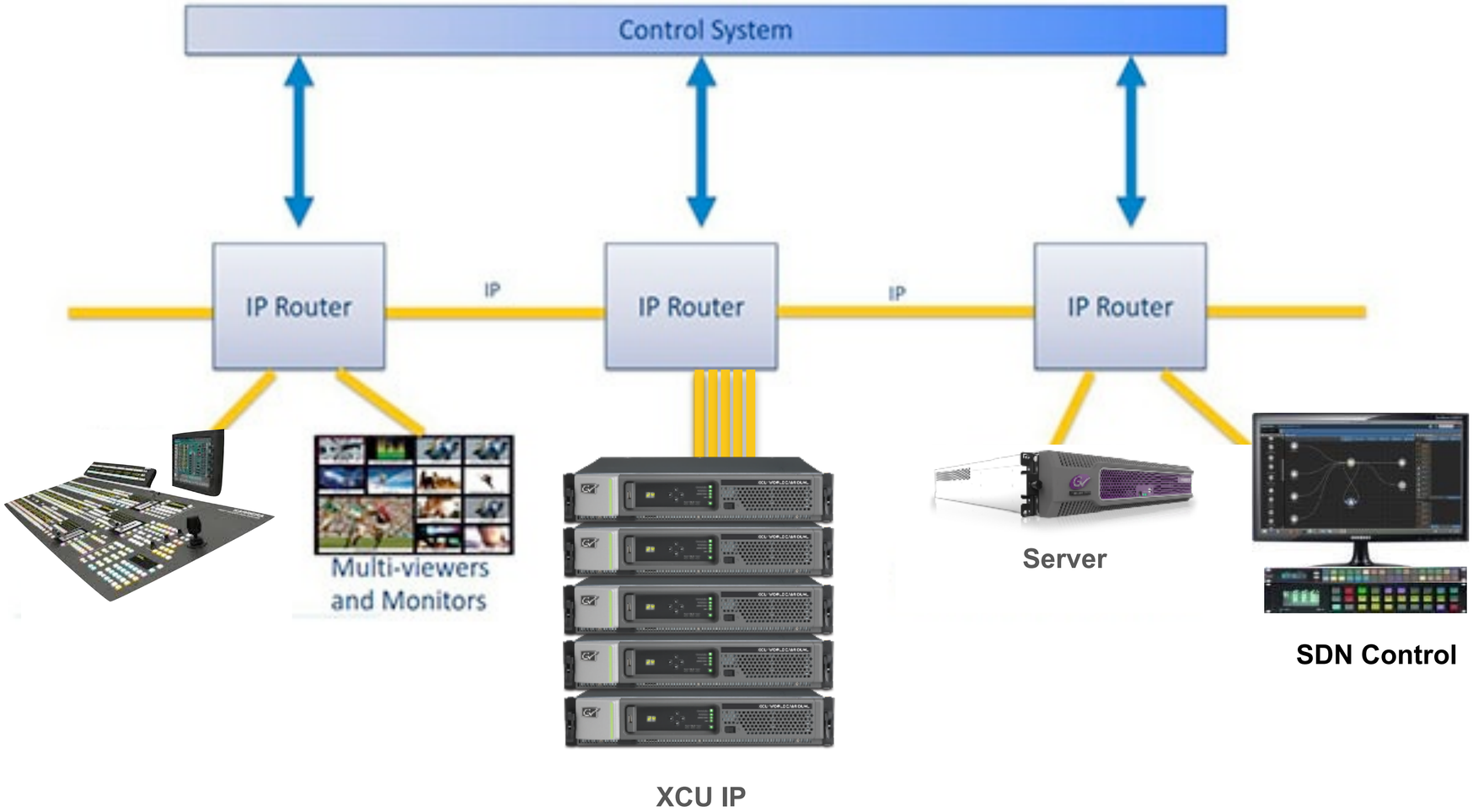
This part gives you some more details about the IP Connection between XCU and the world

In this session:

- **IP XCU introduction**
- **XCU IP connections**
- **IP basics + test**
- **Settings with MCP450**
- **XCU New**

grass valley
A BELDEN BRAND

XCU HD/4K IP – Workflow overview

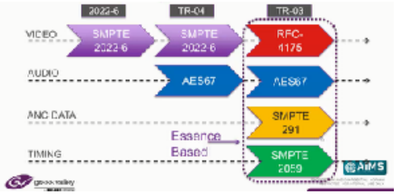


IP

Grass Valley Cameras
XCU UXF details

grass valley
A BELDEN BRAND

New IP XCU : Why ?



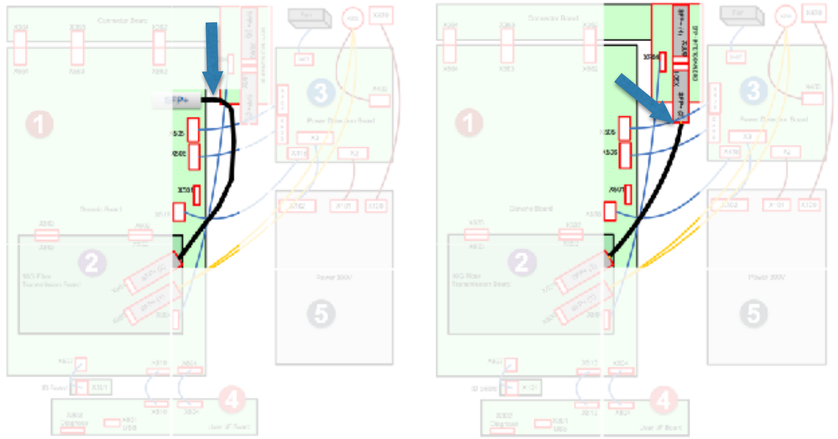
- Market is moving towards IP-solutions in LIVE-broadcast
  - Evertz is pushing **ASPEN** ; Sony is pushing **NMI** ; GV is pushing **AIMS**
  - Last 2 years ; Many POC's with different standards
- ☑ All broadcast companies feel the need to cooperate on one standard
- ☑ **SMPTE 2110** will (AIMS) be the new IP standard for LIVE broadcast

- HD/4k XF IP XCU (Today's IP XCU ; supporting 86 / 86N)
- ☑ First OB's / studio's equiped with HD/4k XF IP XCU (ArenaTV / BCE / etc.)
- ☑ 4k demand is increasing (e.g. Sky is pushing the market)
- ☑ HD/4k XF IP XCU supports 2022-6 standard……..

but…….

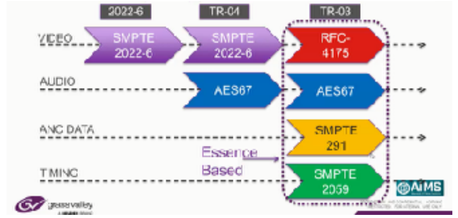
New IP XCU : Why ?

- HD/4k XF IP XCU is GREAT today but has
  HW/SW limitations for future IP-demands



no 4K BNC =>
HS and HDR limitations

- New XCU development should support ;
  - ☑ “UNIVERSE” functionality over IP (and SDI, inc. Redundancy, PTP, etc.)
  - ☑ Support of SMPTE 2110 (AIMS roadmap)
  - ☑ New Cradle (inc. 4x10Gb ports, backwards compatible)



grass valley
A BELDEN BRAND

Introduction plan

NAB ‘17

- ☑ 1x Universe UXF XCU
  - UNIVERSE functionality(SDI) + IP support* (SMPTE2110)

XCU UNIVERSE UXF
XF FIBER

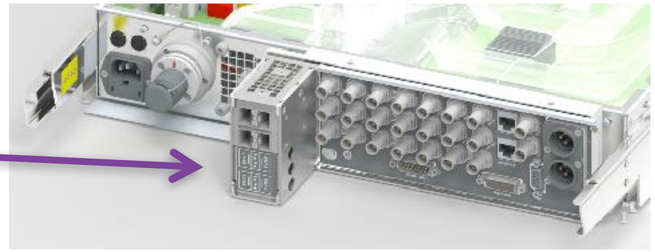
- ☑ 1x Enterprise UXF XCU
  - All Single Speed video formats (SDI) + IP support* (SMPTE2110)

XCU ENTERPRISE UXF
XF FIBER

- ☑ 1x Cradle UXF
  - Current Cradle + 4x 10Gb IP ports

HW available at introduction with TR04+

* SW Increment plan to implement full SMPTE2110



grass valley
A BELDEN BRAND

Differences UNIVERSE <-> UNIVERSE UXF

UNIVERSE

- Full SDI connectivity
- HD/3G/4K/HDR/HS/XS support
- Direct IP support (XF Fiber)
- Cradle

UNIVERSE UXF

- Full SDI connectivity
- HD/3G/4K/HDR/HS/XS support
- Direct IP support (XF Fiber)
- Cradle including 4x10Gb IP ports
- Full IP for HD/3G/4K/HDR/HS/XS
- Full IP for Audio
- Full IP for Intercom
- PTP
- Redundancy (2x 10Gb ports)
- SMPTE2110 support*

* SW Increment plan to implement full SMPTE2110

Differences HD/4k XF IP <-> ENTERPRISE UXF

HD/4k XF IP

ENTERPRISE UXF

- Limited SDI connectivity
- HD/3G/4K/HDR support
- Direct IP support (XF Fiber)
- Cradle (Separate 1x10Gb IP port)
- Limited IP for HD/3G/4K/HDR (2022-6)
- Embedded Audio over IP (2022-6)
- Embedded I-comm over IP (2022-6)
- No PTP (BNC ref.)
- No Redundancy

- Full SDI connectivity
- HD/3G/4K/HDR support
- Direct IP support (XF Fiber)
- Cradle including 4x10Gb IP ports
- Full IP for HD/3G/4K/HDR (2110*)
- Full IP for Audio (2110*)
- Full IP for Intercom (2110*)
- PTP (2059*)
- Redundancy* (2x 10Gb ports)
- SMPTE2110 support*

* SW Increment plan to implement full SMPTE2110

Introduction plan

NAB ‘17

UNIVERSE

Phase out

Intro

UNIVERSE UXF

new

Cradle

Remains available for 3G Fiber/Triax

Intro

Cradle UXF

new

HD/4k XF IP

Phase out

Intro

ENTERPRISE UXF

new

grass valley
A BELDEN BRAND

Camera Support

XF Fiber

ENTERPRISE UXF

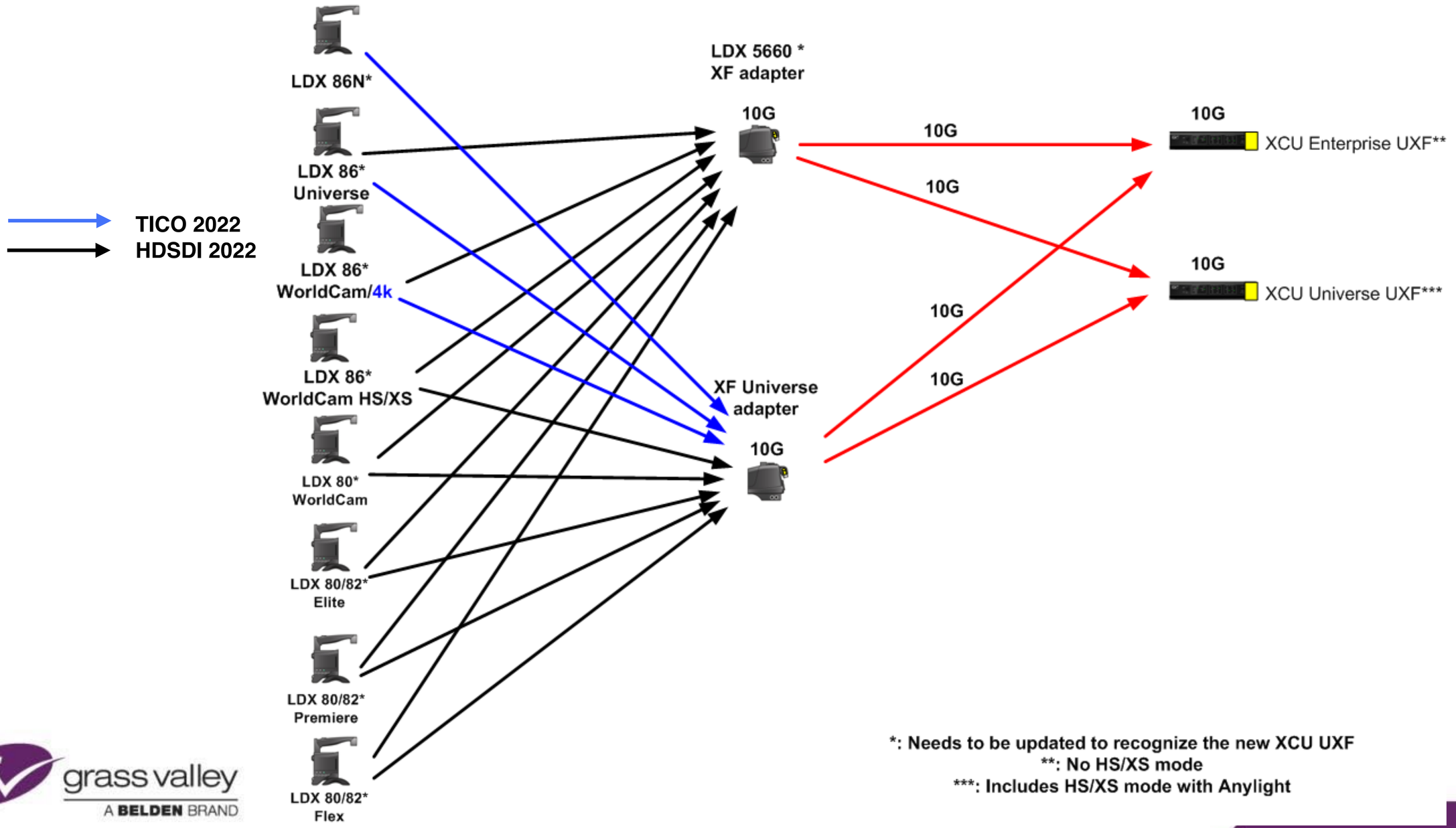
UNIVERSE UXF

LDX86 + UNIVERSE adapter
LDX86N + UNIVERSE adapter
LDX80/82 + UNIVERSE adapter

- XF fiber transmission is supported by ;
  - UNIVERSE adapter
  - ENTERPRISE UXF XCU
  - UNIVERSE UXF XCU

