



Camera Training Center Breda The Netherlands

June 2016



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**



IP XCU 10G Fiber (basics)

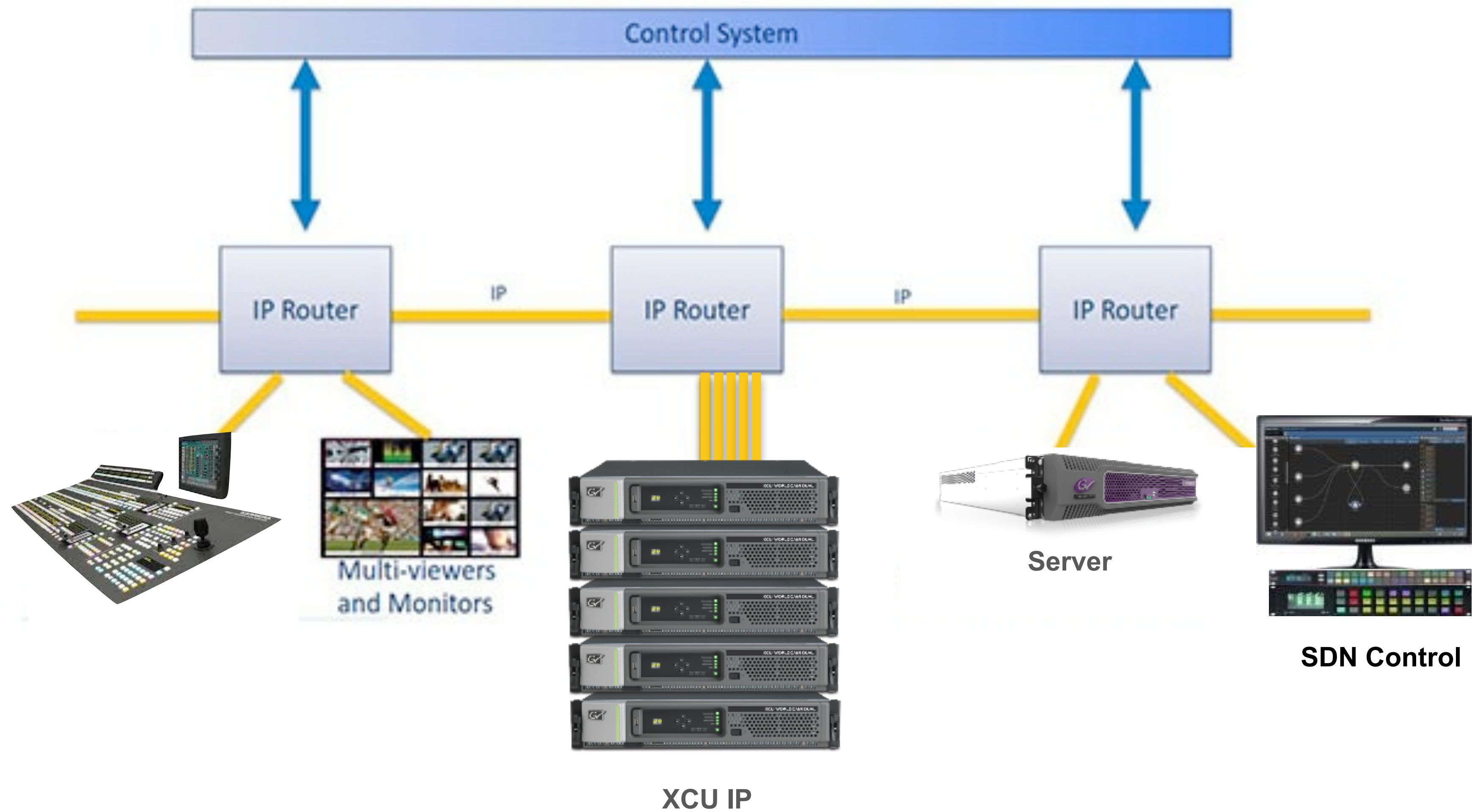
This part gives you some more details about the
IP Connection between XCU and the world

In this session:

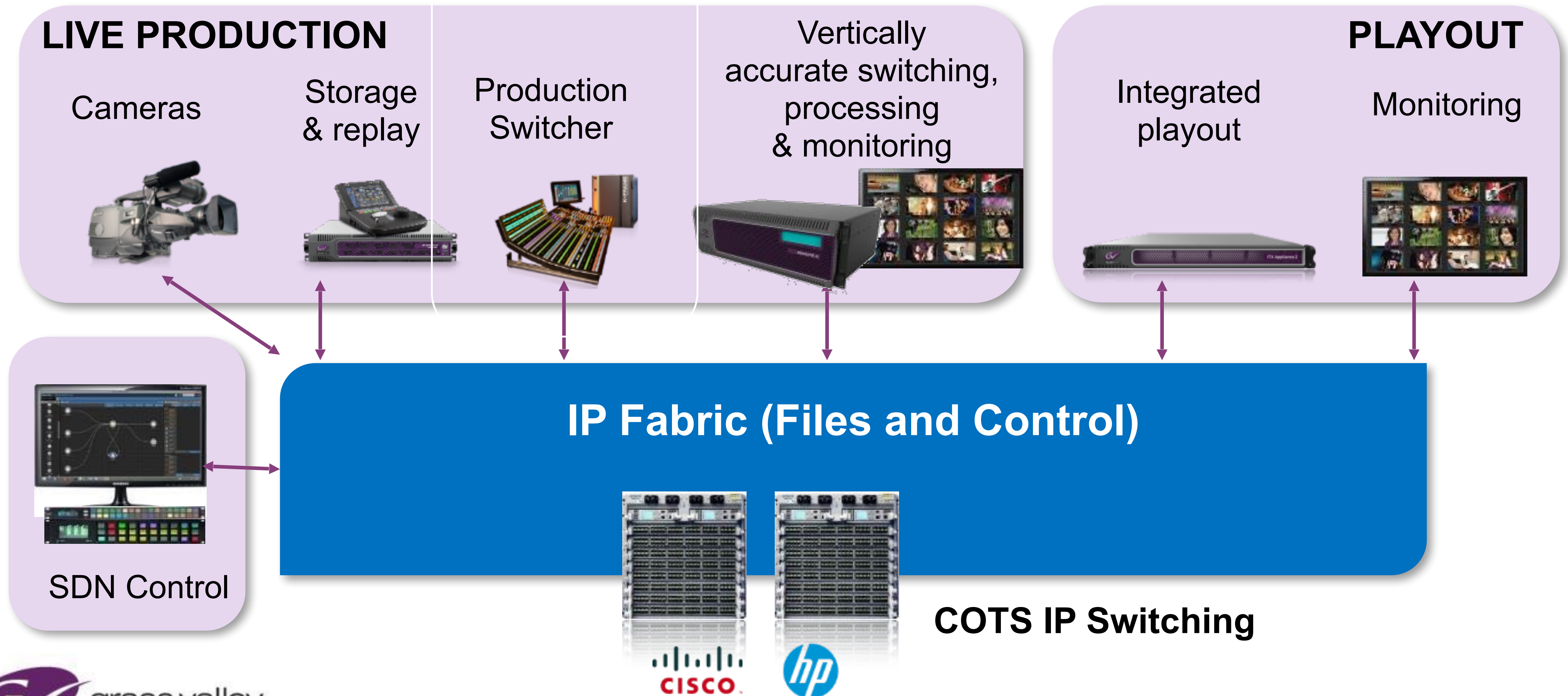
- ◆ **IP XCU introduction**
- ◆ **XCU IP connections**
- ◆ **IP basics + test**
- ◆ **Settings with MCP450**
- ◆ **XCU New**



XCU HD/4K IP – Workflow overview



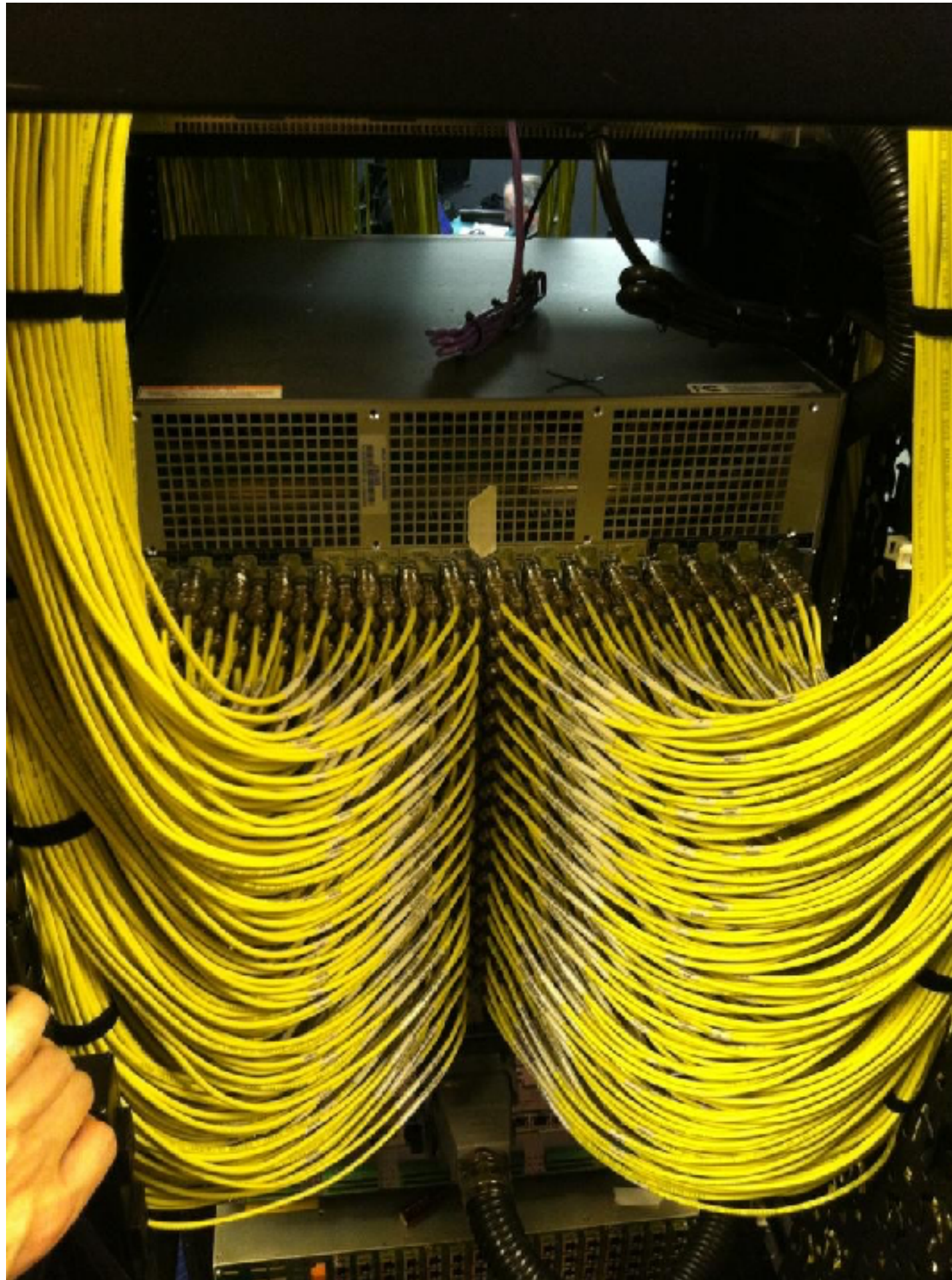
XCU HD/4K IP – Workflow overview



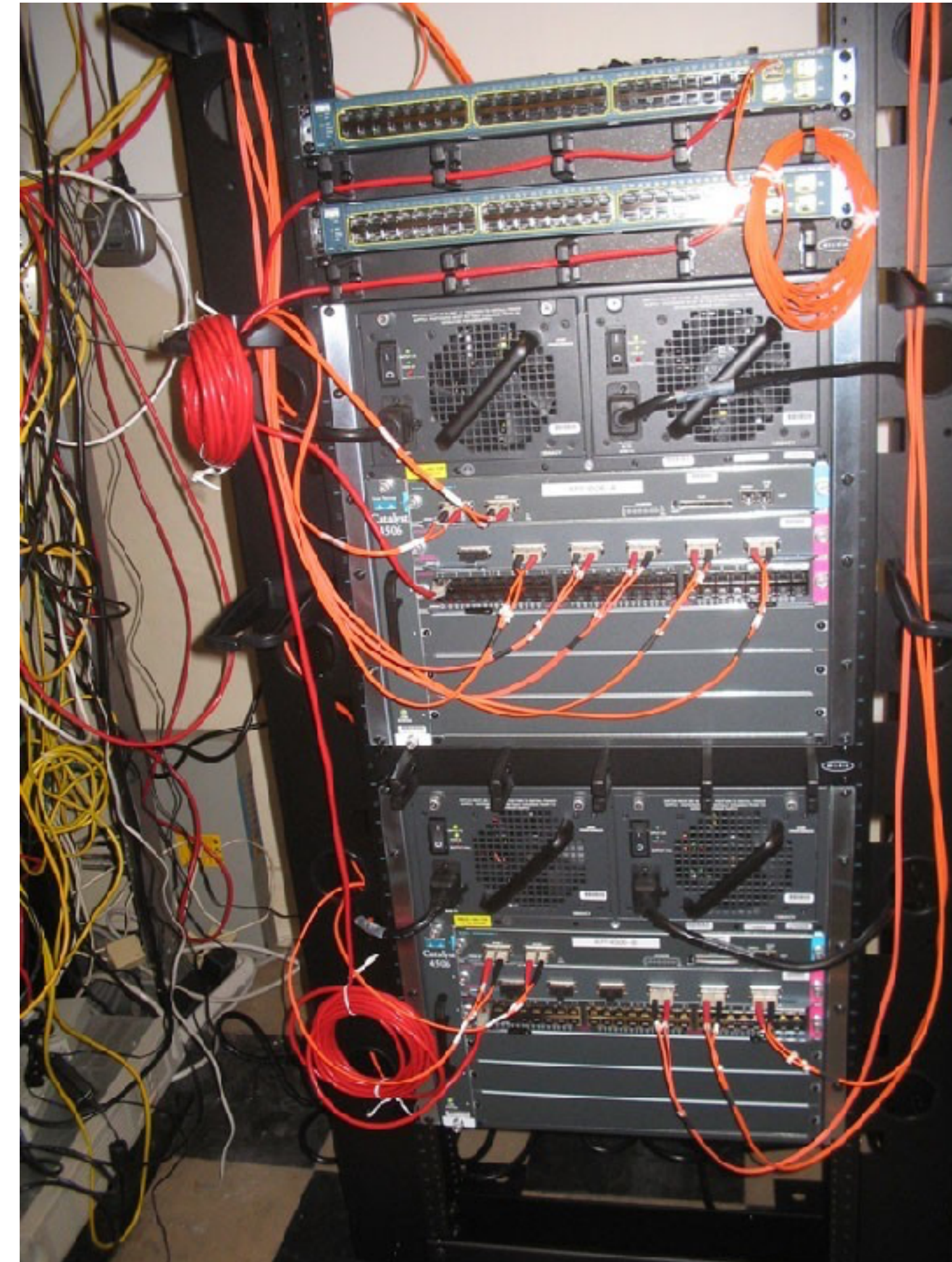
IP delivers *more flexible, more streamlined & scalable* live production infrastructures – ready for 4K / UHD and beyond