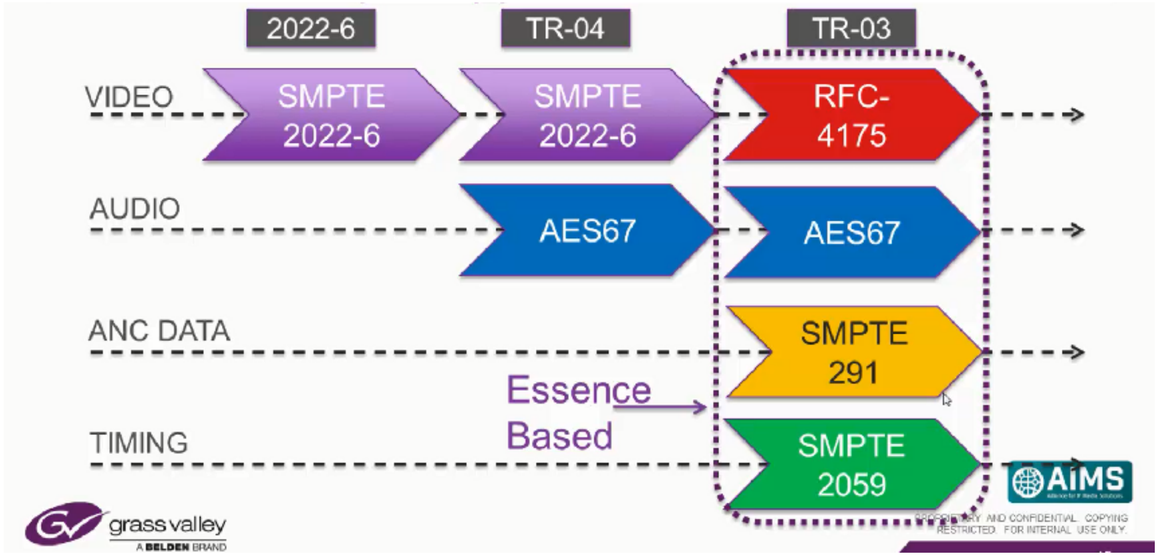
XF Fiber transmission supports video formats ; HD/3G/4K/HDR/HD-HS/HD-XS

Camera interoperability with the XCU UXF



Features / Benefits

- Support all “UNIVERSE” video formats
- Full Hybrid XCU (SDI and IP)
  - Creating Maximum Production Flexibility, Safe Transition from SDI to IP
- Supporting SMPTE2110
  - Interoperability over IP with other brands secured (AIMS roadmap)
- New Cradle (inc. 4x10Gb SFP+ ports)
  - Backwards compatible
  - Redundancy
- XF Fiber transmission (cam-xcu)
  - Support of Direct IP



grass valley
A BELDEN BRAND

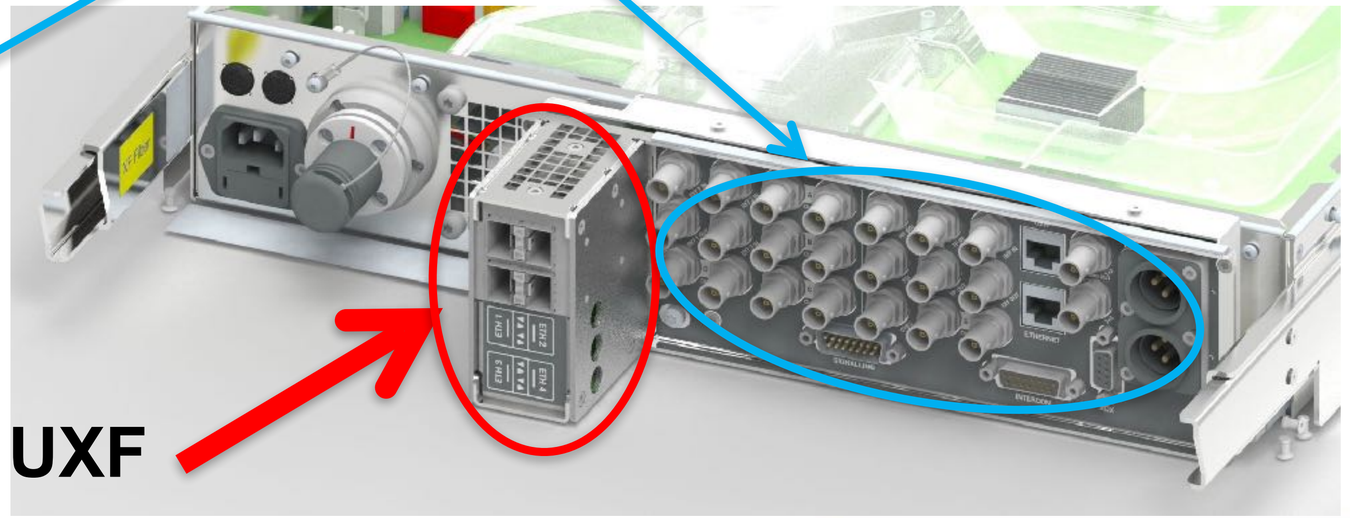
UXF ; interface to the IP network

Cradle type	XCU type	IP connection	SDI connection
UXF Cradle	UNIVERSE UXF	Yes	Yes
UXF Cradle	UNIVERSE	No	Yes
Cradle	UNIVERSE UXF	No	Yes
Cradle	UNIVERSE	No	Yes

Cradle

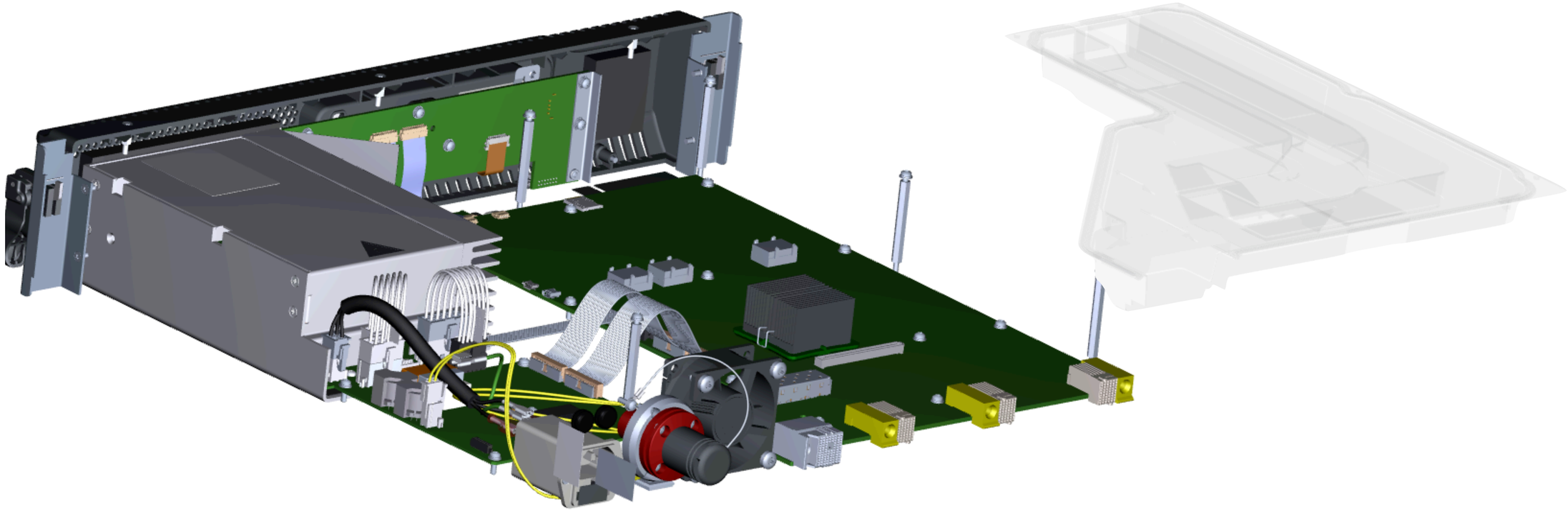
SDI (BNC)
Baseband

UXF Cradle

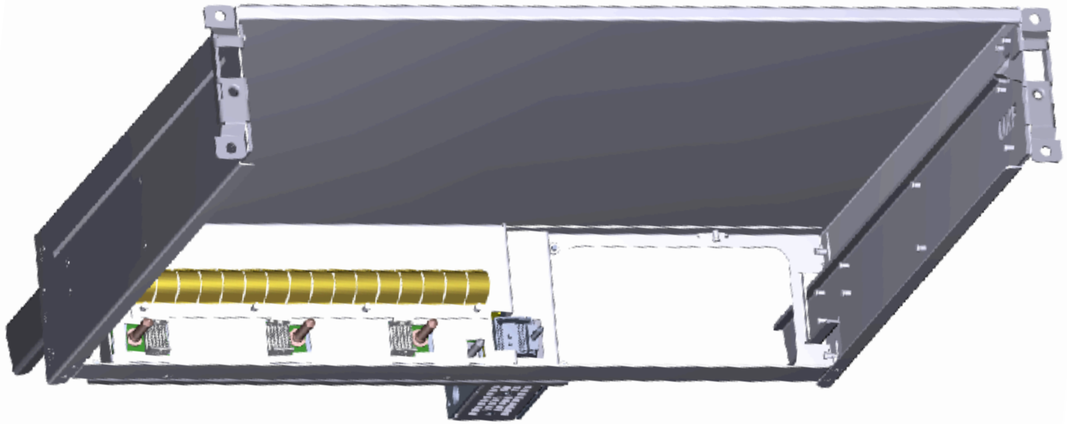


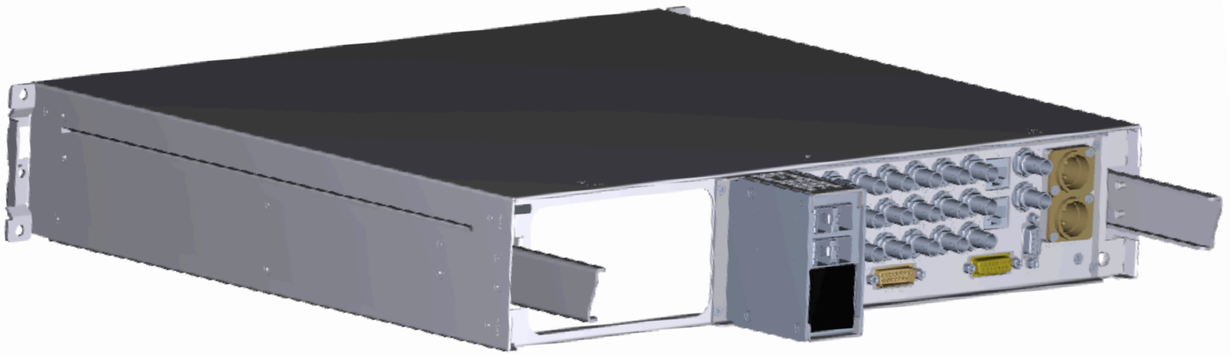
grass valley
A BELDEN BRAND

XCU UXF inside



UXF Cradle inside





How to find out what's is the new Cradle

☑ **New Cradle (front view)**
- Text inside (left/right)
- Mechanical changes
-

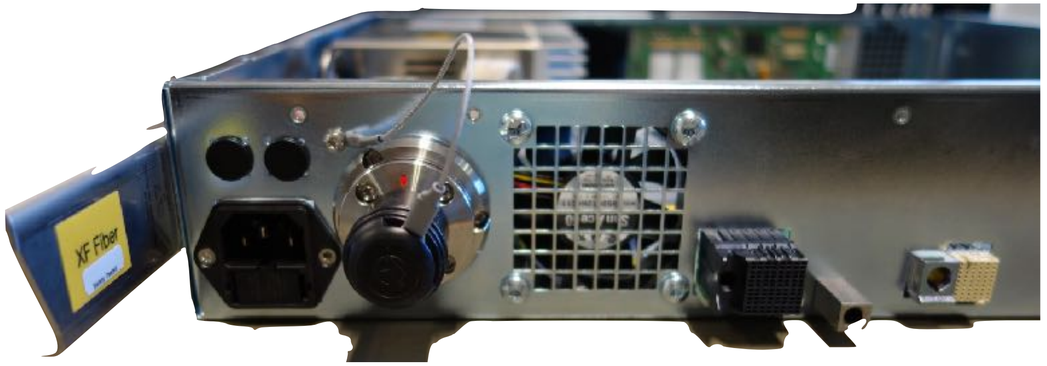
☑ **New Cradle (back view)**
- LED lights
- SFP docking
- Text colours (see Densite rack)
  - Orange = 3G SDI
  - Blue Ring = Analog

☑ **SFP** bay with **4 SFP slots**
-

Compatibility **OLD <=> NEW** see next page

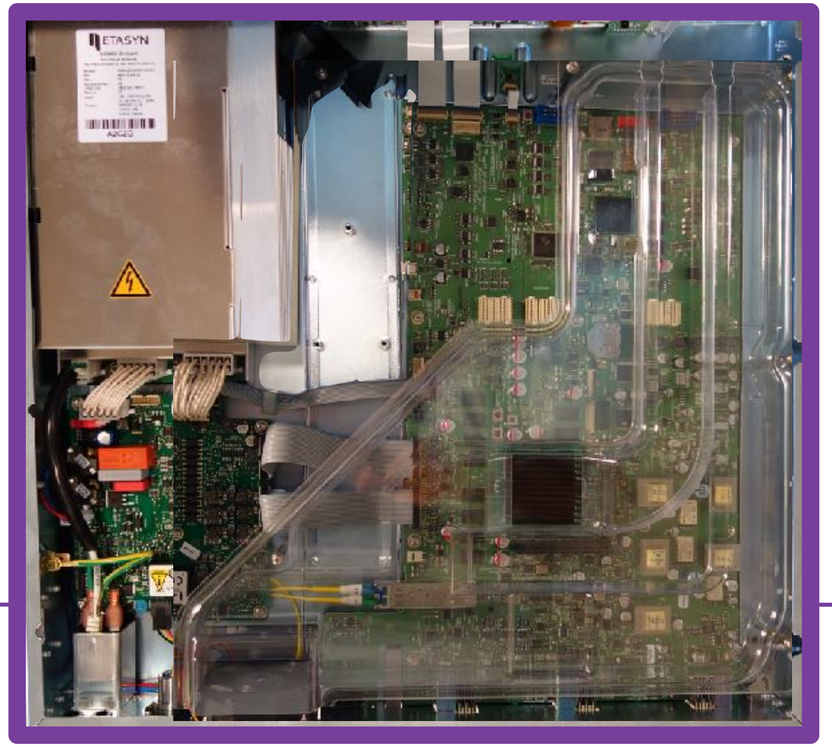
Special ridge for New Cradle

What’s is the new and different in the XCU UXF

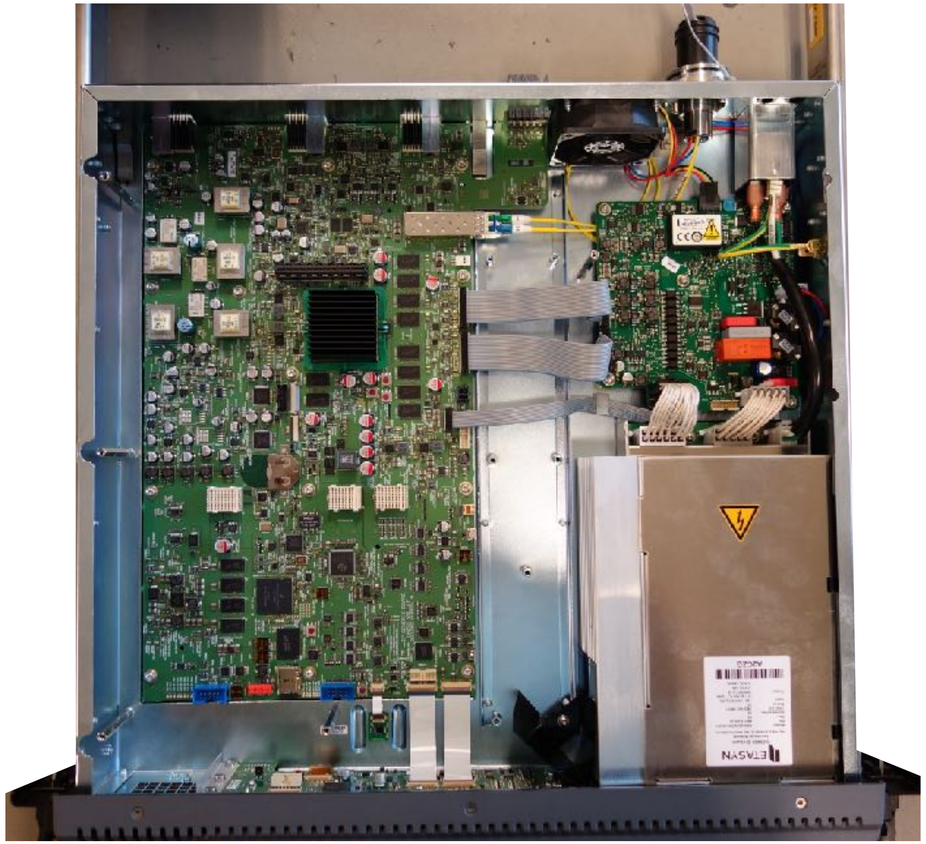


☑ Extension for SFP modules on board (see IP generic board)
- Fan is moved and with better capacity.
- No space for a DUAL XCU version.

☑ Old and new CRADLE compatibility is required. (see slide 15)
- New air guide for enhanced cooling.
- New Generic board.



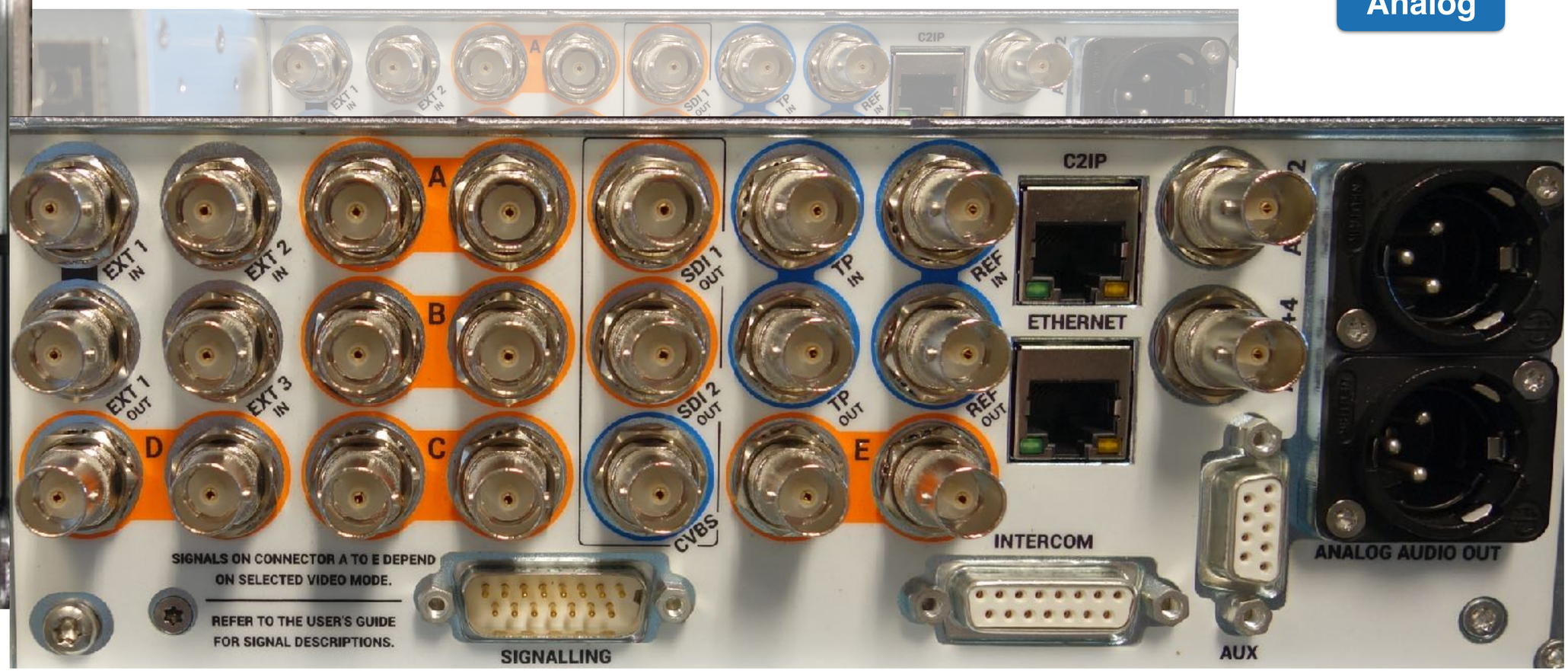
What’s is the new and different in the XCU UXF



OUTPUTS (baseband) from the XCU UXF

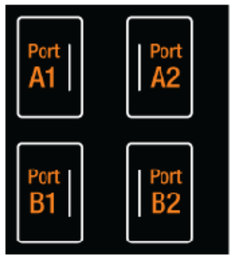
3G SDI

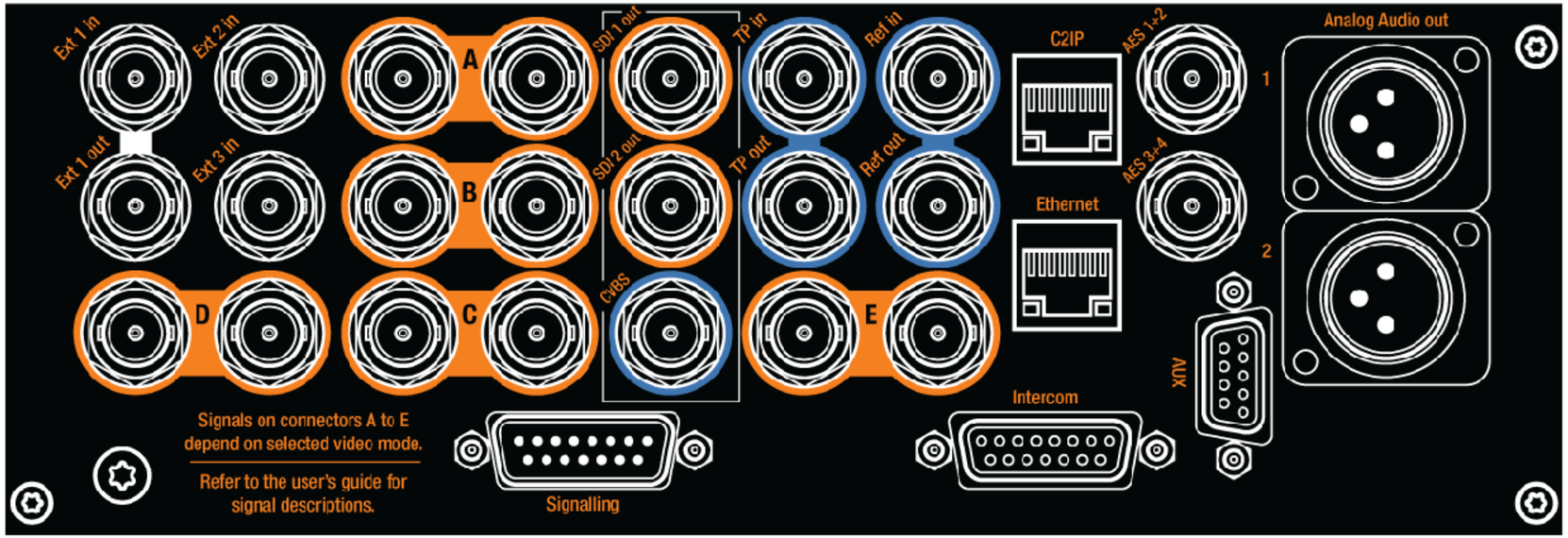
Analog



Connections UXF Cradle (improved)

- SDI positions remain as is
  - Colour-identification in line with Densité (**SDI=orange** / **Analog=Blue**)
  - SDI outputs (A,B,C,D,E) have different signals per video mode (HD / 4K / HDR / XS)
- IP ports (4x 10Gb)
  - Port A for main signals
  - Port B for redundancy