The End Result: Dramatic Reduction in Cabling

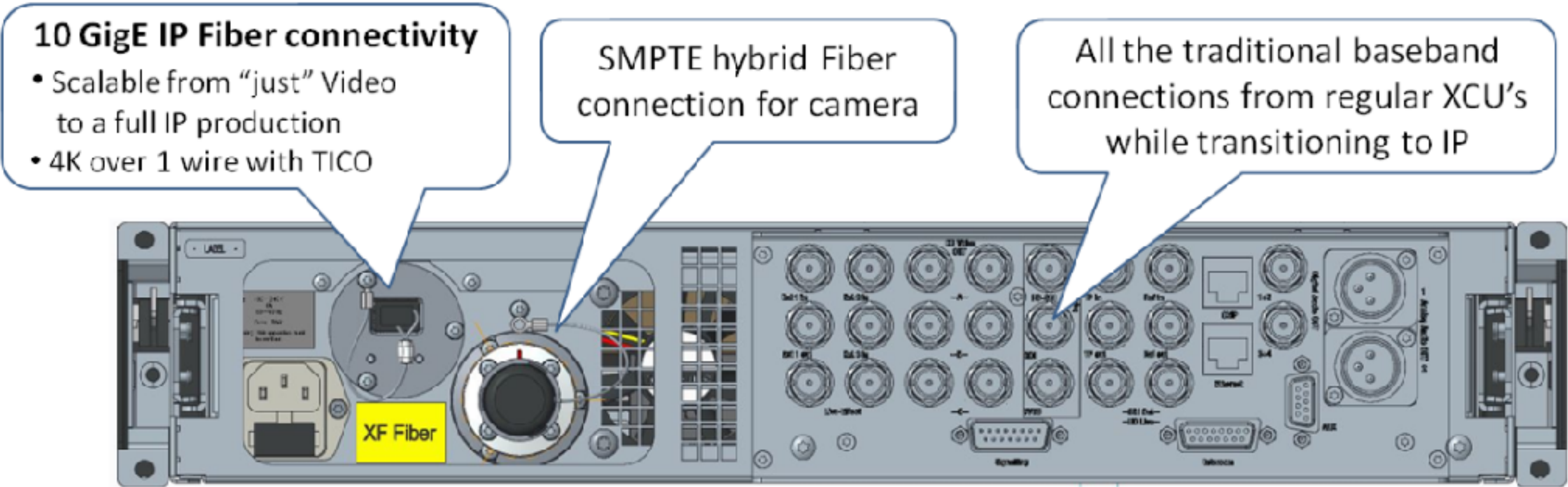


Before IP

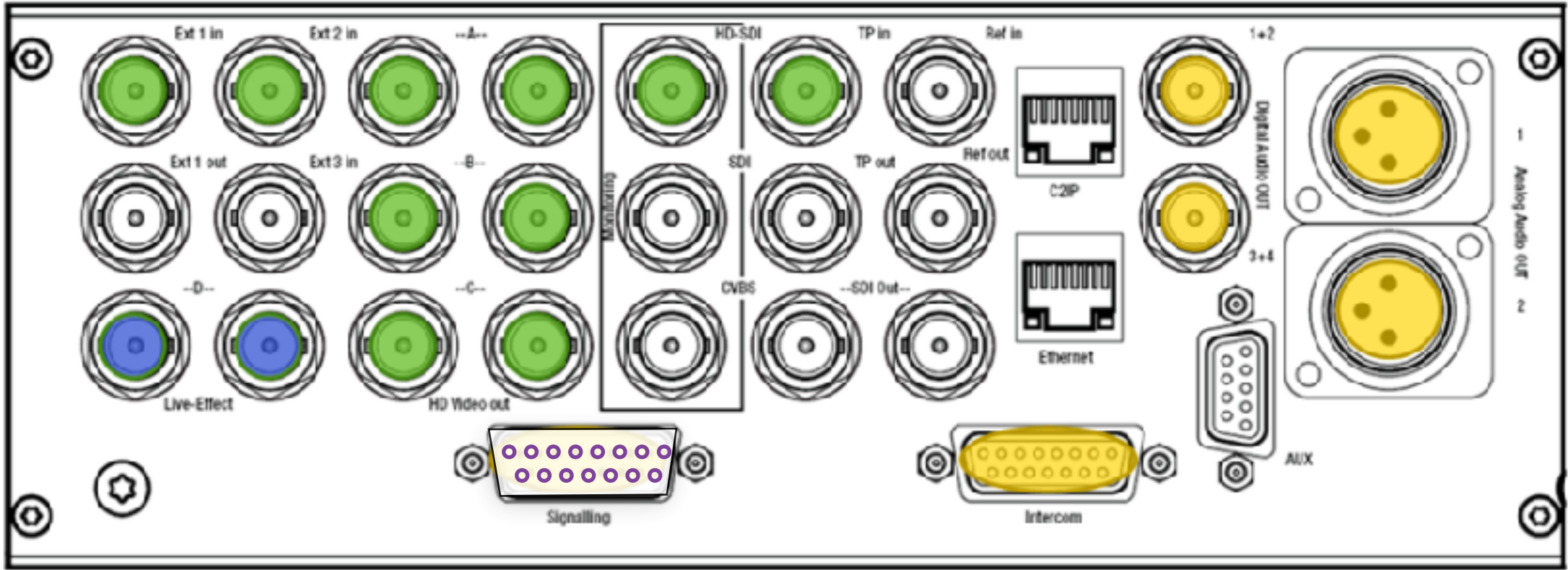


After IP

XCU HD/4K IP – Connectivity



Capabilities – In addition to Baseband



- Available in IP
- Available inside the SMPTE 2022-6
- Available in 4K operation only

XCU HD/4K IP – Connectivity

UNCOMPRESSED
SMPTE 2022-6 IP I/O (HD)

Or

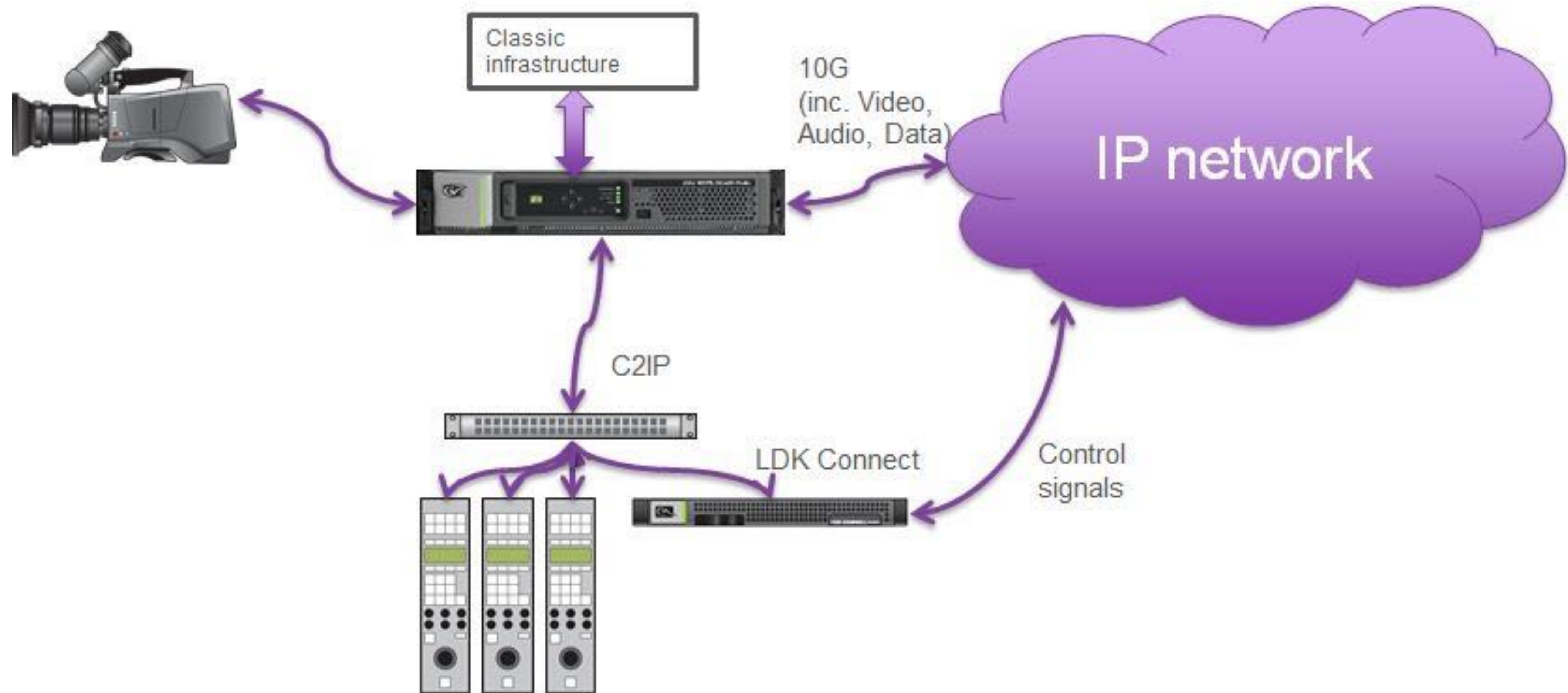
COMPRESSED
4K / UHD one-wire (TICO)
2 pixel Interleave