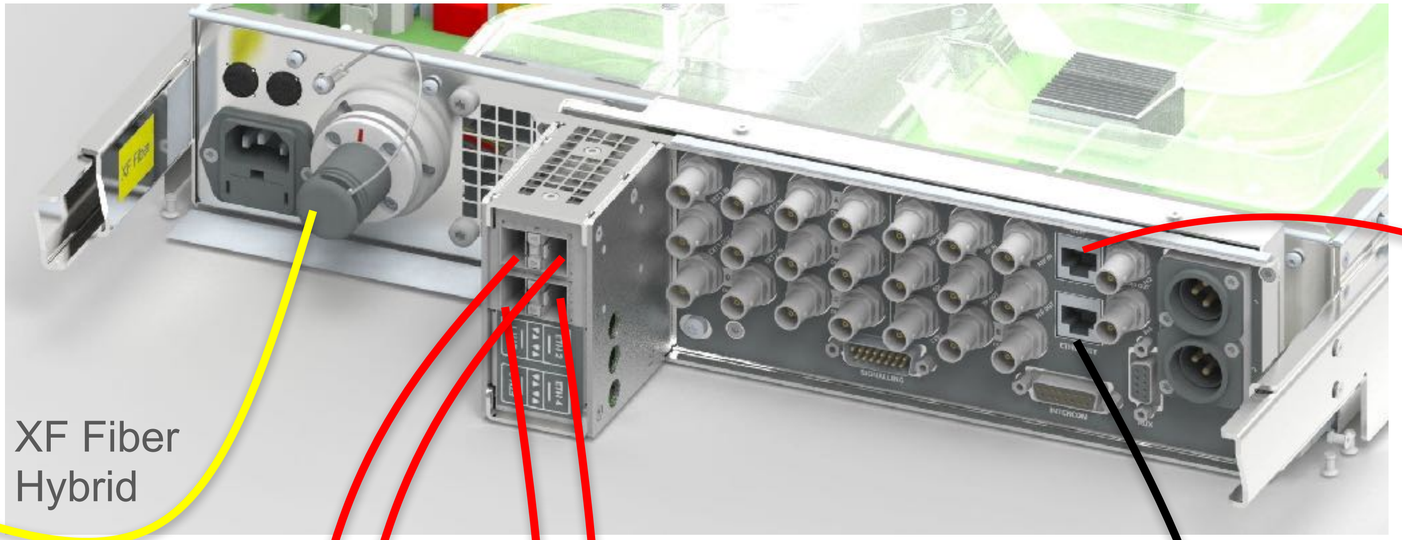
SFP Case configuration from the XCU UXF

4 Functional SFP Cages

A1 A2 for different signals (live)
B1 B2 for high speed / or redundancy

also 12G-SDI will be possible
with a Embrionix module

IP-XCU connections



XF Fiber
Hybrid

2x10Gb

2x10Gb

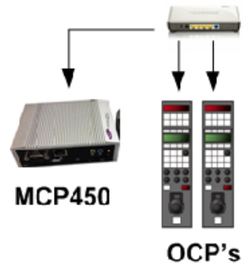
Main
IP Network

Redundant
IP Network

IP Trunk
10/100/1000Mb

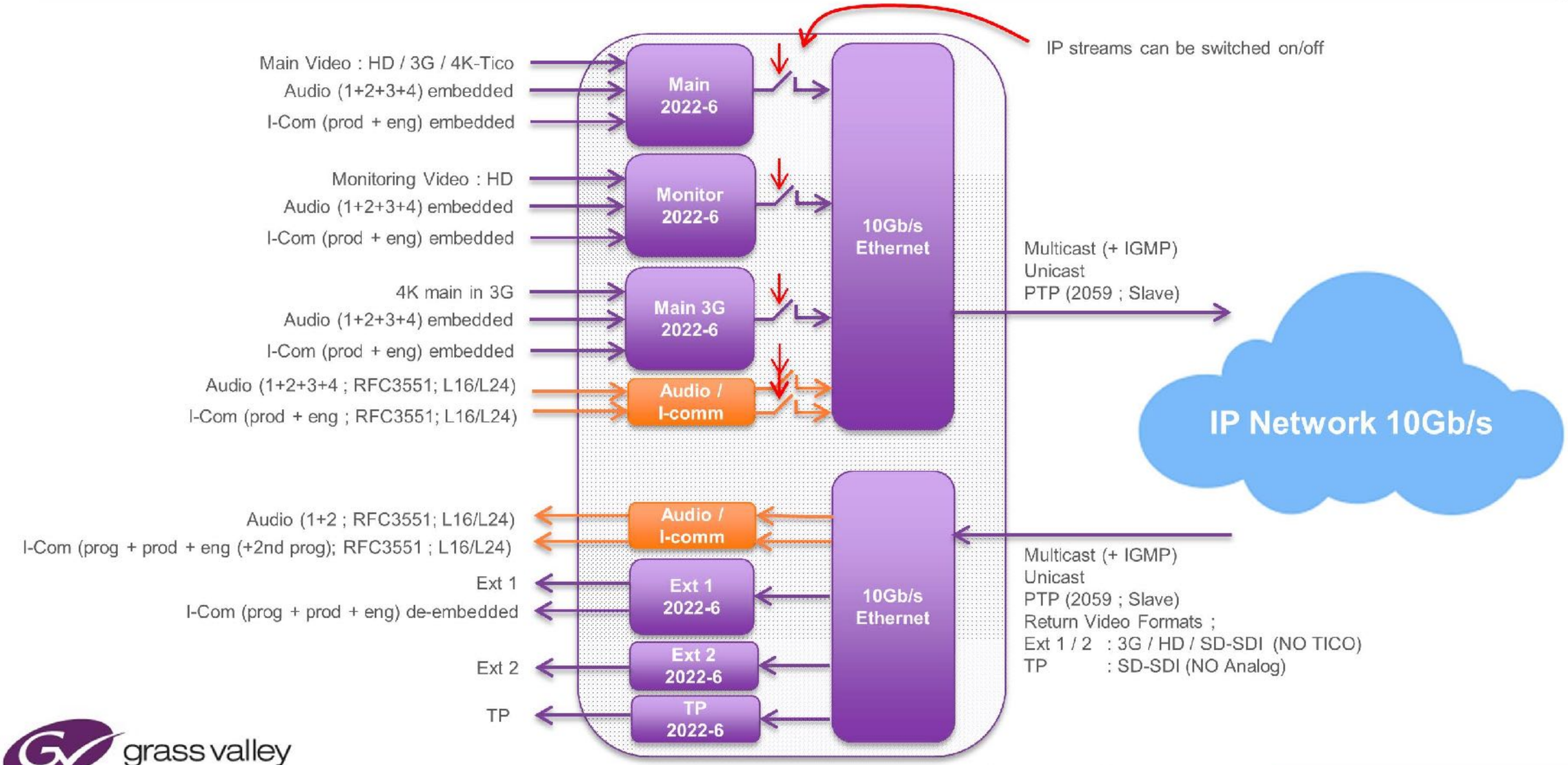
IP Trunk
10/100/1000Mb

C2IP
10/100Mb



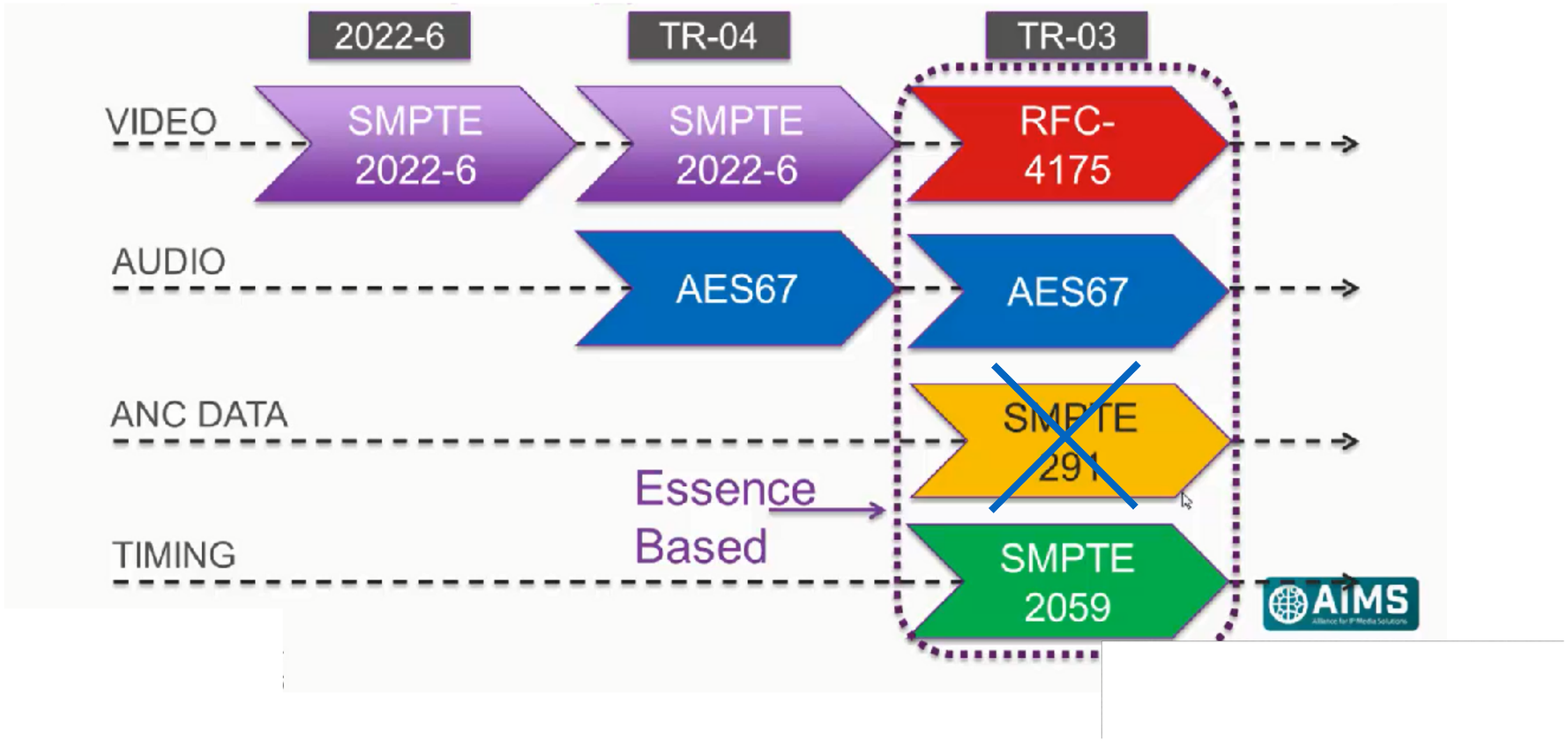
grass valley
A BELDEN BRAND

New XCU UXF – IP Media streams: Video & Audio & I-Com



grass valley
A BELDEN BRAND

AIMS Roadmap → SMPTE 2110



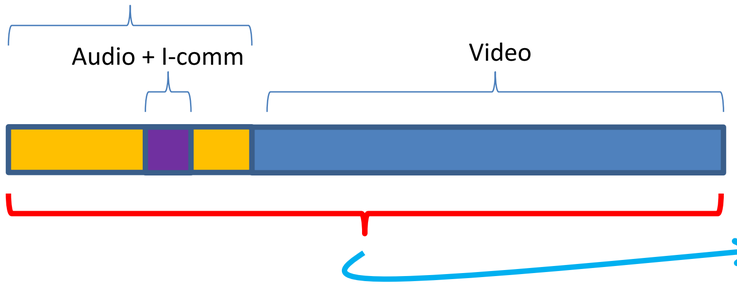
Abstract / high level view

SDI → SMPTE 2022 -6

IP header
Video 2110 -20
Audio AES67 2110 -30
SDP-file
ANC Data

SDI - World

SDI



All “info” available in the SDI stream about video, audio, etc.

IP / SDI - World

SMPTE 2022 -6

Additional IP+2022-6 header

All “info” available in the SDI stream about video, audio, etc.

Abstract / high level view

SMPTE 2022 -6 → SMPTE 2110

IP header
Video — 2110 -20
Audio AES67 — 2110 -30
SDP-file
ANC Data

IP / SDI - World

ANC Data
IP+2022 -6 Header
Audio + I-comm
Video

SMPTE 2022 -6

IP – World
SMPTE 2110

IP+RFC4175 Header
Video

SMPTE 2110 -20 — RFC4175 (video)

IP+RFC3190 Header

SMPTE 2110 -30 — AES67 (audio)

IP+RFC3190 Header

SMPTE 2110 -30 — AES67 (I-comm)

IP+SDP

SDP
Session Description Protocol

SDP “example” ;

m=audio 49170 RTP/AVP 0
m=video 30000 RTP/AVP 112
c=IN IP4 239.252.0.1
a=rtpmap:112 raw/90000
a=fmtp:112 sampling=YCbCr-4:2:2; width=1920; height=1080; exactframerate=60000/1001; depth=10; TCS=SDR; colorimetry=BT709; PM=2110GPM; SSN=”ST2110-20:2017”;
a=mid:2

All “info” available about video, audio, etc. necessary for the “receivers” to understand the content of the IP-packages (Static configuration Info)

Abstract / high level view

IP header
Video 2110 -20
Audio AES67 2110 -30
SDP-file
ANC Data

SDI - World

SDI

ANC Data
Audio + I-comm
Video

All “info” available in the SDI stream about video, audio, etc.

IP / SDI - World

SMPTE 2022 -6

IP+2022 -6 Header
Audio + I-comm
Video

IP – World
SMPTE 2110

SMPTE 2110 -20

IP+RFC4175 Header
Video
RFC4175 (video)

SMPTE 2110 -30

IP+RFC3190 Header
AES67 (audio)

SMPTE 2110 -30

IP+RFC3190 Header
AES67 (I-comm)

SDP “example” ;

m=audio 49170 RTP/AVP 0
m=video 30000 RTP/AVP 112
c=IN IP4 239.252.0.1
a=rtpmap:112 raw/90000
a=fmtp:112 sampling=YCbCr-4:2:2; width=1920; height=1080; exactframerate=60000/1001; depth=10; TCS=SDR; colorimetry=BT709; PM=2110GPM; SSN=”ST2110-20:2017”;
a=mid:2

SDP
Session Description Protocol

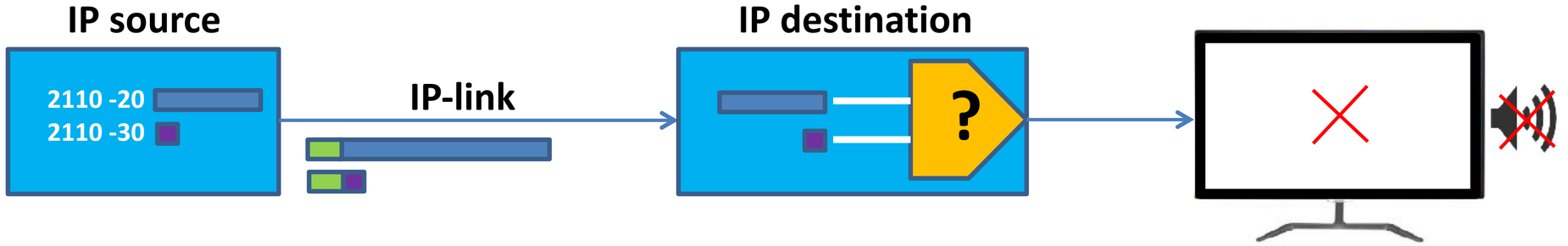
IP+SDP

All “info” available about video, audio, etc. necessary for the “receivers” to understand the content of the IP-packages (Static configuration Info)

Why SDP file ?

IP – SMPTE 2110

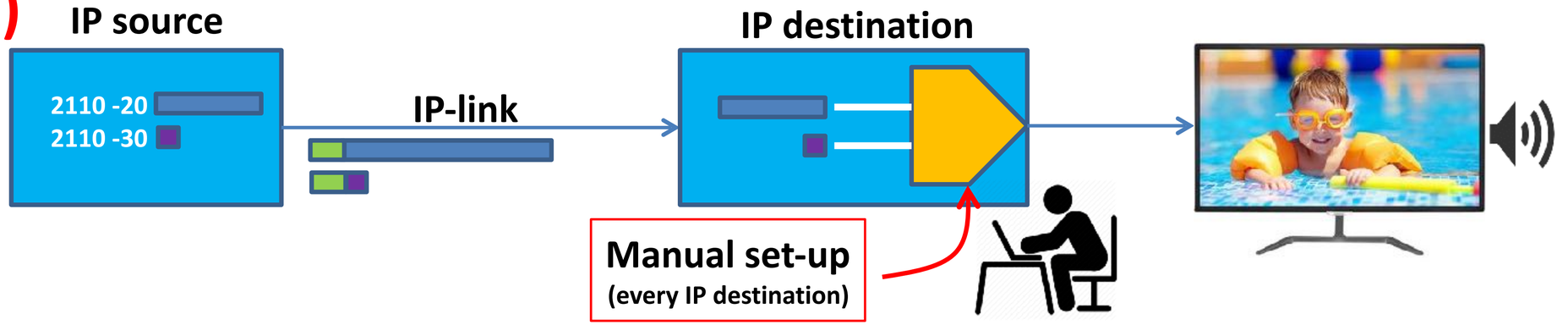
IP header
Video 2110 -20
Audio AES67 2110 -30
SDP-file
ANC Data



In the SMPTE 2110 standard the IP streams are called essence. This means only video but no “discriptive information” like video format, framerate, etc. The same is applicable for the Audio as AES67.
Video is 2110 -20
Audio is 2110 -30
The “discriptive information” has to be known at the “IP-destination” !!! If this is not the case, the IP destination will not understand the content of the IP packages as it doesn’t know how to interpret the stream of bits. This means; no video and no sound.

There are 2 ways to get that “other additional information” at the IP-destination
1) Manually via local set-up, where you simply tell the destination what it is and therewith how to interpret
2) Automatically via SDP file-transfer, sent with the essences

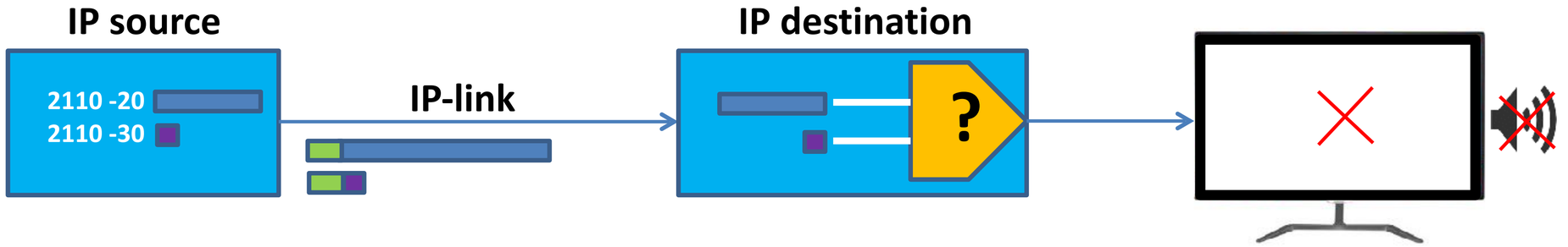
1)



IP – SMPTE 2110

Why SDP file ?

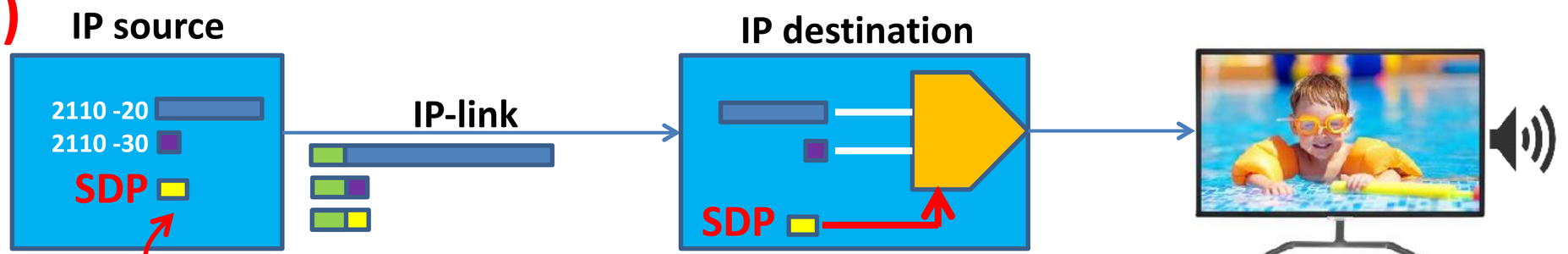
IP header
Video 2110 -20
Audio AES67 2110 -30
SDP-file
ANC Data



In the SMPTE 2110 standard the IP streams are called essence. This means only video but no “discriptive information” like video format, framerate, etc. The same is applicable for the Audio as AES67.
Video is 2110 -20
Audio is 2110 -30
The “discriptive information” has to be known at the “IP-destination” !!! If this is not the case, the IP destination will not understand the content of the IP packages as it doesn’t know how to interpret the stream of bits. This means; no video and no sound.

There are 2 ways to get that “other additional information” at the IP-destination
1) Manually via local set-up, where you simply tell the destination what it is and therewith how to interpret
2) Automatically via SDP file-transfer, sent with the essences

2)

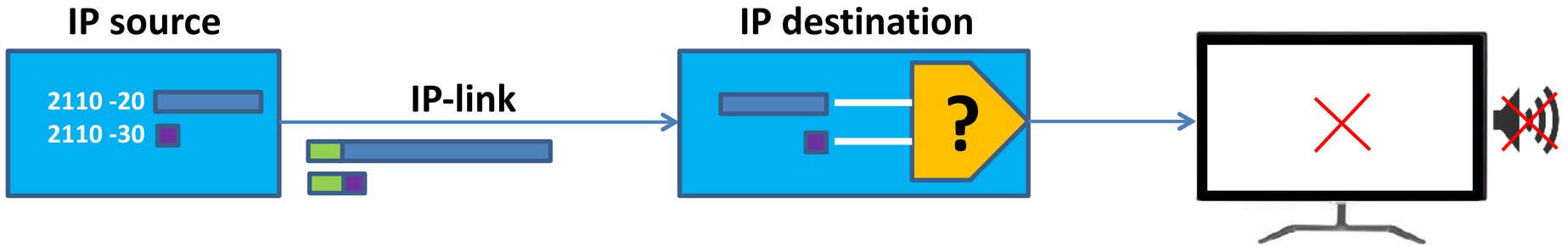


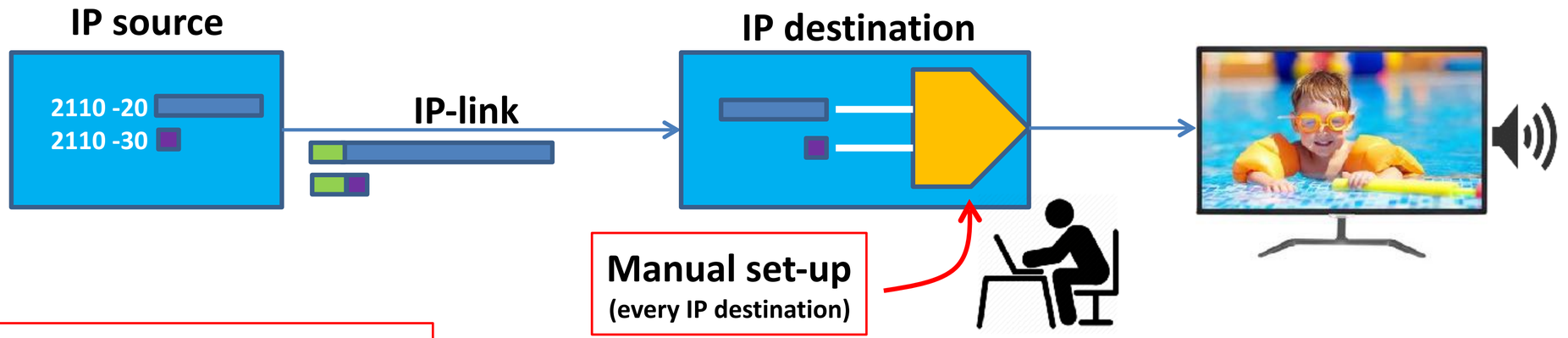
Automatic set-up via SDP
Generated by IP source

IP – SMPTE 2110

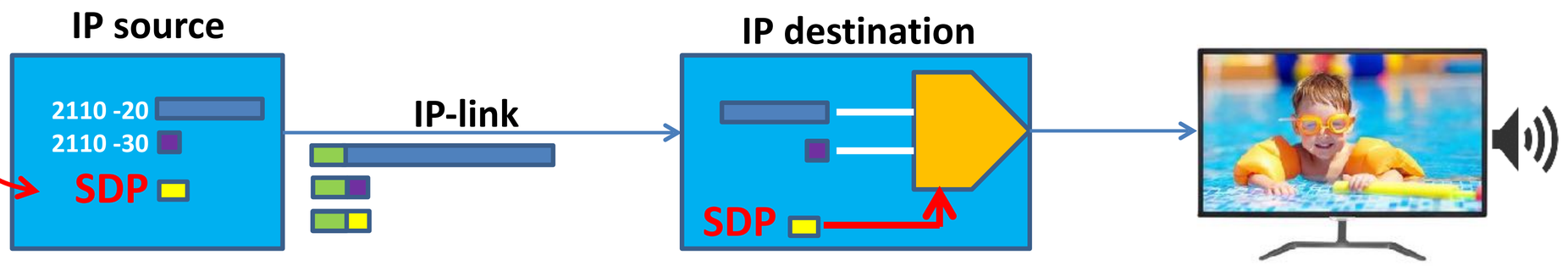
Why SDP file ?
Additional info needed for each receiver to "understand" the content of the IP packages

IP header
Video 2110 -20
Audio AES67 2110 -30
SDP-file
ANC Data





Automatic set-up via SDP
Generated by IP source



Abstract / high level view

4K uncompressed SMPTE 2110 (2 options)

IP header
Video 2110 -20
Audio AES67 2110 -30
SDP-file
ANC Data

2x 10 Gb

3Gb (1) | 3Gb (2) | 3Gb (3) | 3Gb (4)