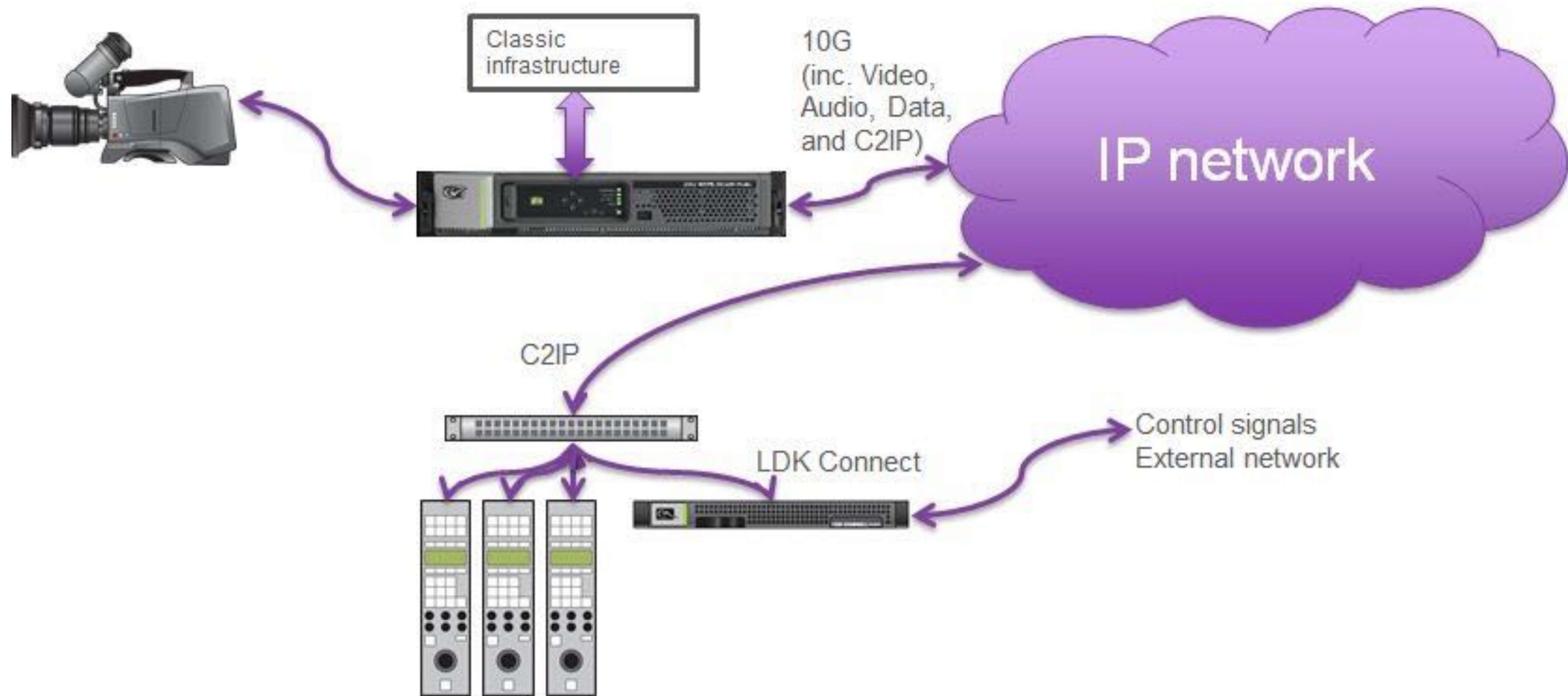
One
bi-directional
IP signal

All existing
baseband
signals

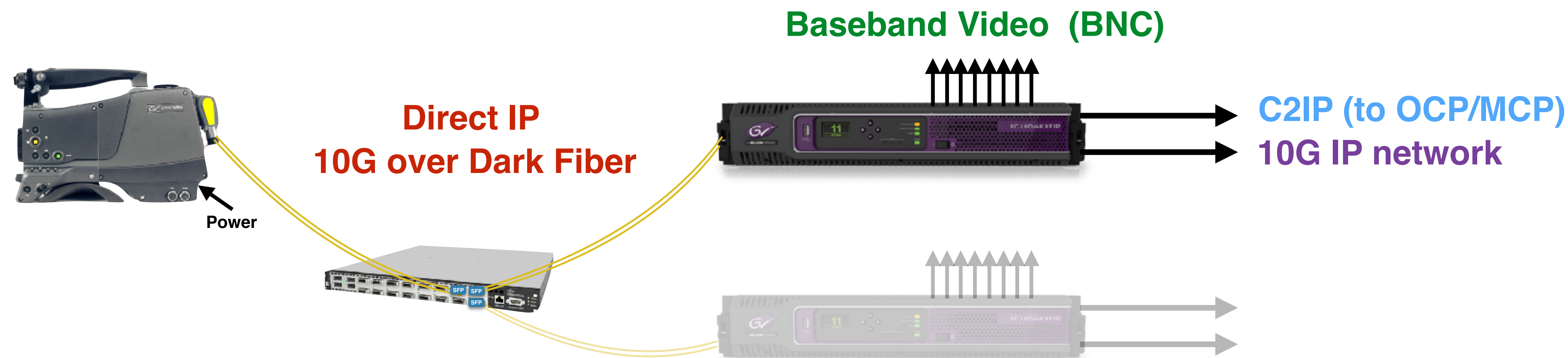
XCU IP – C2IP connection standard



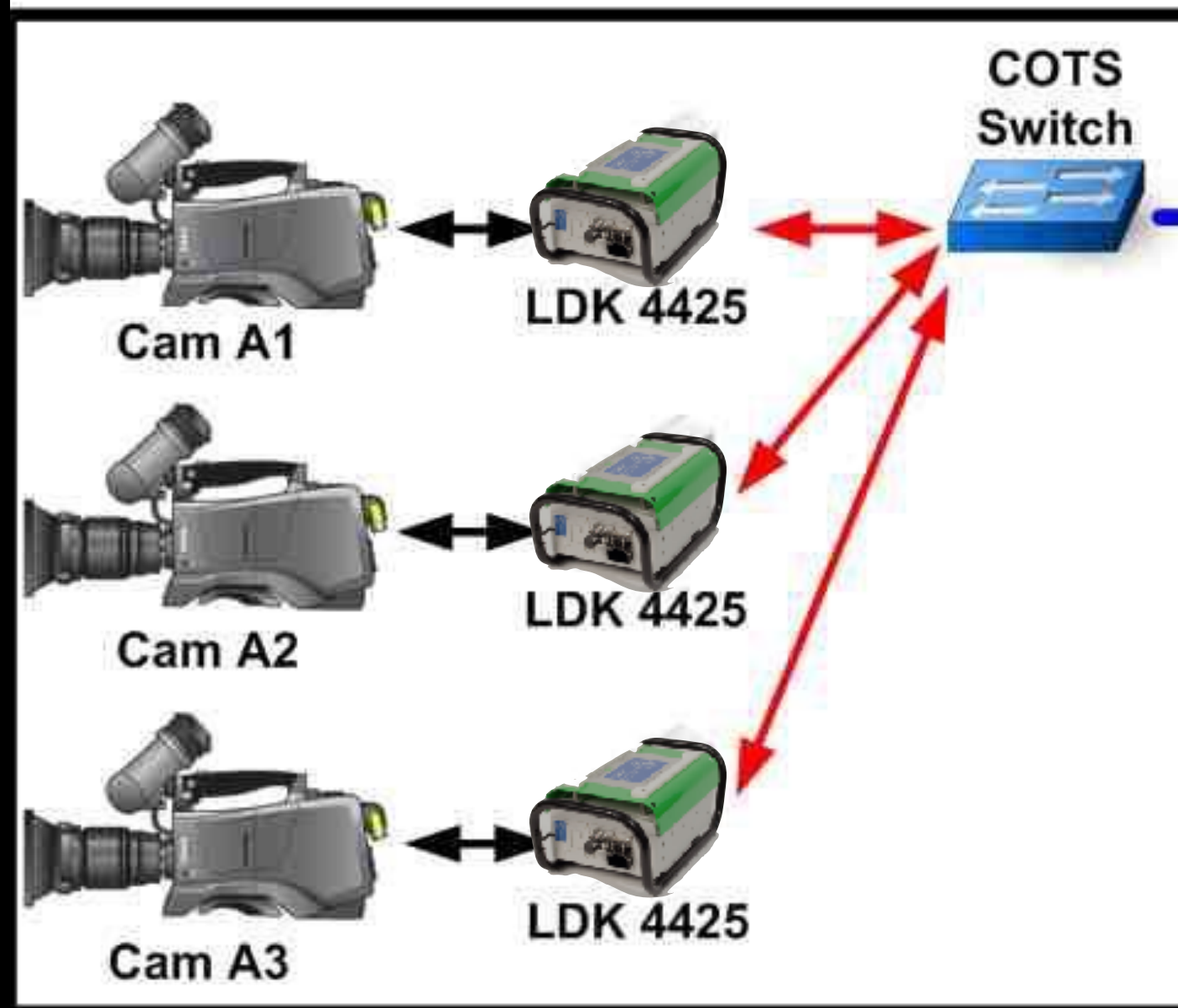
XCU IP – C2IP connection via external IP network



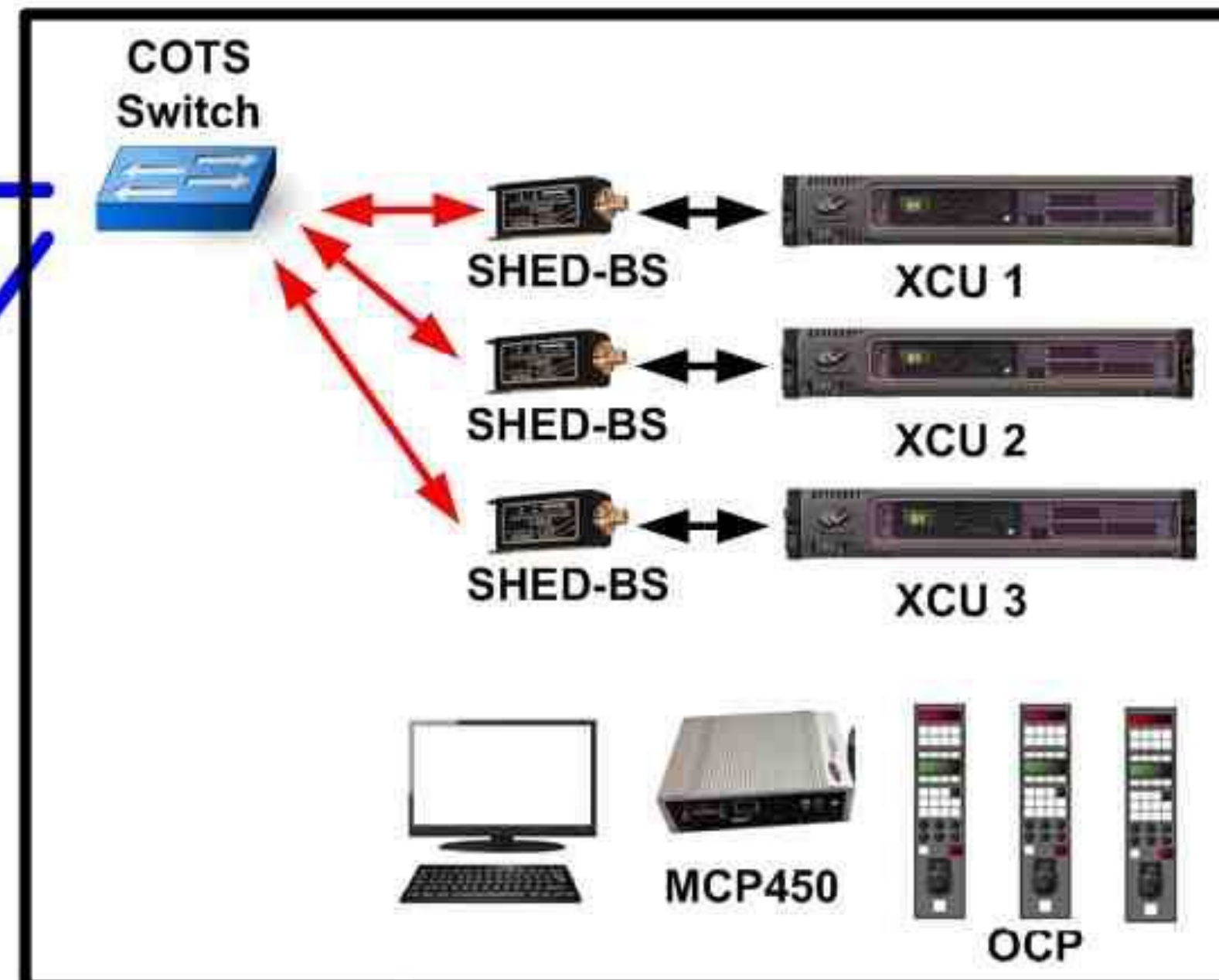
Camera link to XCU



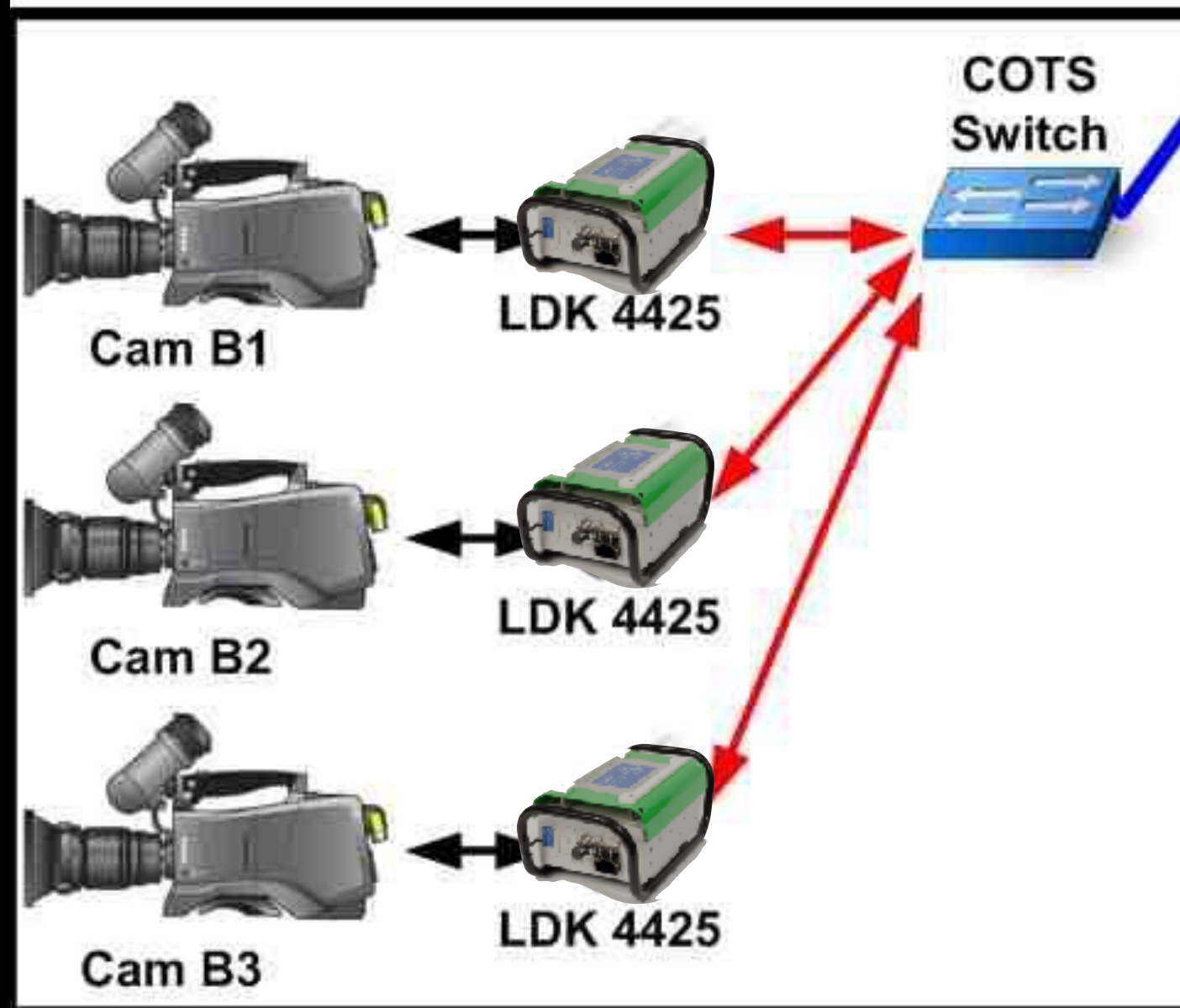
Studio A



Control Room






Studio B



IP Trunk
(same network)

IP Trunk
(same network)