SDP file streaming ;
Audio info + Video info +
“Group info” ; 1+2+3+4

1x 25 Gb

12Gb

SDP file streaming ;
Audio info + Video info

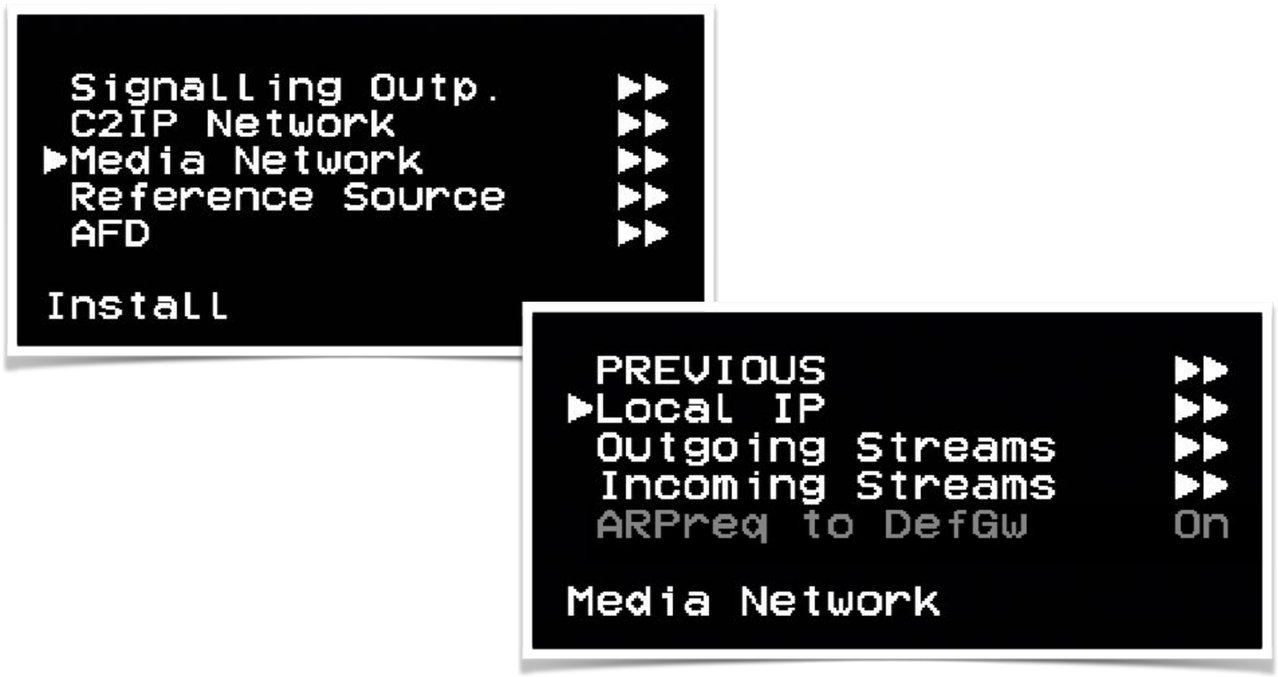
4K uncompressed = 4x 2SI/SDQS stream ; 2110 -20)

3Gb (1) + 3Gb (2) + 3Gb (3) + 3Gb (4)

4K uncompressed = 1x stream ; 2110 -20)

12Gb

Media Network XCU Menu items (Video Streams) IP settings



=> Local IP settings
=> Outgoing Streams from XCU to Cloud
=> Incoming Streams to XCU (Ext 1/2 TP)

Menu XCU

Media Network XCU Menu items (Reference Source)

```
 C2IP Network          ▶▶
 Media Network         ▶▶
▶Reference Source      ▶▶
 AFD                   ▶▶
 Video inputs          ▶▶

Install
```

```
▶Source        RefVideoIn




Reference Source
```

```
▶Source                PTP
 PTP Profile           User
 PTP Settings          ▶▶


Reference Source
```

```
▶Domain Nr                127
 DelayReqInterval          -3
 ReceiptTimeout             3


PTP Settings
```

Menu XCU

Set-up with Connect gateway

Main 10Gb IP Network

10Gb

Redundant 10Gb IP Network

10Gb

Media Streams

Main 10Gb IP Network

Main 10Gb IP Network

Camera Control Streams

C2IP

C2IP Camera control Network

<xml />

VSM control Network

AMWA/NMOS

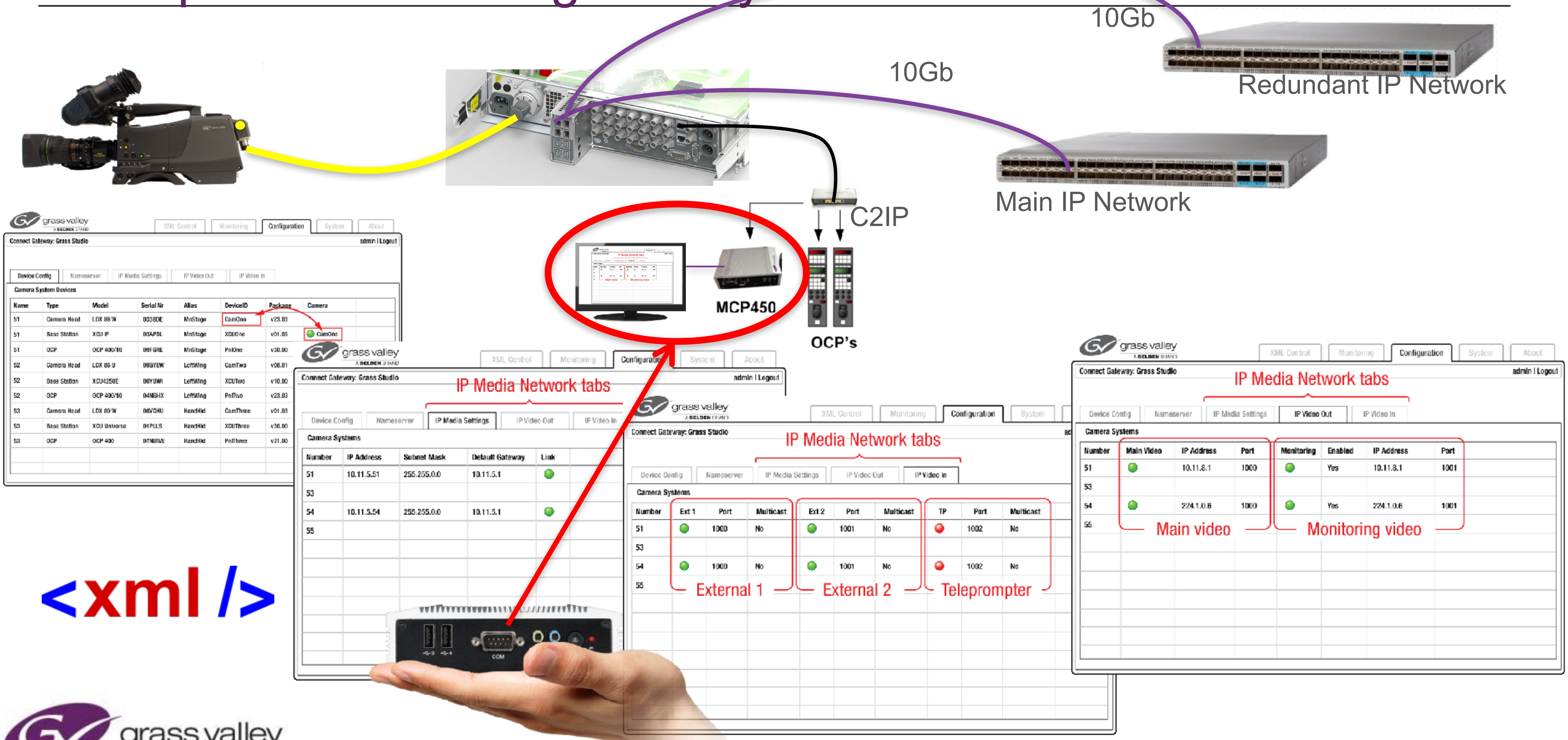
OCP's

Connect Gateway

External control Streams

grass valley
A BELDEN BRAND

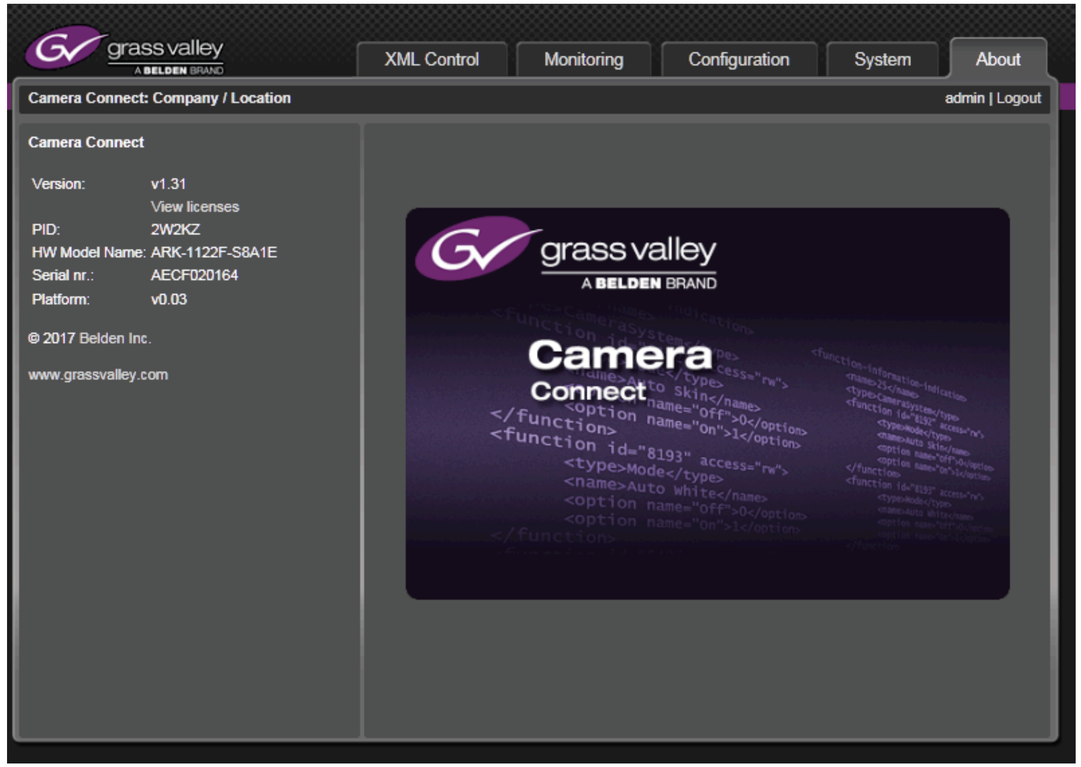
Set-up via Connect gateway



CAMERA CONNECTED changes

Live session

Available as Video



PTP:
Precision Time Protocol

FUTURE-READY

grass valley
A BELDEN BRAND

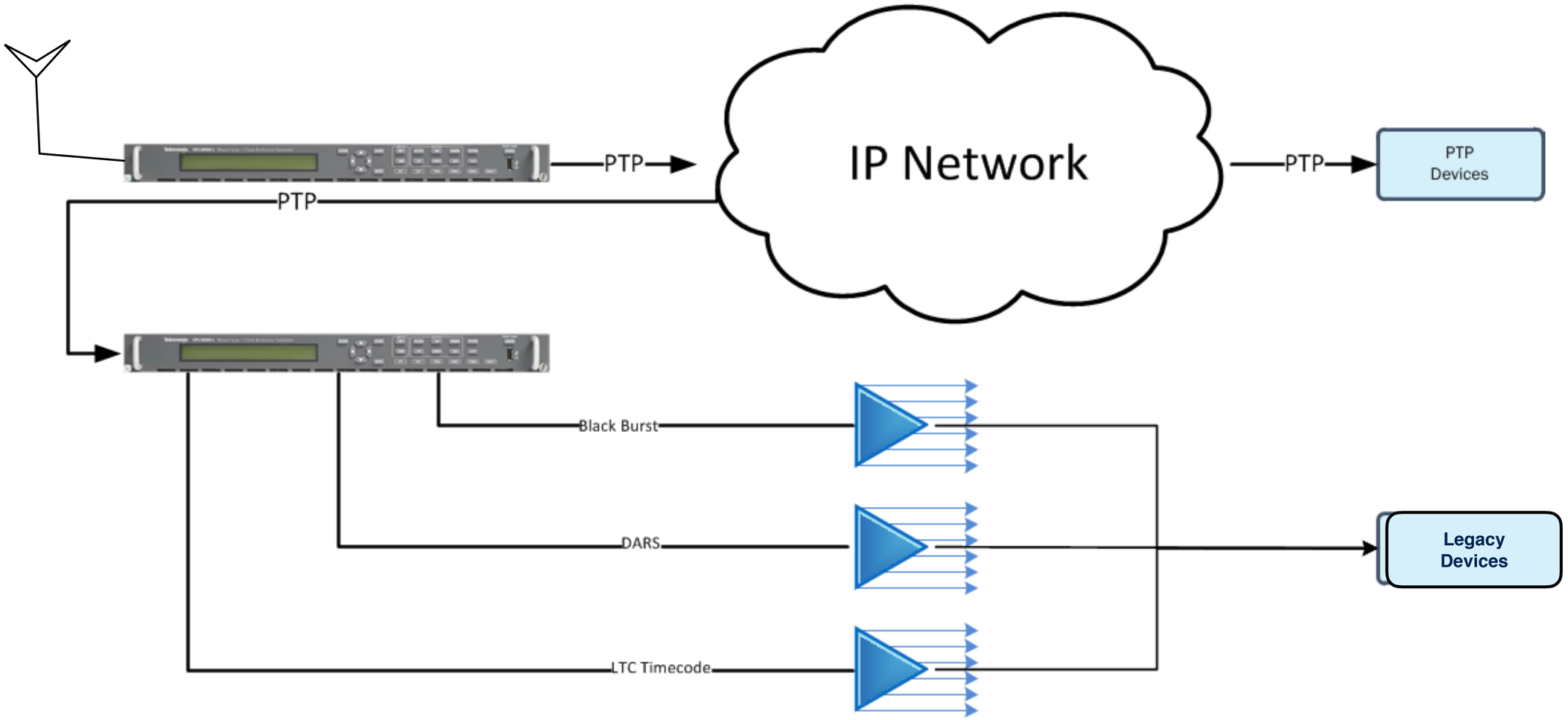
Etienne Brule

January 2017

PTP Overview

- **PTP** - Precision Time protocol will replace traditional analog reference.
  Since we move the Data link transport over IP it make sense to migrate the synchronize information over the same data plane.
- **PTP** is the new “BLACK”.
- **PTP** is a more accurate version of NTP – Network Time Protocol, which controls the synchronizing and timing of data packets in the IP environment. In the world of bits and bytes, locking each bit to a slice of time is highly accurate or should be.

PTP Overview



PTP Standards

- IEEE Standard 1588-2008 Precision Time Protocol
- •SMPTE ST 12-1:2014, Time and Control Code
- •SMPTE ST 2059-1:2015x Generation and Alignment of Interface Signals to the SMPTE Epoch
- •SMPTE ST 2059-2:2015x SMPTE Profile for use of IEEE-1588 Precision Time Protocol in Professional Broadcast Applications
- •SMPTE ST 2059-2:201X, SMPTE Profile for use of IEEE-1588 Precision Time Protocol in Professional Broadcast Applications — Amendment 1
- •AES67-, AES Standards Report PTP parameters for AES67 interoperability
- •AES-R16-2016, AES Standards Report PTP parameters for AES67 and SMPTE ST 2059-2 interoperability

PTP Standards (Clock Types)

- **Ordinary Clock**
  End Device on a network (not a switch or router)
  Slave only Clock (never acts as a Master)
  Preferred Grandmaster (never acts as a Slave)
  Master/Slave Clock (can be either)
- **Transparent clock**
  Accounts for queueing delays in switches or routers
  Hardware time stamps Sync and Delay Request messages on arrival and departure and adds the difference to a correction field in the message header
- **Boundary Clock**
  Receives time from a Master on one Slave port
  Provides Multiple Master (not Grandmaster) ports to downstream Slaves in a domain
  Removes the effect of its own queue

PTP Overview

Ordinary Clock
Communicates with the network based on a single physical port, similar to an end host. An ordinary clock can function as a grandmaster clock.

SPG 8000 Tektronix

PTP Overview

Boundary clock

- Typically has several physical ports, with each port behaving like a port of an ordinary clock. However, each port shares the local clock, and the clock data sets are common to all ports.
- Each port decides its individual state, either master (synchronizing other ports connected to it) or slave (synchronizing to a downstream port), based on the best clock available to it through all of the other ports on the boundary clock.
- Messages related to synchronization and establishing the master-slave hierarchy terminate in the protocol engine of a boundary clock and are not forwarded.

PTP Process

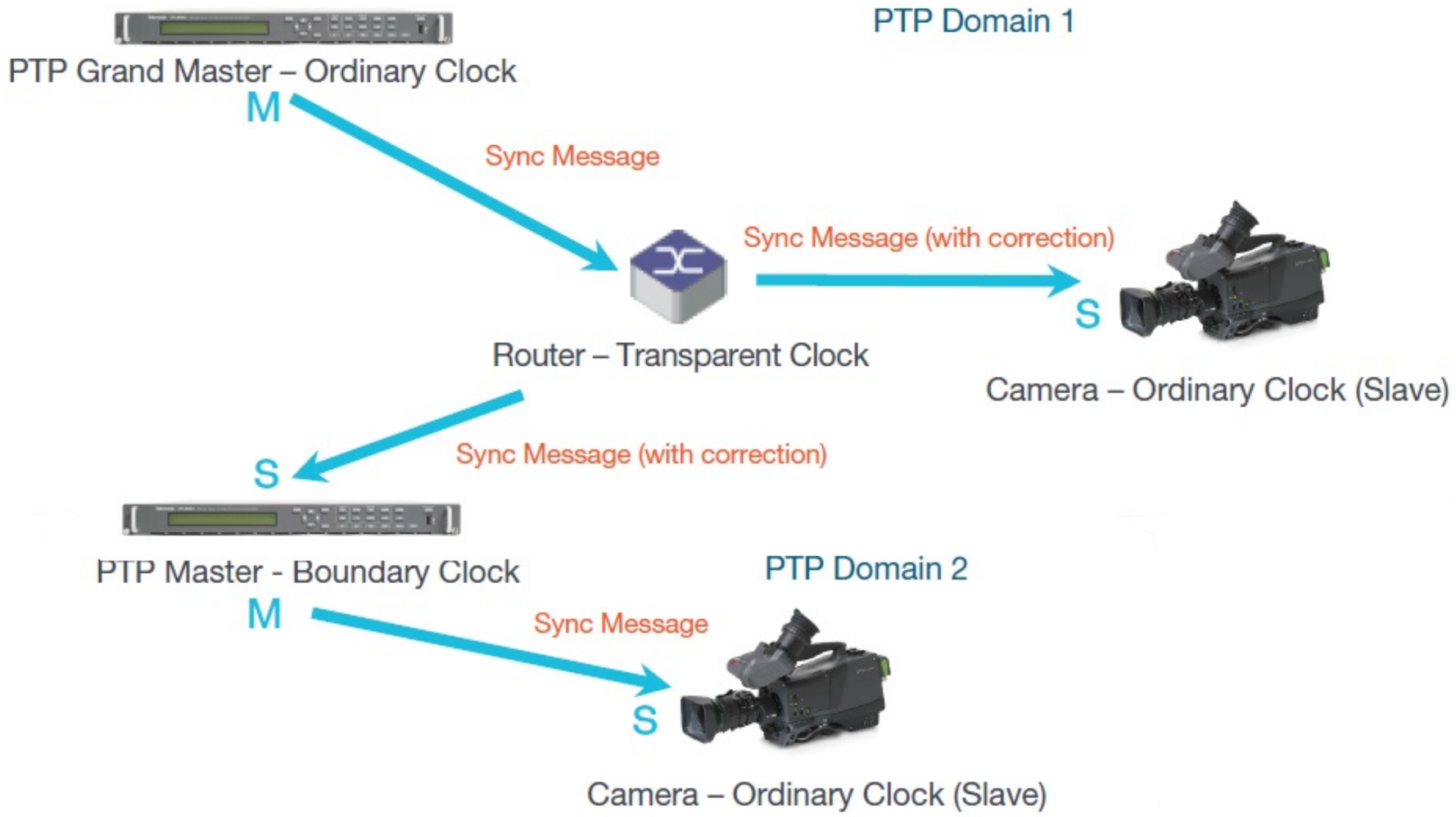
The PTP process consists of two phases:

Establishing the master-slave hierarchy and
synchronizing the clocks.

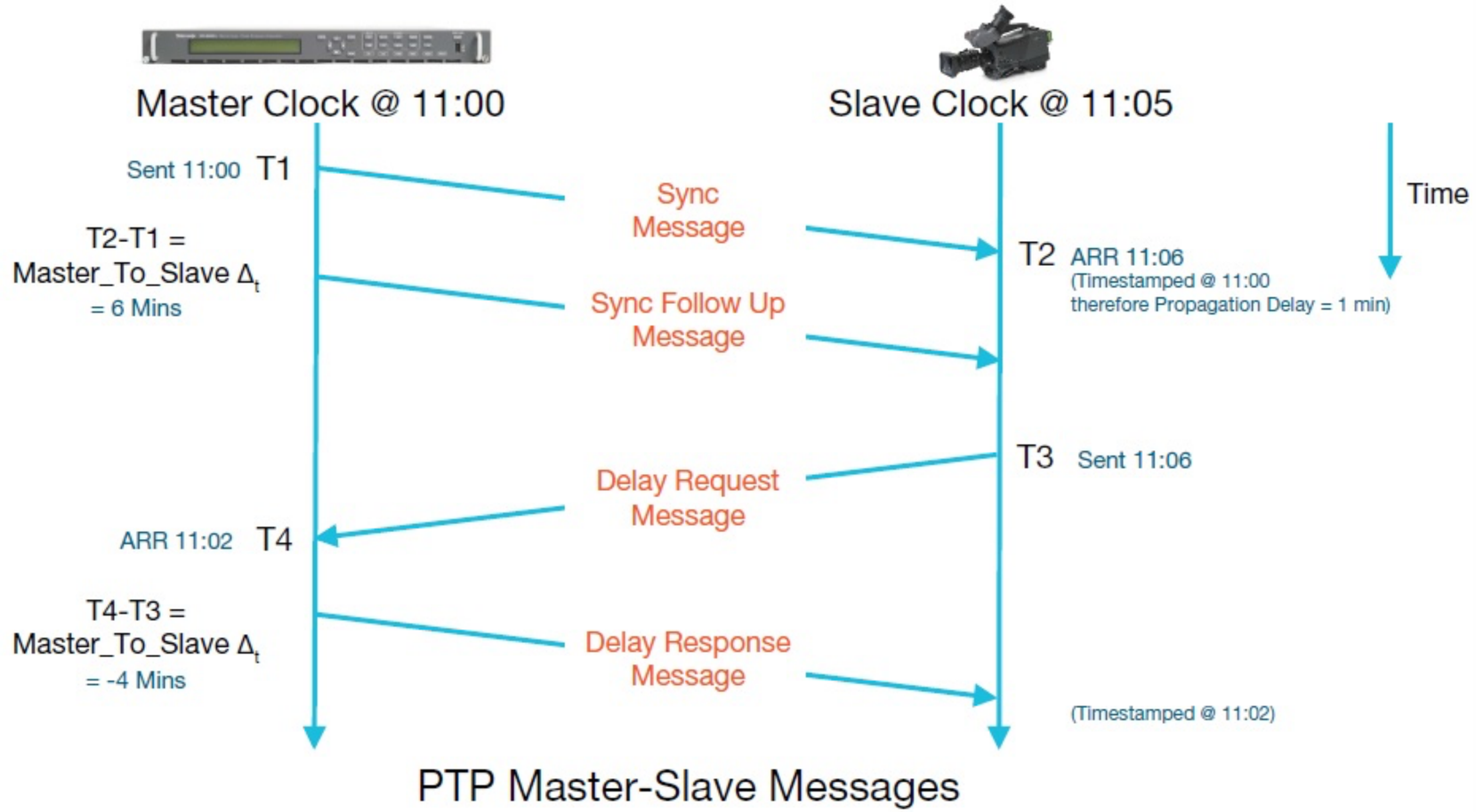
Within a PTP domain, each port of an ordinary or boundary clock follows this process to determine its state:

Examines the contents of all received announce messages (issued by ports in the master state)
Compares the data sets of the foreign master (in the announce message) and the local clock for priority, clock class, accuracy, and so on
Determines its own state as either master or slave

PTP Process


PTP Domain 1
PTP Grand Master – Ordinary Clock
M
Sync Message
Sync Message (with correction)
S
Router – Transparent Clock
Camera – Ordinary Clock (Slave)
S
Sync Message (with correction)
PTP Master - Boundary Clock
PTP Domain 2
M
Sync Message
S
Camera – Ordinary Clock (Slave)