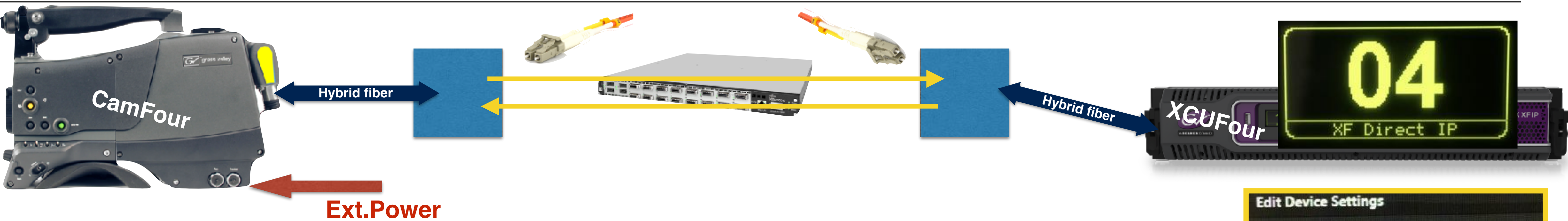
XF Transmission **Direct IP**
(e-Licence needed)

-  2x Single mode fiber / 10Gb SFP+ module
-  Standard SMPTE hybrid fiber cable
-  IP Network trunk between 2 COTS switches

IP Trunk
Example
DutchView

IP

XCU IP Direct



>Direct IP Perpetual

License Needed

Active Licenses

Camera Menu

Security >>

>XCU Conn >>

Disable Camera Off

Lens >>

Intercom >>

Configuration

Camera Menu

>ConnectType Direct IP

XCU Name XCUFour

XCU Conn

Camera Menu

grass valley

XML Control Monitoring Configuration System

Camera Connect: Company / Location

Device Config Nameserver IP Media Settings IP Video In

Camera System Devices

Name	Type	Model	Serial Nr	Alias	DeviceID	Package	Camera
Camera Head	?	037D6G	LDX86w	CamOne	v10.97		

Edit Device Settings

Devicetype: Base Station

Name: 4

Alias: CamXS



DeviceID: XCUFour

Cam.ConnectType: Direct IP

Cam.Name: CamFour

Ok Cancel

Camera Head	LDX 80 W	02PA5U	CamXS	CamFour	v28.00	
Base Station	XCU IP	03FHR4	CamXS	XCUFour	v03.00	CamFour
OCP	OCP400/10		CamXS	OCP 1	v28.00	

Camera Head	Ldk8000		LDK8000	Head	v21.00	
Base Station	XCU4200W		LDK8000	XCU	v11.00	
Camera Head	LDX 80 W	02PA5U	CamXS	CamFour	v28.00	
Base Station	XCU IP	03FHR4	CamXS	XCUFour	v03.00	 CamFour
OCP	OCP400/10		CamXS	OCP 1	v28.00	
Camera Head	Focus 70 L	03CZXF	Focus	03CZXF	v08.00	
Base Station	Focus BU		Focus		v03.00	
Base Station	XCU IP	03E2TC	System6	XCU06	v03.00	



SMPTE 2022 standards

ST 2022-1:2007 “Forward Error Correction for Real-Time Video/Audio Transport Over IP Networks”

defines row/column FEC (Forward Error Correction) for IP video streams. Along with Section 2, this standard has been widely implemented. Row/Column FEC works by grouping IP video packets into logical rows and columns, and then appending one FEC packet to each row and each column. In the event that one packet is lost from a row or a column, the data in that packet can be perfectly recreated using the contents of the FEC packet in conjunction with the other packets in the row or column. This method works quite well, and allows the packet stream to survive lengthy bursts of lost packets.

ST 2022-2:2007 “Unidirectional Transport of Constant Bit Rate MPEG-2 Transport Streams on IP Networks”

specifies how constant bit rate compressed video signals that are encoded within MPEG-2 transport streams are encapsulated into IP packets. This standard covers the transport layer (RTP and UDP) as well as comments about timing and buffer sizes.

ST 2022-3:2010 “Unidirectional Transport of Variable Bit Rate MPEG-2 Transport Streams on IP Networks”

defines IP packets for variable bit-rate MPEG-2 TS streams that are constrained to have a constant bit rate between PCR messages (called piecewise-constant).

ST 2022-4:2011 “Unidirectional Transport of Non-Piecewise Constant Variable Bit Rate MPEG-2 Streams on IP Networks”

is similar to Section 3, except that it removes the constraint on bit rates.

ST 2022-5:2012 “Forward Error Correction for High Bit Rate Media Transport Over IP Networks”

expands on Section 1 to allow larger row/column FEC combinations to support signals with bit rates up to 3 Gbps and beyond. A minor revision to this standard is scheduled to be published in 2013 by SMPTE.

ST 2022-6:2012 “Transport of High Bit Rate Media Signals over IP Networks (HBRMT)”

specifies a way to transport high bit-rate signals (including uncompressed 3 Gbps 1080p video) that are NOT encapsulated in MPEG-2 transport streams.

2022-7 (approval pending) “Seamless Protection Switching of SMPTE ST 2022 IP Datagrams”

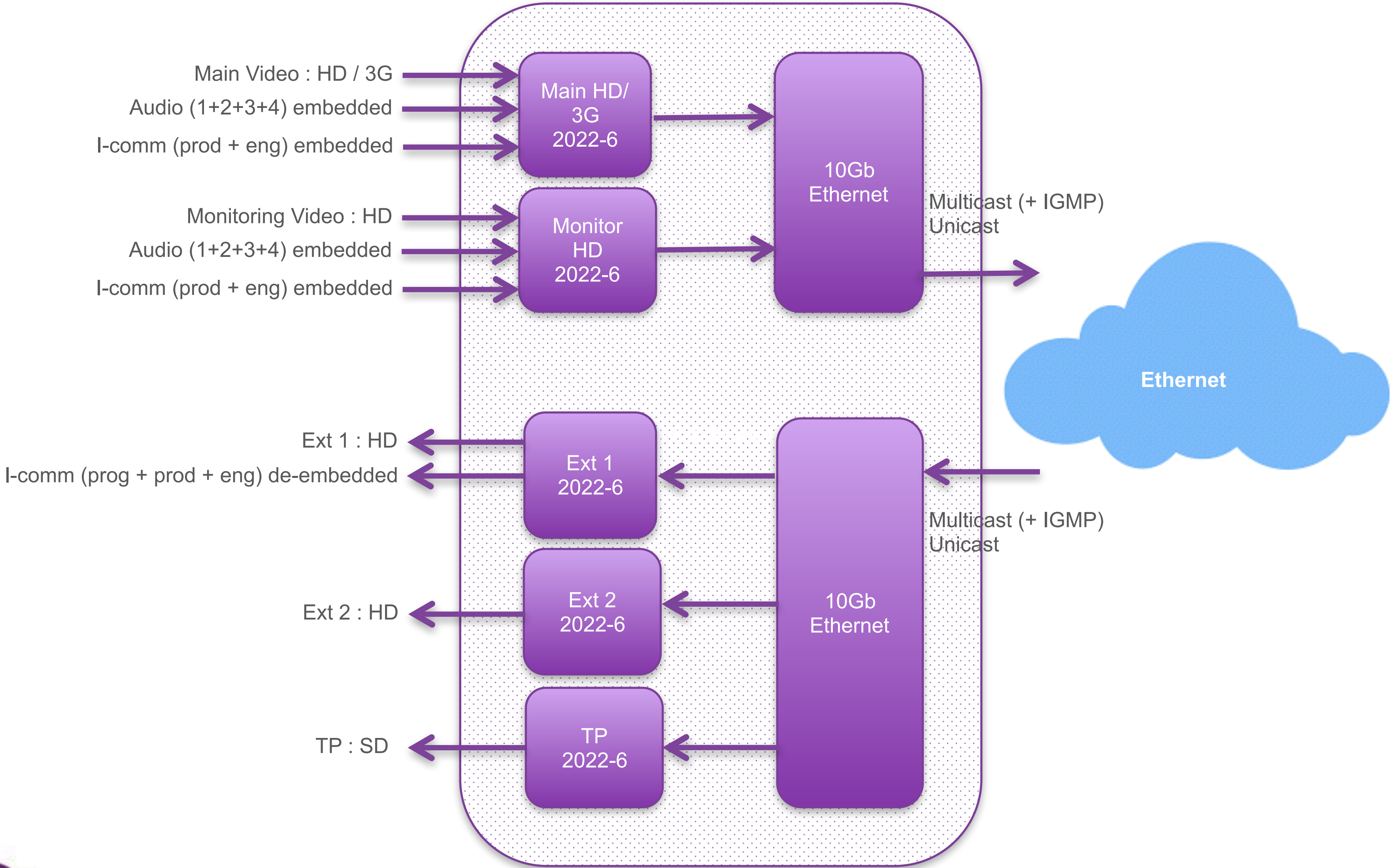
describes a way to send two matching streams of packets from a source to a destination over different paths, and have the receiver switch automatically between them. This allows a perfect video signal to be reconstructed at the receiver as long as both paths do not fail simultaneously.

Today



See
UXF-XCU

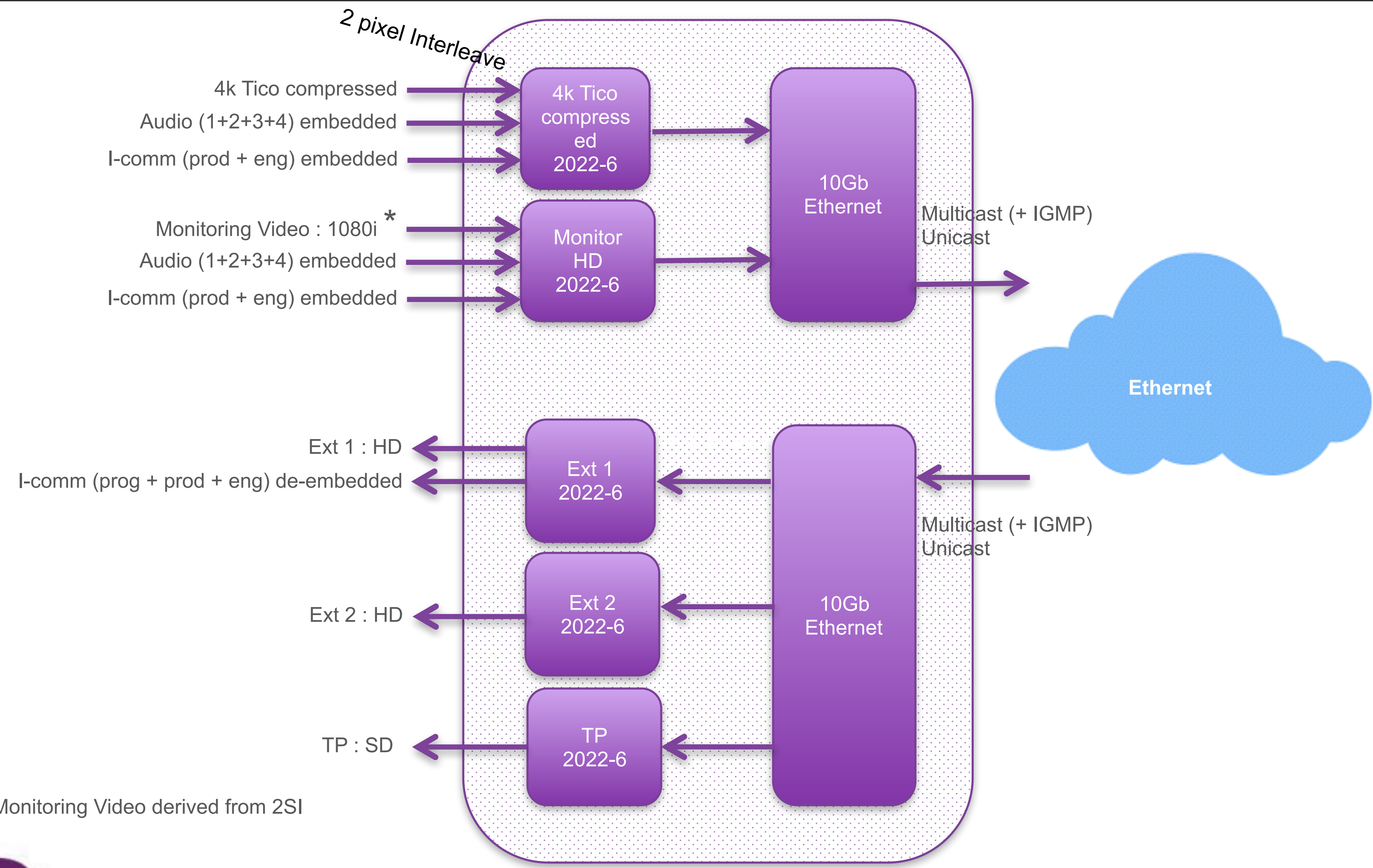
XCU IP – Streams (HD) Uncompressed



IP timing can be delayed / advanced with respect to the main Gen-lock (BNC)



XCU IP – Streams (4K) TICO Compressed



* : 1080i Monitoring Video derived from 2SI



XCU IP – Streams (4K)



4K⁵⁰₅₉ p over a single 3G-SDI



2 sample
interleave

TICO Alliance Members – IBC 2015

ALTERA

ARTEL
VIDEO SYSTEMS

DELTA CAST
VIDEO SOLUTIONS FOR DEVELOPERS

embrionix

EVE

grass valley
A BELDEN BRAND

KG KEISOKU
GIKEN

Imagine
COMMUNICATIONS

image
matters

intoPIX
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MACNICA

MEDIA LINKS®
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ROSS
Production Technology Experts

Tektronix®

XILINX®

info@tico-alliance.org
www.tico-alliance.org

TICO
Alliance



IP XCU 10G Fiber (basics)