PTP Process

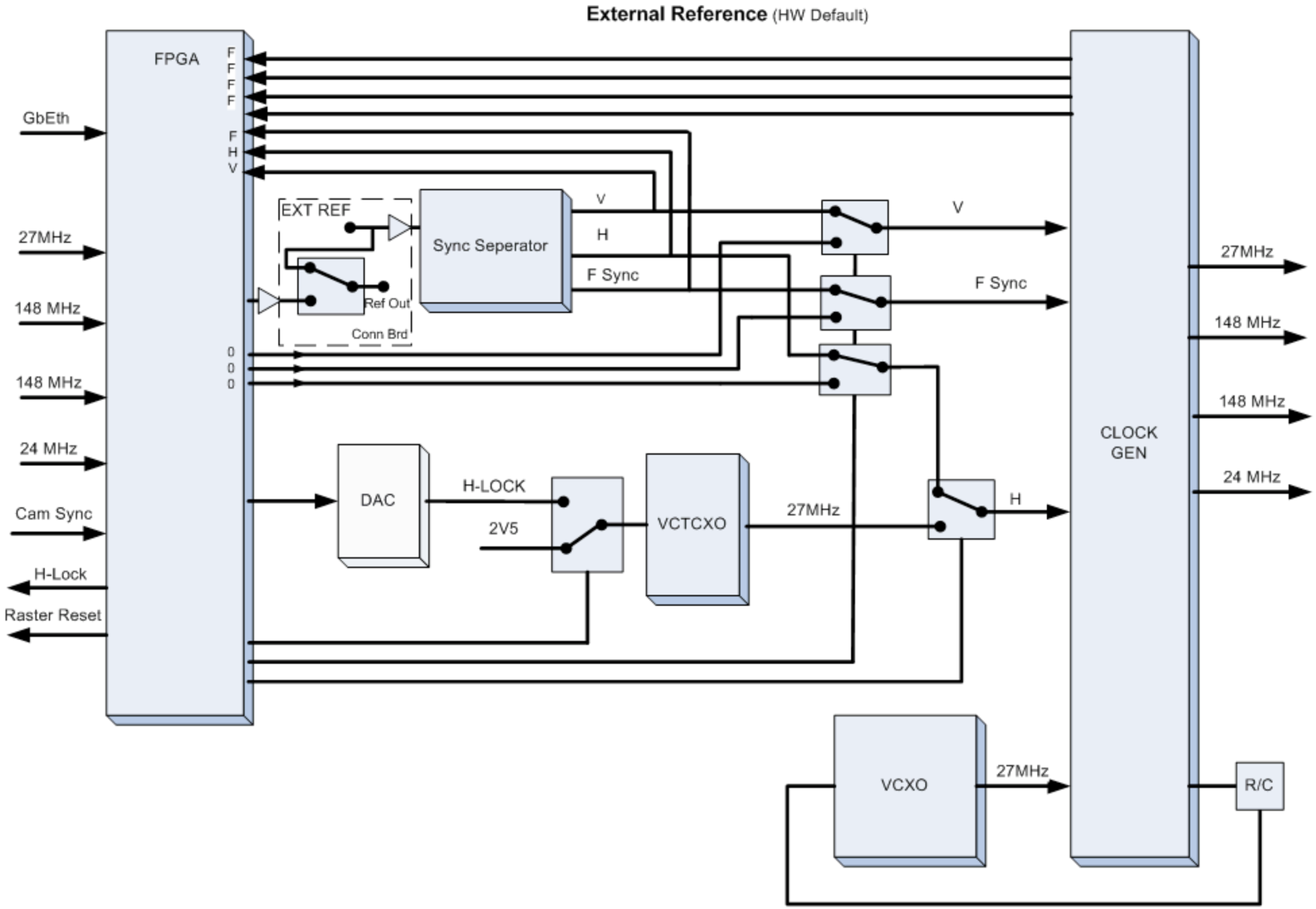


Offset = (Master_To_Slave Δ_t – Slave_To_Master Δ_t)/2 = **5 Mins**

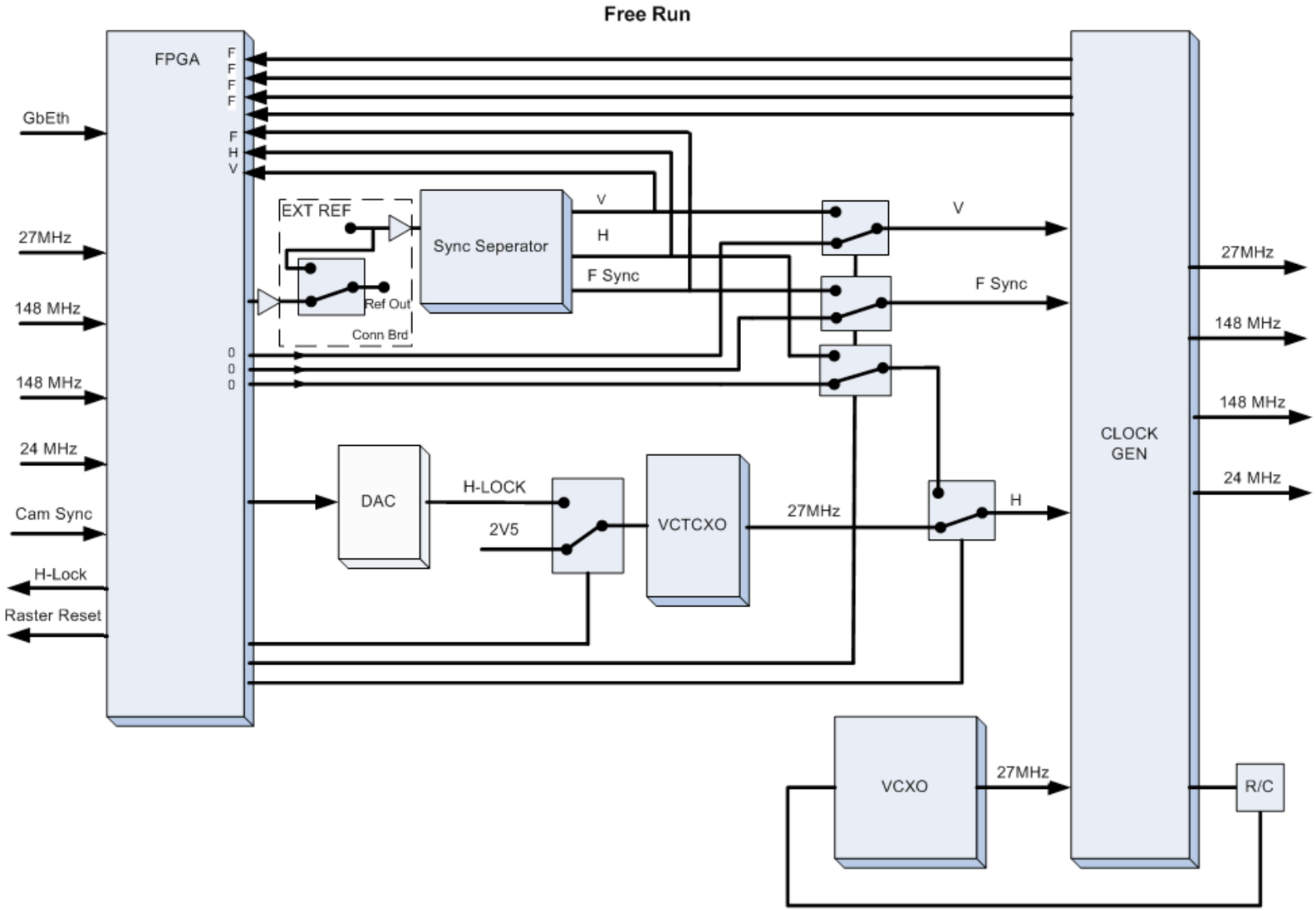
Oneway Delay = (Master To Slave Δ_t + Slave To Master Δ_t)/2 = **1 Min**

grass valley
A BELDEN BRAND

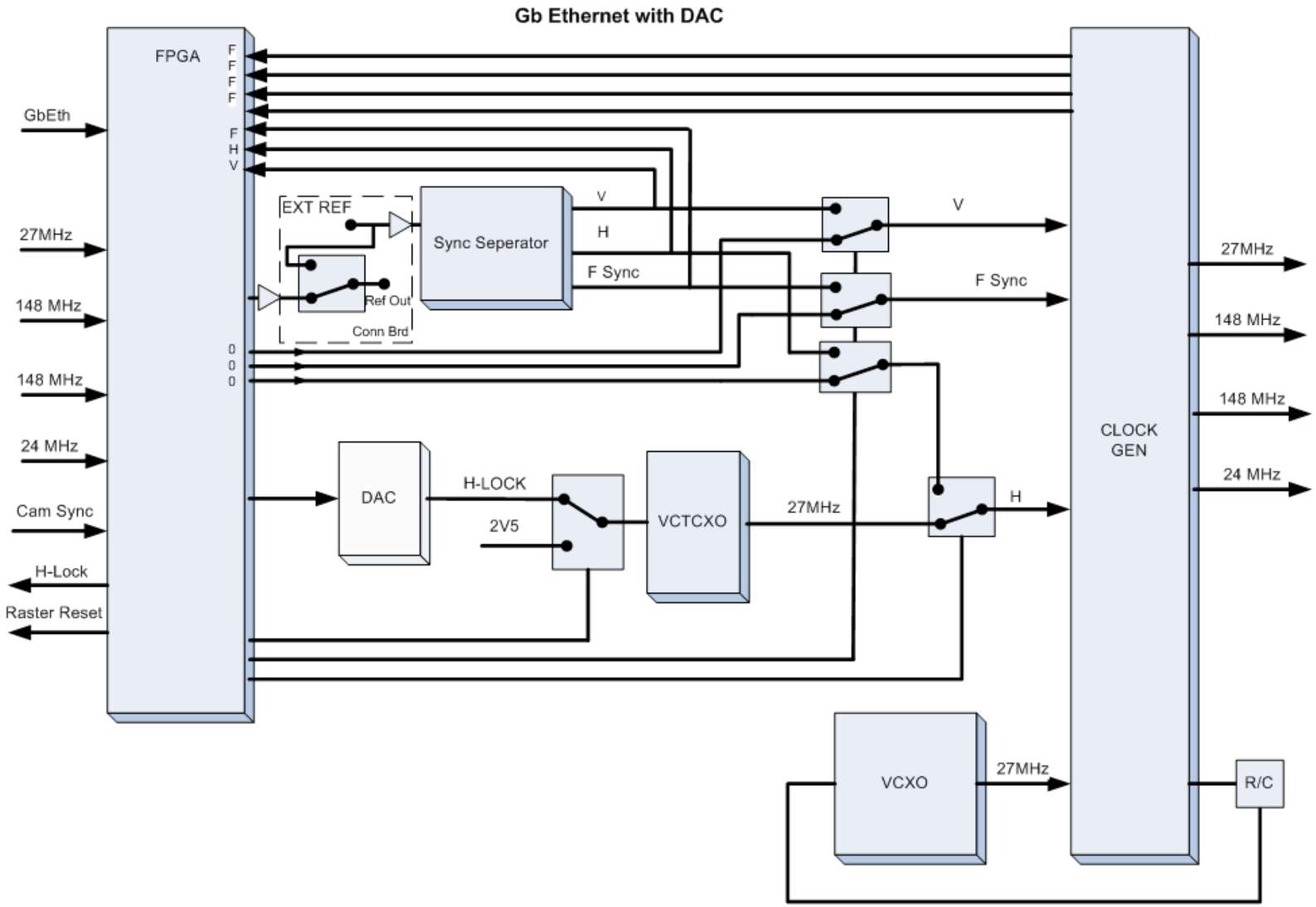
PTP Overview Ext Ref (BB or TL)



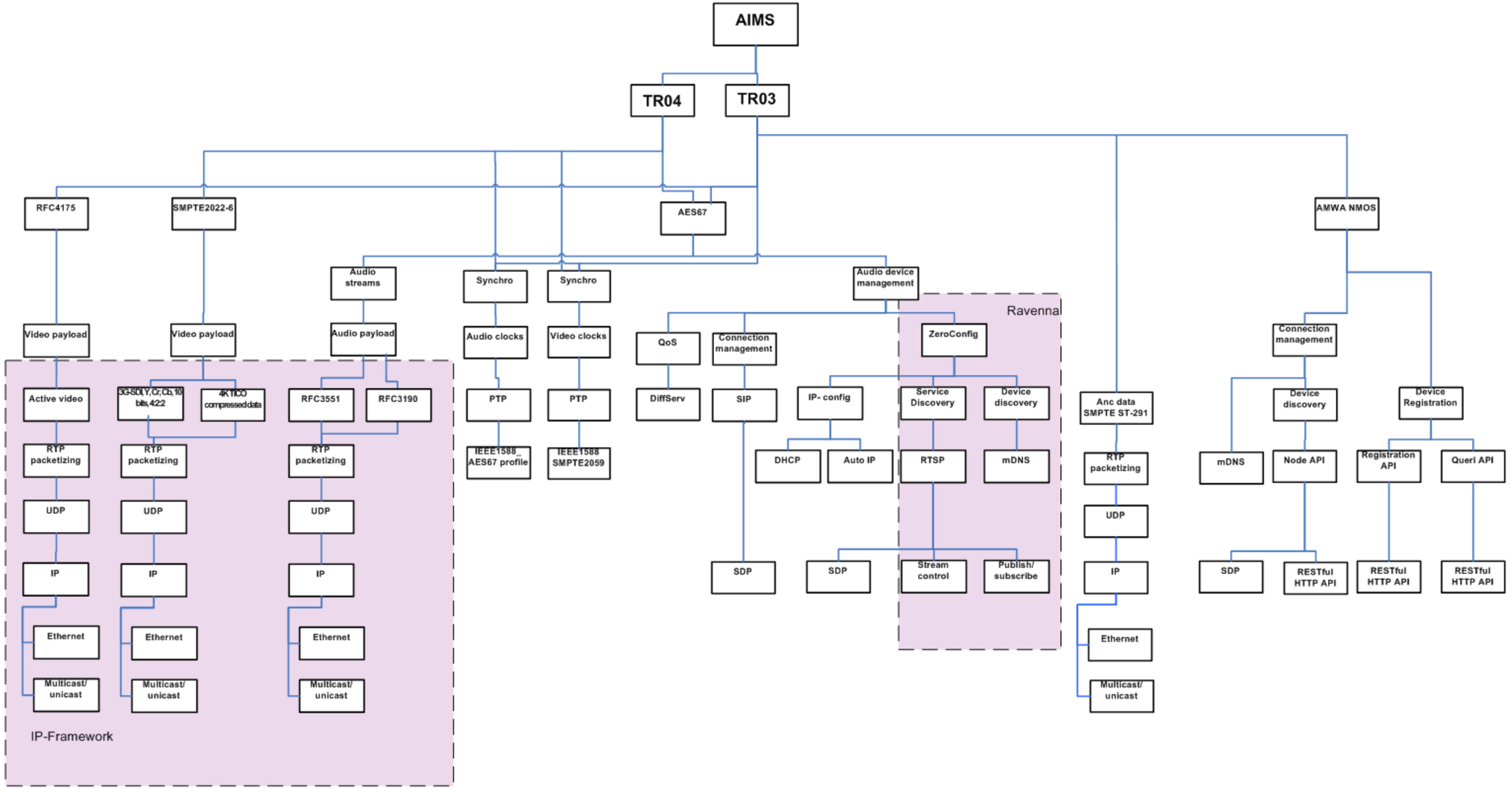
PTP Overview Ext Ref (Free Run)



PTP Overview Ext Ref (PTP)



AIMS IP layer overview



Thanks for your attention.