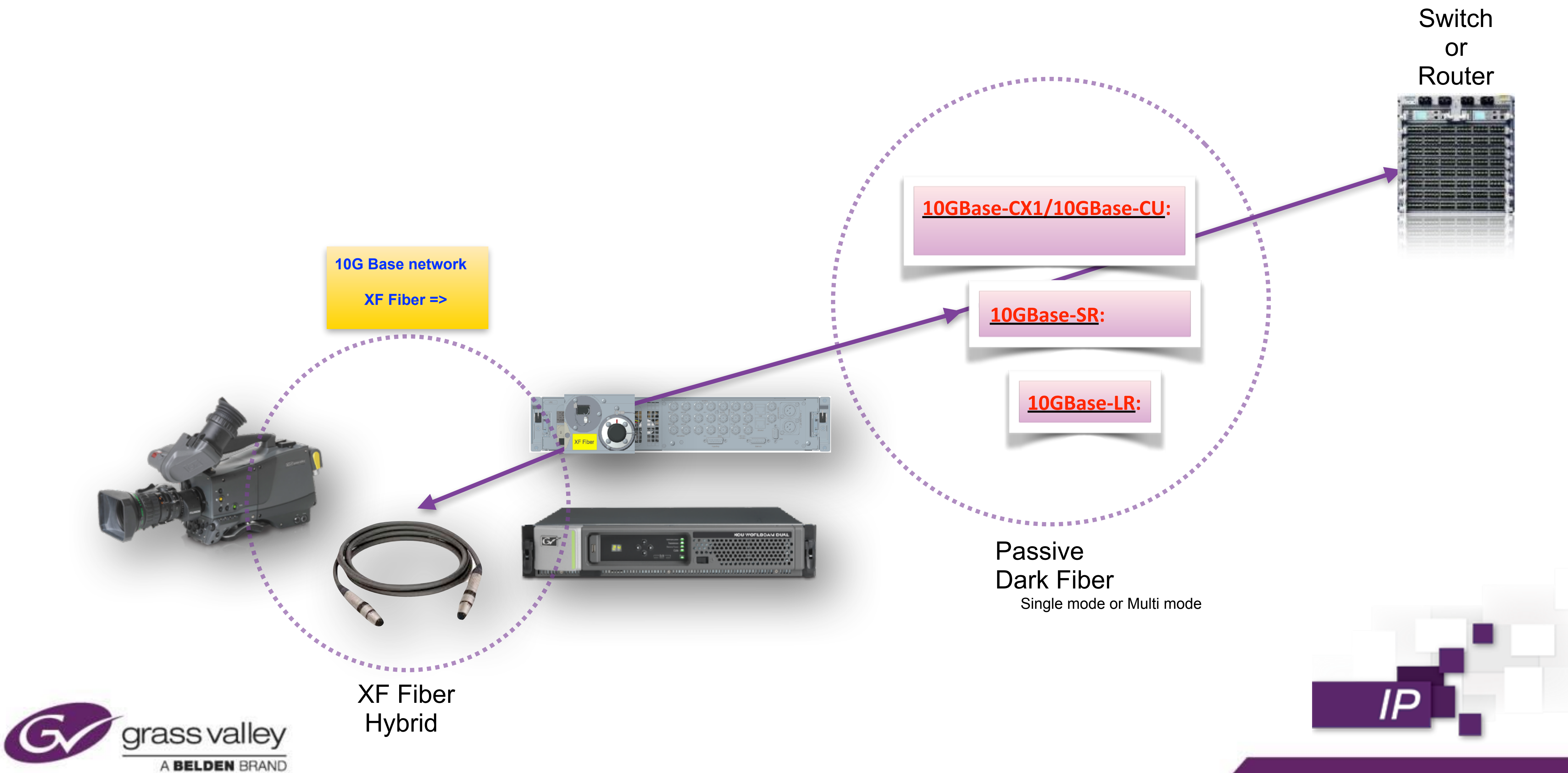
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XCU HD/4K IP – Connections (Fiber or Coax)



XCU HD/4K IP – Connections

10GBase-CX1/10GBase-CU:

Passive Copper cable with on both sides SFP+interface
Length max 7 meters (specified < 5m)
Details visible in I2C (type,lenght)

Used for short connections

Used inside XCU (from Muxboard to Output)



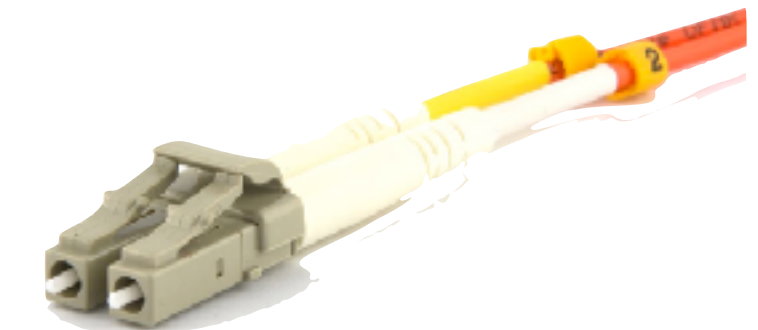
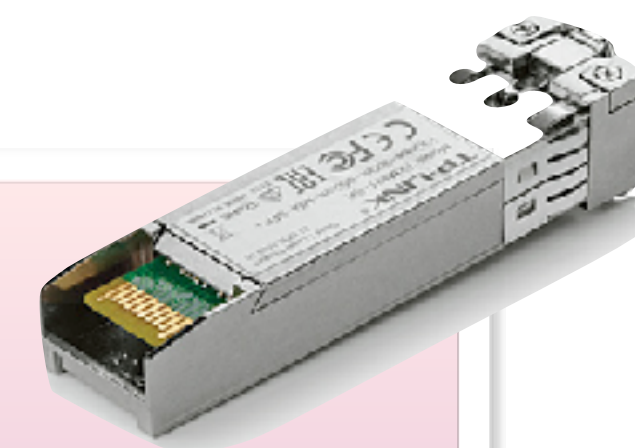
10GBase-SR:

Multi-mode, 850 nm optische transceivers.

Two versions:

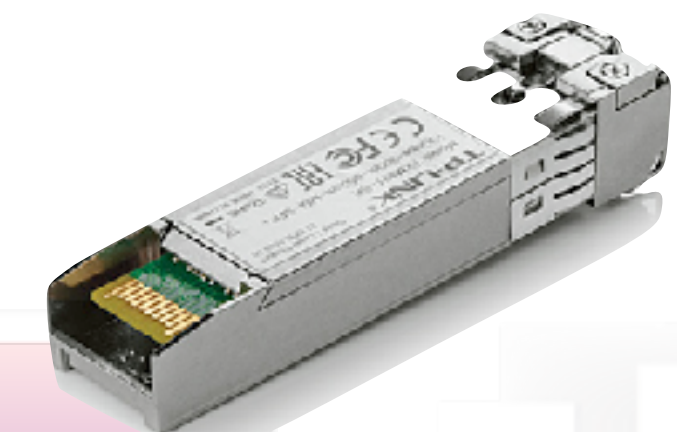
- 1 **SFP+ module**, placed in a SFP+ cage (in XCU) and then connect with LC fiber cables to Multimode transceiver in a switch
Take Care! It important to use matching optical wavelengths
OM3 recommend

- 2 **AOC: Active optical cable.**
Here both Optical Receivers and Transceivers are integrated in a case assembly.



10GBase-LR:

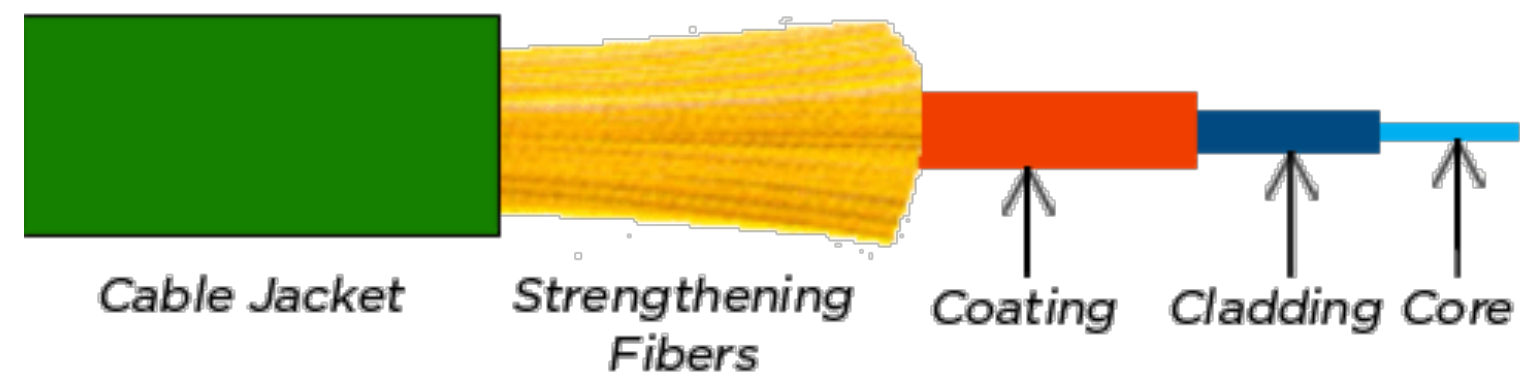
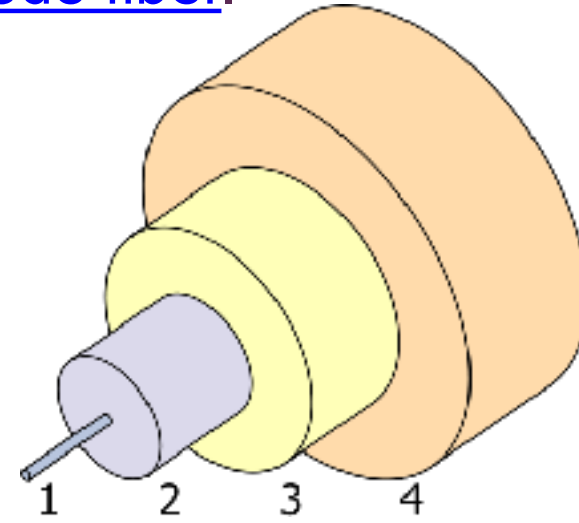
Single-mode 1310nm optical transceivers also used in our LDX fiber transmission



XCU HD/4K IP Multi-Mode Vs. Single Mode Fiber

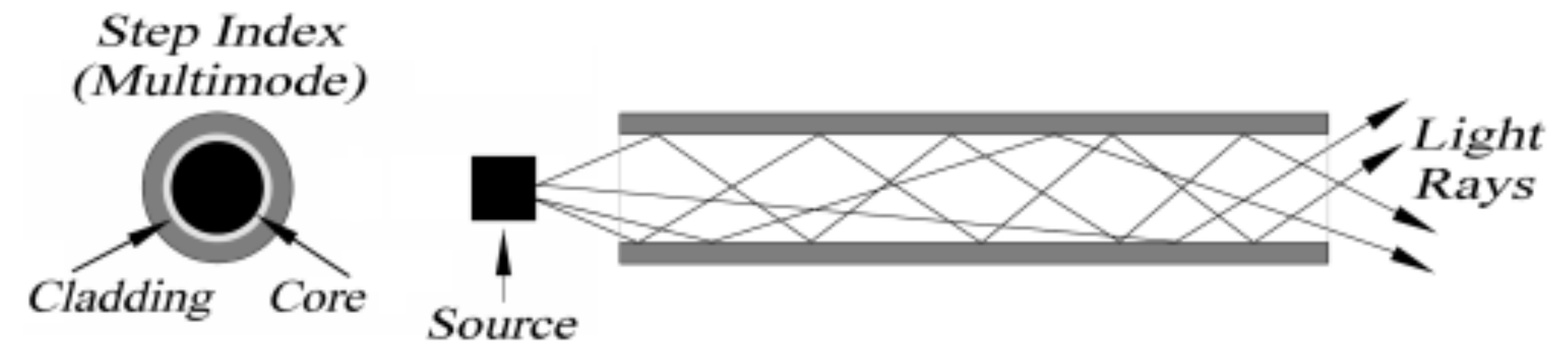
The structure of a typical [single-mode fiber](#).

1. Core 8 μm diameter
2. Cladding 125 μm dia.
3. Buffer 250 μm dia.
4. Jacket 400 μm dia.



Multi-Mode Fiber

62.5 Micron
50 Micron



Single Mode Fiber

8 Micron
The thickness of a human hair

Single Mode
(Monomode)



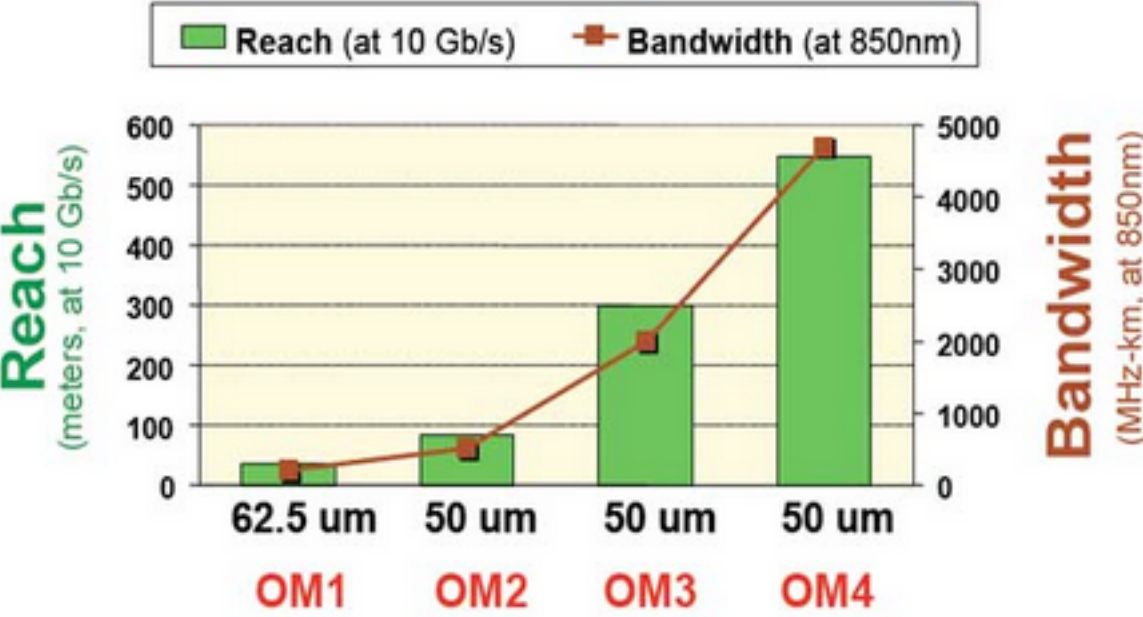
XCU HD/4K IP Cable Colors

Color	Type	Application (connections may by through patch panels)
Aqua	OM3 fiber	LAN/SAN device to device MultiMode 850nm
Yellow OS1/OS2	Single Mode Fiber	LAN/SAN device to device over long distance SingleMode 1310nm
Orange	OM1 or OM2 fiber	LAN/SAN device to device MultiMode 850nm

Cable Type	Color
Multimode 50 μm and 62.5 μm (OM1, OM2)	Orange
Multimode 50 μm, laser optimized (OM3)	Aqua
Single-mode (OS1/OS2)	Yellow

Reach and modal bandwidth

Reach & Bandwidth by MM Fiber Type



Transmission Standards (core/cladding size μm)	Jacket Color (non-military)	Jacket Color (military)
Multimode 100 / 140 μm	Orange	Green
OM1 62.5 / 125 μm	Orange	Slate
OM2 50 / 125 μm	Orange	Orange
OM3 50 / 125 μm	Aqua	N/A
OM4 50 / 125 μm	Aqua	N/A
OS1 ~8-10 / 125 μm	Yellow	Yellow
OS2 ~8-10 / 125 μm	Yellow	Yellow

XCU HD/4K IP – Connections

SFP+ modules *Small Form Factor*

Integrated I2C functionality
with following details:

- Type number
- Light indication (yes/no)
- Send and Receive power level
- Temperature

Most SFP+ modules use transceivers with less than 1 Watt (Power level II)

SFP+ module maximum power consumption shall meet one of the following power classes:






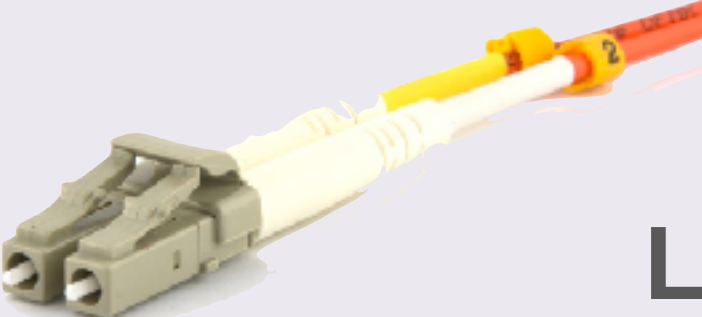

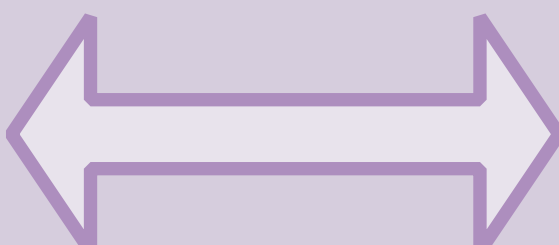



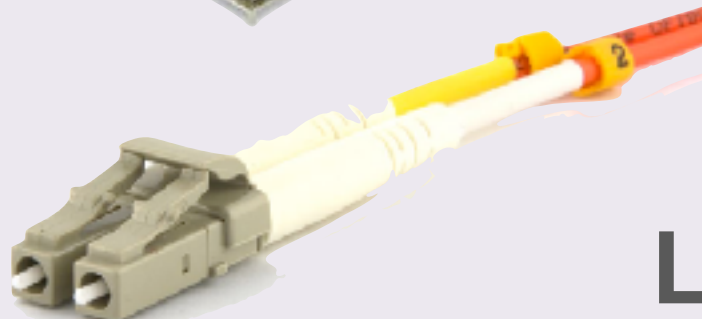
Power Level I modules - Up to 1.0 W

Power Level II modules - Up to 1.5 W

Power Level III modules - Up to 2.0 W



XCU HD/4K IP – Connections

	optical freq.	XCU inside SFP+ Case	Interface	Cable
Passive Copper	low power			 SFP+
Fiber MultiMode SFP+ module	850nm		 SFP+	 LC
Fiber MultiMode Active Optical Case	850nm			 AOC
Fiber SingleMode also in LDX fiber	1310nm (10km)		 SFP+	 LC

IP XCU 10G Fiber (basics)

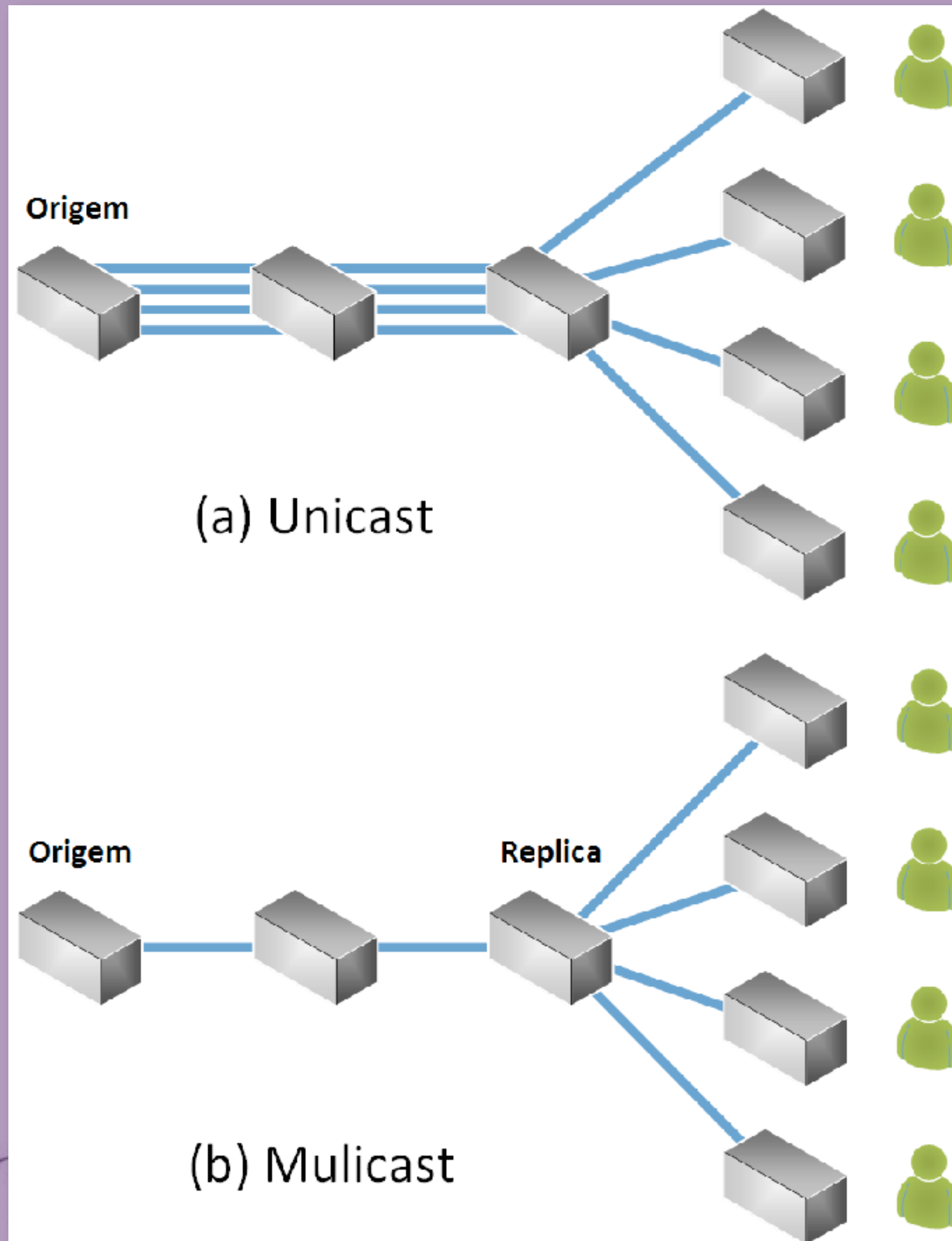
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- ◆ IP basics + Test
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XCU HD/4K IP – Settings Explained



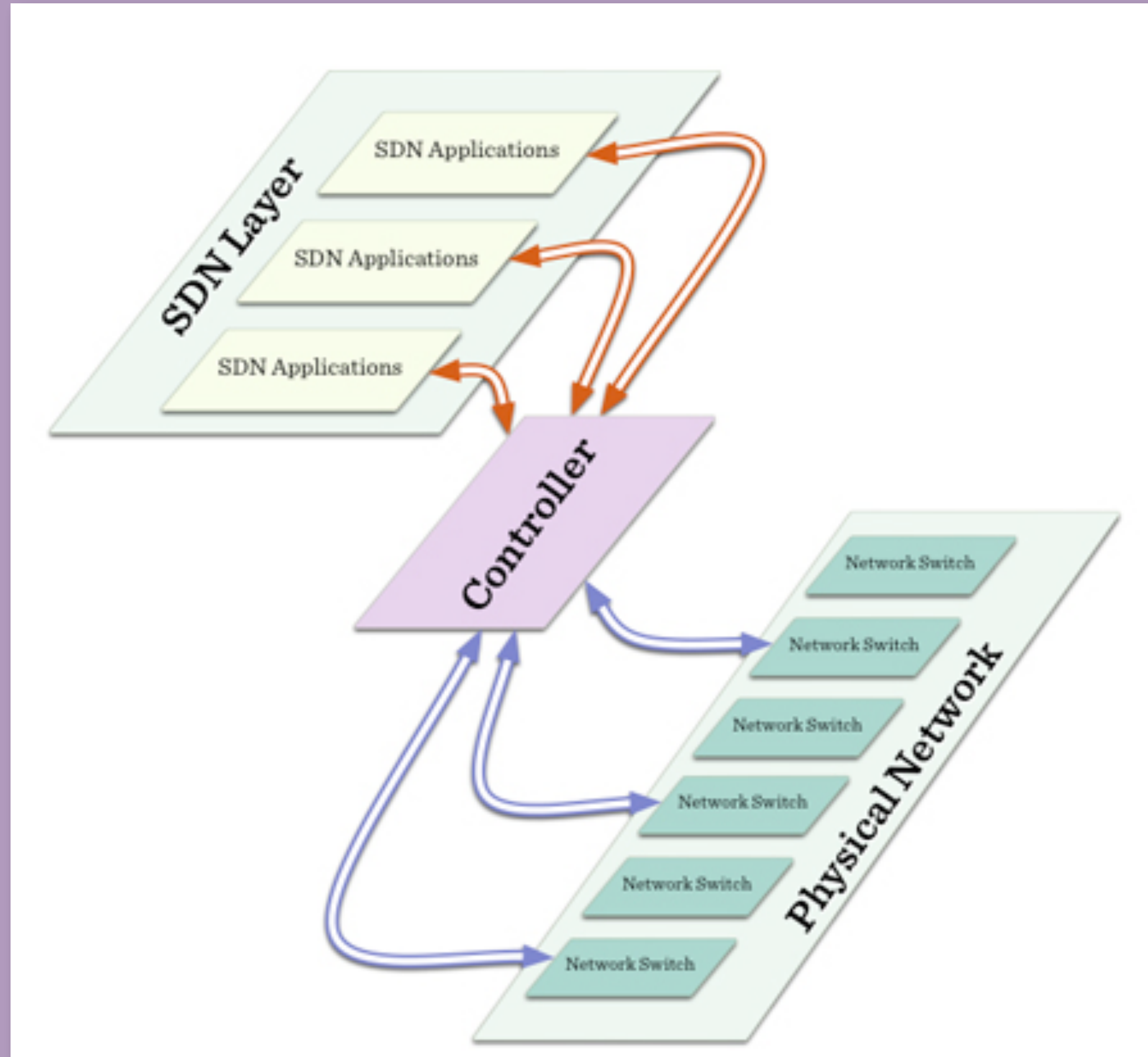
(a) Unicast is the term used to describe communication where a piece of information is sent from one point to another point. In this case there is just one sender, and one receiver.

Broadcast is the term used to describe communication where a piece of information is sent from one point to all other points. In this case there is just one sender, but the information is sent to all connected receivers.

(b) Multicast is the term used to describe communication where a piece of information is sent from one or more points to a set of other points. In this case there is may be one or more senders, and the information is distributed to a set of receivers (there may be no receivers, or any other number of receivers).



XCU HD/4K IP – Settings Explained



Software-defined networking (SDN) is an approach to computer networking that allows network administrators to manage network services through abstraction of higher-level functionality

not *yet* used this moment in GV products

XCU HD/4K IP – Settings

TEST Before connection to the world !

With 2x IP XCU

< IP Stream > package


This is an example
to test the system.
2x IP XCU needed.
All setting in
UNICAST

Set IP
STEP 1

Set IP
STEP 2


IP address 10.11.5.51
SubnMask 255.255.252.0
Default GW 10.11.5.1

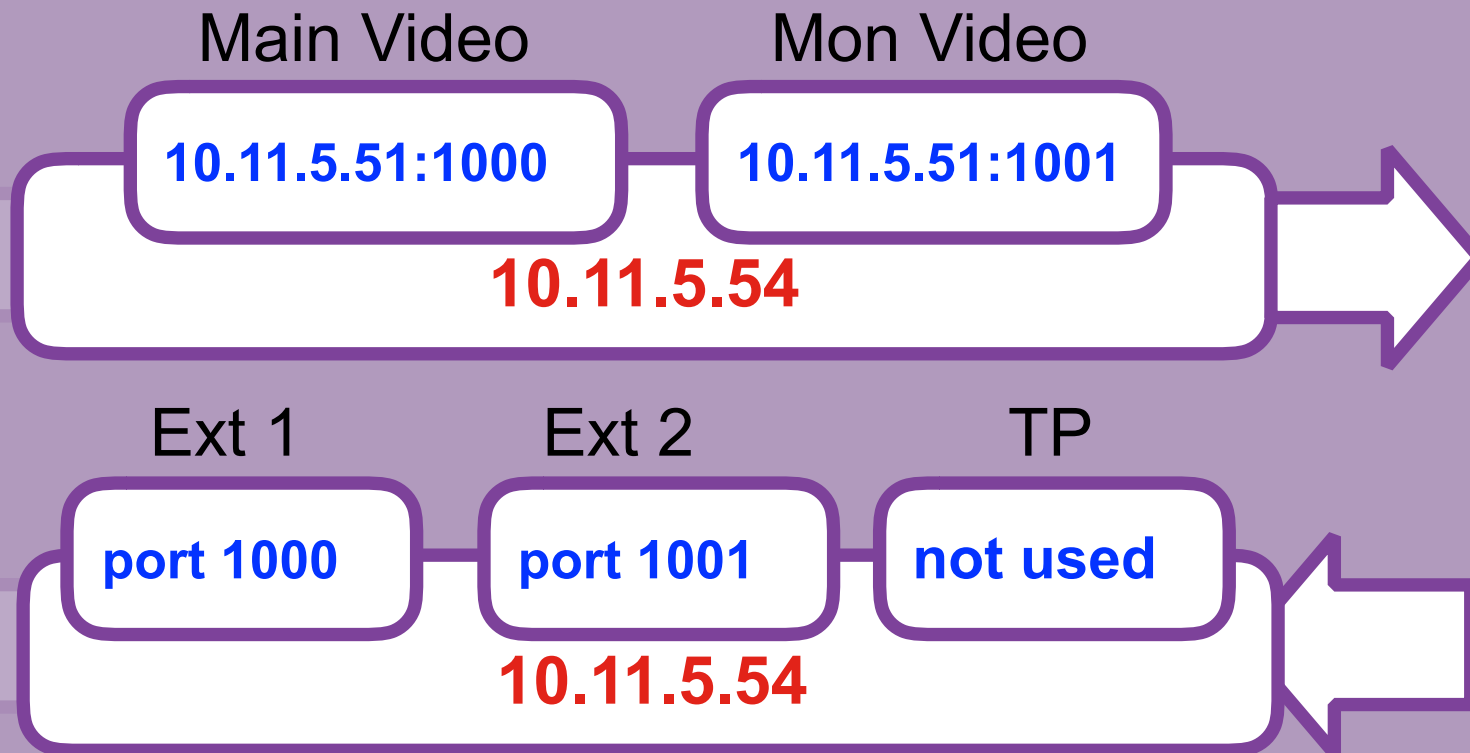
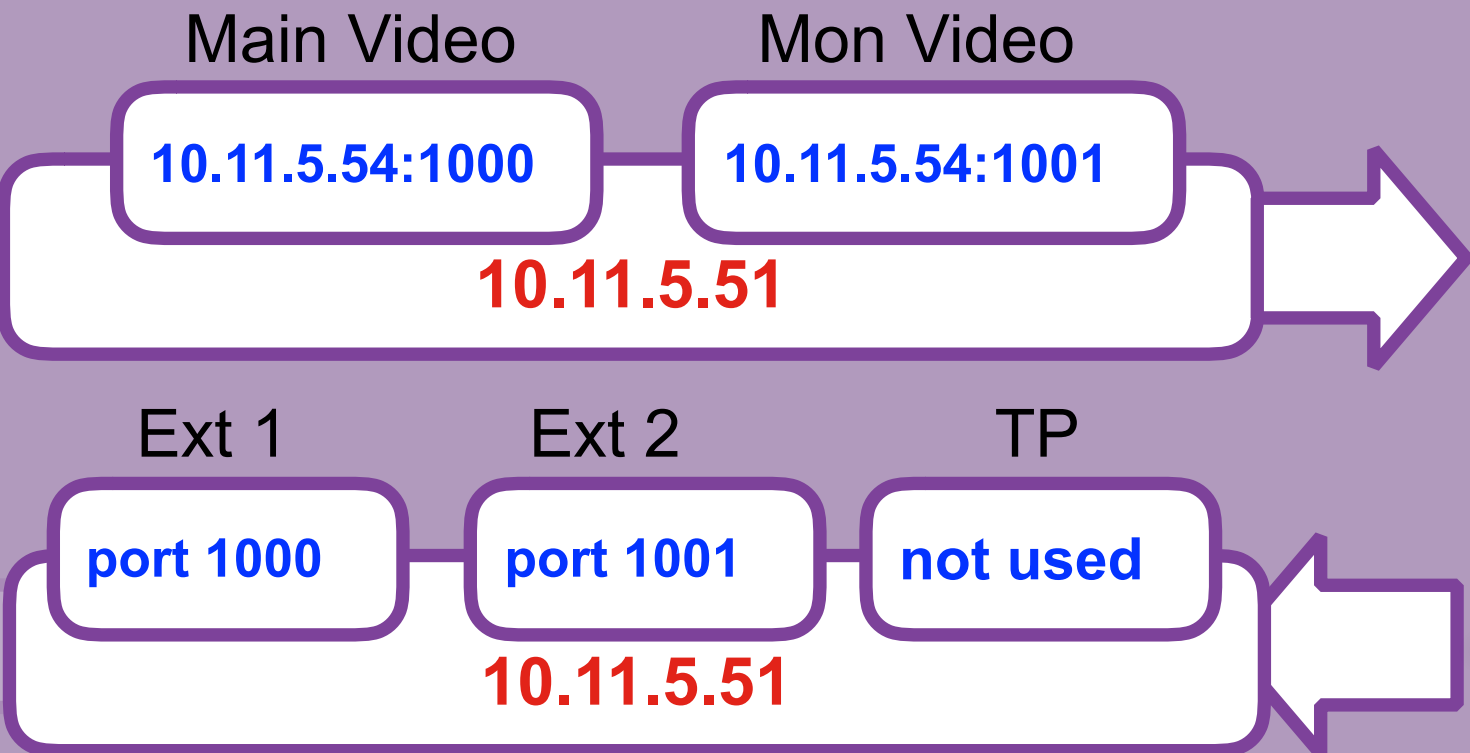
Main Video 10.11.5.54 port 1000
Mon Video 10.11.5.54 port 1001
Ext 1 port 1000
Ext 2 port 1001



IP address 10.11.5.54
SubnMask 255.255.252.0
Default GW 10.11.5.1

Main Video 10.11.5.51 port 1000
Mon Video 10.11.5.51 port 1001
Ext 1 port 1000
Ext 2 port 1001





XCU HD/4K IP – Settings

TEST Before connection to the world !

With 1 IP XCU

< IP Stream >
package


This is an example
to test the system.
1 IP XCU needed.
All setting in
UNICAST

Set IP
STEP 1

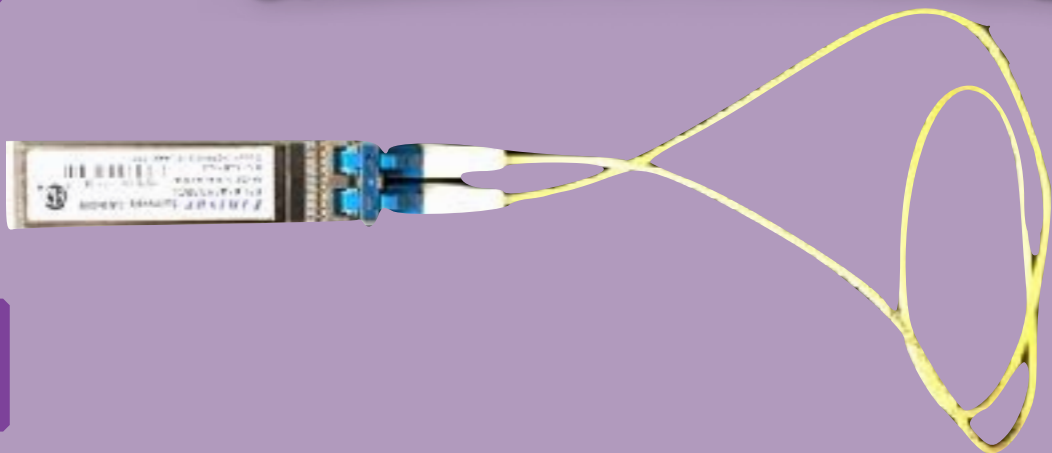
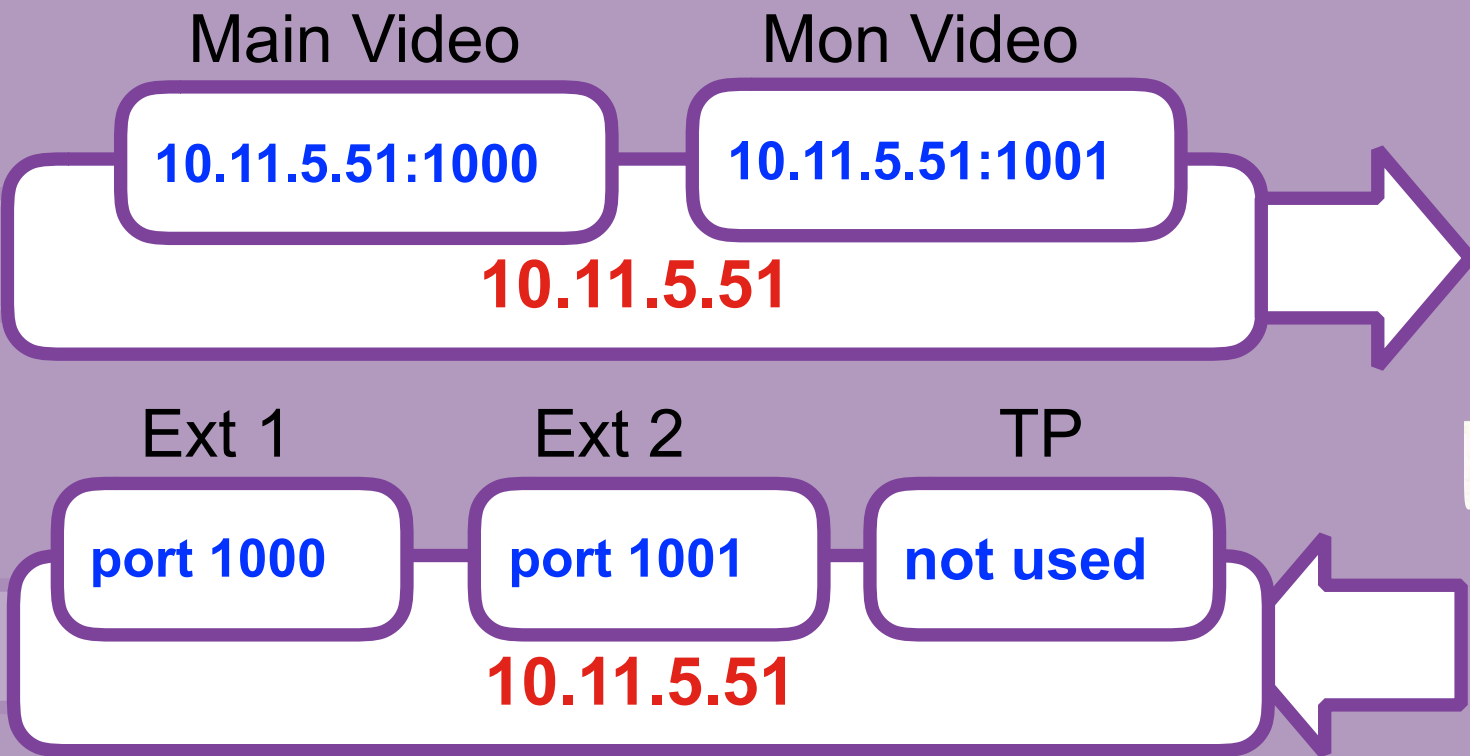
Set IP
STEP 2

IP address 10.11.5.51
SubnMask 255.255.252.0
Default GW 10.11.5.1

Main Video 10.11.5.51 port 1000
Mon Video 10.11.5.51 port 1001
Ext 1 port 1000
Ext 2 port 1001



XCU 51



All IP UniCast

10.11.5.1 XCU
10.11.7.1 Summit
10.11.8.1 Kframe

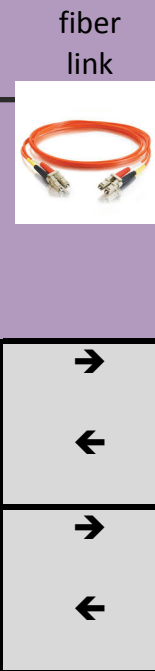


INPUTS XCU IP	OUTPUTS XCU IP
Cam 4 Ext 1 Cam 4 Ext 2	Cam 4 Main Video Cam 4 Mon Video
Cam 6 Ext 1 Cam 6 Ext 2	Cam 6 Main Video Cam 6 Mon Video

OUTPUTS Summit
Sum Channel 3 Sum Channel 3 Sum Channel 4 Sum Channel 4

MCP 450 Camera connect		
Default GateWay	Sent IP	port
10.11.5.1	10.11.8.4	1000
10.11.5.1	10.11.8.4	1001
auto	auto	1000
auto	auto	1001
10.11.5.1	10.11.8.6	1000
10.11.5.1	10.11.8.6	1001
auto	auto	1000
auto	auto	1001

Summit Channel settings	
Local IP	Vid OUT IP
10.11.7.1	10.11.7.9
10.11.7.1	10.11.7.10
10.11.7.1	10.11.7.11
10.11.7.1	10.11.7.12



INPUTS KFRAME	OUTPUTS KFRAME	Config I/O Kframe
	Modulair I/O	Local IP Recieve IP port
M5 (IP)		10.11.8.1 10.11.8.4 1000
M6 (IP)		10.11.8.1 10.11.8.4 1001
	your choice	10.11.8.1 10.11.5.4 1000
	your choice	10.11.8.1 10.11.5.4 1001
M7 (IP)		10.11.8.1 10.11.8.6 1000
M8 (IP)		10.11.8.1 10.11.8.6 1001
	your choice	10.11.8.1 10.11.5.6 1000
	your choice	10.11.8.1 10.11.5.6 1001
M9 (IP)		10.11.7.9 10.11.7.9 47873
M10 (IP)		10.11.7.10 10.11.7.10 47873
M11 (IP)		10.11.7.11 10.11.7.11 47873
M12 (IP)		10.11.7.12 10.11.7.12 47873

Config I/O Kframe

	Recevie IP	UDP Port	Local IP	Transmit IP	UDP Port
M5	10.11.8.4	1000	10.11.8.1	10.11.5.4	1000
M6	10.11.8.4	1001	10.11.8.1	10.11.5.4	1001
M7	10.11.8.6	1000	10.11.8.1	10.11.5.6	1000
M8	10.11.8.6	1001	10.11.8.1	10.11.5.6	1001
M9	10.11.7.9	47873	10.11.8.1	0.0.0.0	1000
M10	10.11.7.10	47873	10.11.8.1	0.0.0.0	1000
M11	10.11.7.11	47873	10.11.8.1	0.0.0.0	1000
M12	10.11.7.12	47873	10.11.8.1	0.0.0.0	1000

MCP 450 Camera Connect CONFIGURATION settings

Camera Connect

Number	IP Address	Subnet Mask	Default Gateway	Link
1				
2				
3				
4	10.11.5.4	255.255.0.0	10.11.5.1	●
5				
6	10.11.5.6	255.255.0.0	10.11.5.1	●

IP Video Out

Number	Main Video	IP Address	Port	Monitoring	Enabled	IP Address	Port
1							
2							
3							
4	●	10.11.8.4	1000	●	Yes	10.11.8.4	1001
5							
6	●	10.11.8.6	1000	●	Yes	10.11.8.6	1001

IP Video In

Number	Ext 1	Port	Multicast	Ext 2	Port	Multicast	TP	Port	Multicast
1									
2									
3									
4	●	1000	No	●	1001	No	●	20004	No
5									
6	●	1000	No	●	1001	No	●	20004	No

Summit Channel setting menu

System

Live network streaming: No

Stream bitrate: 1 Mbps

Channel

Recorder Setup:

Video input format: 1080i

Compression format: MPEG

Long GOP: No (I-frame only)

Chroma format: 4:2:2

Recording data rate: 25 Mb/s

10GigE Setup:

Local IP Address (Base): 10.11.7.1

MAC Address: 00-60-09-02-DF-16

Audio Input Tags:

<Add T>

Data Track Input:

Record ancillary data: Yes

Video Output:

Video output format: 1080i (1920x1080)

Aspect ratio conversion: Bar

Still-play mode: Field (interpolated)

Motion smoothing: Off

Test mode (colorbars + tone): Off

10GigE Output 1: On

Remote IP Address 1: 10.11.7.9

10GigE Output 2: On

Remote IP Address 2: 10.11.7.10

Video Output Timing:

IP XCU 10G Fiber (basics)

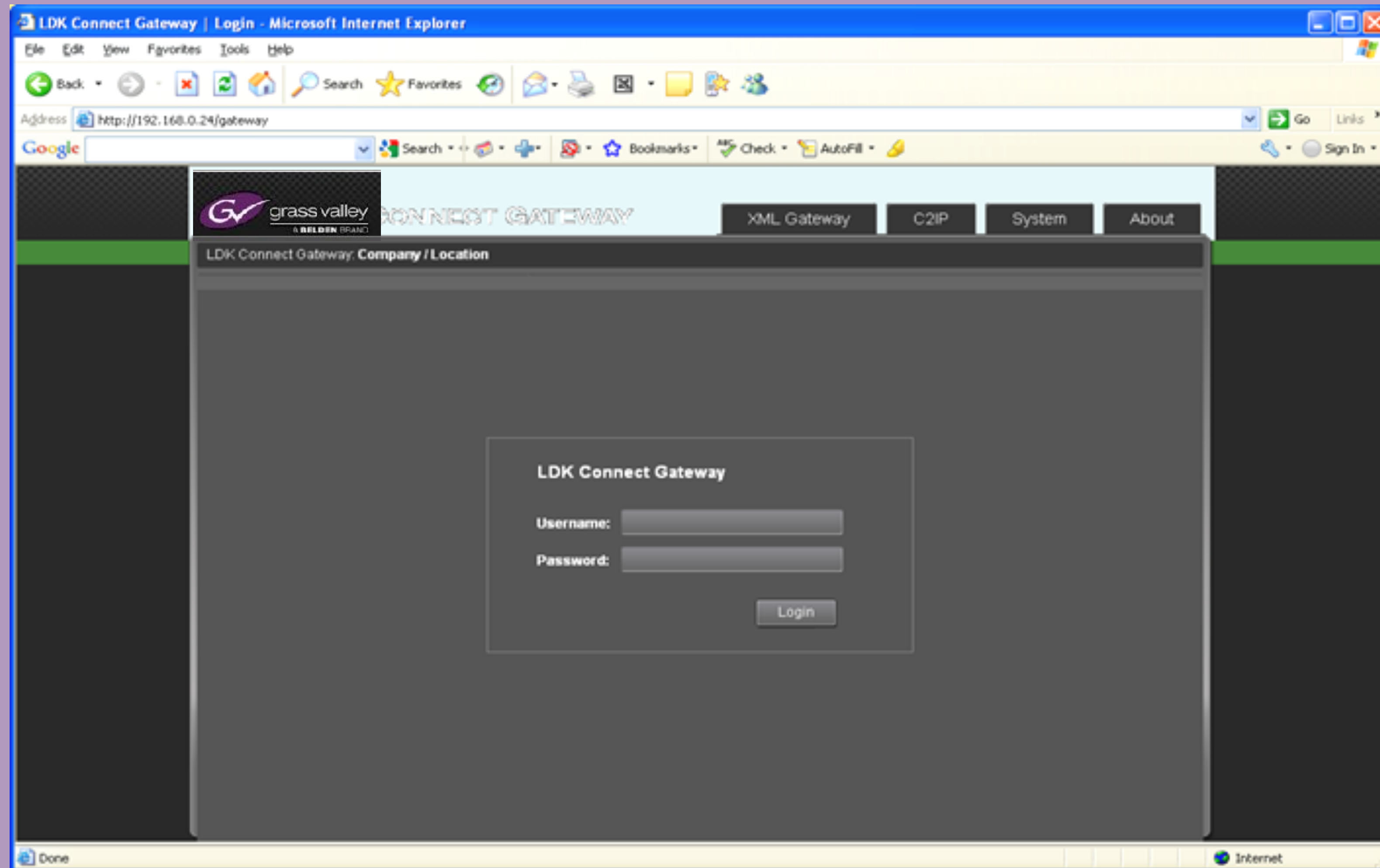
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XCU HD/4K IP – Settings with MCP 450



XCU HD/4K IP – Settings with MCP 450

Camera 51 details

Configuration Main IP adress

Optical link OK but it is still possible to have the wrong TX or RX SFP+ modules

WARNING!

Optical link OK STEP 1

Number	IP Address	Subnet Mask	Default Gateway	Link
51	10.11.5.51	255.255.252.0	10.11.5.1	
53				
54	10.11.5.54	255.255.0.0	10.11.5.1	
55				

Edit IP Media Settings

Camera System: 51

IP Address: 10.11.5.51

Subnet Mask: 255.255.252.0

Default Gateway: 10.11.5.1

Ok Cancel

IP Range defined by GV for cameras

UniCast 10.11.5.x

MultiCast 224.1.0.x



XCU HD/4K IP – Settings with MCP 450

Camera 51 details

IP Main OK STEP 2a

IP Mon OK STEP 2b

Configuration Main IP adress

IP Range defined by GV for cameras
UniCast 10.11.5.x
MultiCast 224.1.0.x

XML ControlMonitoringConfigurationSystemAbout

Camera Connect: Company / Locationadmin | Logout

Device ConfigNameserverIP Media SettingsIP Video OutIP Video In

Camera Systems

Number	Main Video	IP Address	Port	Monitoring	Enabled	IP Address	Port
51		10.11.5.54	1000		Yes	10.11.5.54	1001
53							
54		10.11.5.51	1000		Yes	10.11.5.51	1001
55							

Edit IP Video Out

Camera System: 51

Main Video IP: 10.11.5.54

Main Video Port: 1000

Monitoring: ☒

Monitoring IP: 10.11.5.54

Monitoring Port: 1001

OkCancel

UniCast



XCU HD/4K IP – Settings with MCP 450

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XML ControlMonitoringConfigurationSystemAbout

Camera Connect: Company / Locationadmin | Logout

Device ConfigNameserverIP Media SettingsIP Video OutIP Video In

Camera Systems

Number	Ext 1	Port	Multicast	Ext 2	Port	Multicast	TP	Port	Multicast
51		1000	No		1001	No		20006	No
53									
54		1000	No		1001	No		1002	No
55									

Edit IP Video In

Camera System: 51

Ext1 Port: 1000

Ext1 Multicast: ☐

Ext1 Multicast IP: 224.1.0.111

Ext2 Port: 1001

Ext2 Multicast: ☐

Ext2 Multicast IP: 224.1.0.6

TP Port: 1002

TP Multicast: ☒

TP Multicast IP: 224.1.0.6

OkCancel

Camera 51 details

IP Ext 1,2
OK
STEP 3

Configuration
Poort settings

TP not
available

IP Range defined by
GV for cameras
UniCast 10.11.5.x
MultiCast 224.1.0.x

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 Menu XCU



XCU HD/4K IP – Settings with Menu XCU

Video
Monitoring
Audio/Intercom
▶ Install
Security
Root

▶ Camera
Alias
Device ID
Timing
Time/Date
Install

▶ Connect Type
Name
Number

▶▶
032TZU
032TZU
▶▶
▶▶
Cable
--
51



Cable is Standard
Network is (DutchView)



Standard (Cable)



XCU HD/4K IP – Settings with Menu XCU

Video
Monitoring
Audio/Intercom
▶ Install
Security
Root

▶ Camera
Alias
Device ID
Timing
Time/Date
Install

▶ Connect Type
Name
Number

▶▶
032TZU
032TZU
▶▶
▶▶
Cable
--
51



Cable is Standard
Network is (DutchView)



DutchView (Network)



XCU HD/4K IP – Settings with Menu XCU

Video
Monitoring
Audio/Intercom
▶ Install
Security
Root

Signalling Input
Signalling Outp.
C2IP Network
▶ Media Network
AFD
Install

▶ Local IP
Video Out IP
Video In IP
Media Network

Step 1

▶ Subnet Mask 16
Loc IP digit 1 10
Loc IP digit 2 11
Loc IP digit 3 5
Loc IP digit 4 51
GW IP digit 1 10
GW IP digit 2 11
GW IP digit 3 5
▶ GW IP digit 4 1
Local IP

XCU HD/4K IP – Settings with Menu XCU

Video ▶▶
Monitoring ▶▶
Audio/Intercom ▶▶
▶ Install ▶▶
Security ▶▶
Root

Signalling Input ▶▶
Signalling Outp. ▶▶
C2IP Network ▶▶
▶ Media Network ▶▶
AFD ▶▶
Install

Local IP ▶▶
▶ Video Out IP ▶▶
Video In IP ▶▶
Media Network

▶ Main Video ▶▶
Monitoring Video ▶▶
Video Out IP
▶ Rem IP digit 1 10
Rem IP digit 2 11
Rem IP digit 3 5
Rem IP digit 4 54
Rem PortNr 1000
Main Video

Step 2



Main Video



Monitoring Video



XCU HD/4K IP – Settings with Menu XCU

Video ▶▶
Monitoring ▶▶
Audio/Intercom ▶▶
▶Install ▶▶
Security ▶▶
Root

Signalling Input ▶▶
Signalling Outp. ▶▶
C2IP Network ▶▶
▶Media Network ▶▶
AFD ▶▶
Install

Local IP ▶▶
▶Video Out IP ▶▶
Video In IP ▶▶
Media Network

Main Video ▶▶
▶Monitoring Video ▶▶
▶IP Stream Remote IP ▶▶
Video Out IP

▶Rem IP digit 1	10
Rem IP digit 2	11
Rem IP digit 3	5
Rem IP digit 4	54
Rem PortNr	1000

Step 2



→ Main Video
→ Monitoring Video



XCU HD/4K IP – Settings with Menu XCU

Video ▶▶
Monitoring ▶▶
Audio/Intercom ▶▶
▶ Install ▶▶
Security ▶▶
Root

Signalling Input ▶▶
Signalling Outp. ▶▶
C2IP Network ▶▶
▶ Media Network ▶▶
AFD ▶▶
Install

Local IP ▶▶
Video Out IP ▶▶
▶ Video In IP ▶▶
Media Network

▶ Ext1 (RX0) ▶▶
Ext2 (RX1) ▶▶
TP (RX2) ▶▶
Video In IP
Ext1 (RX0)

PortNr 1000
Multicast Yes
Multicast IP ▶▶

▶ IP digit 1 224
IP digit 2 1
IP digit 3 0
IP digit 4 111
Multicast IP

Step 3

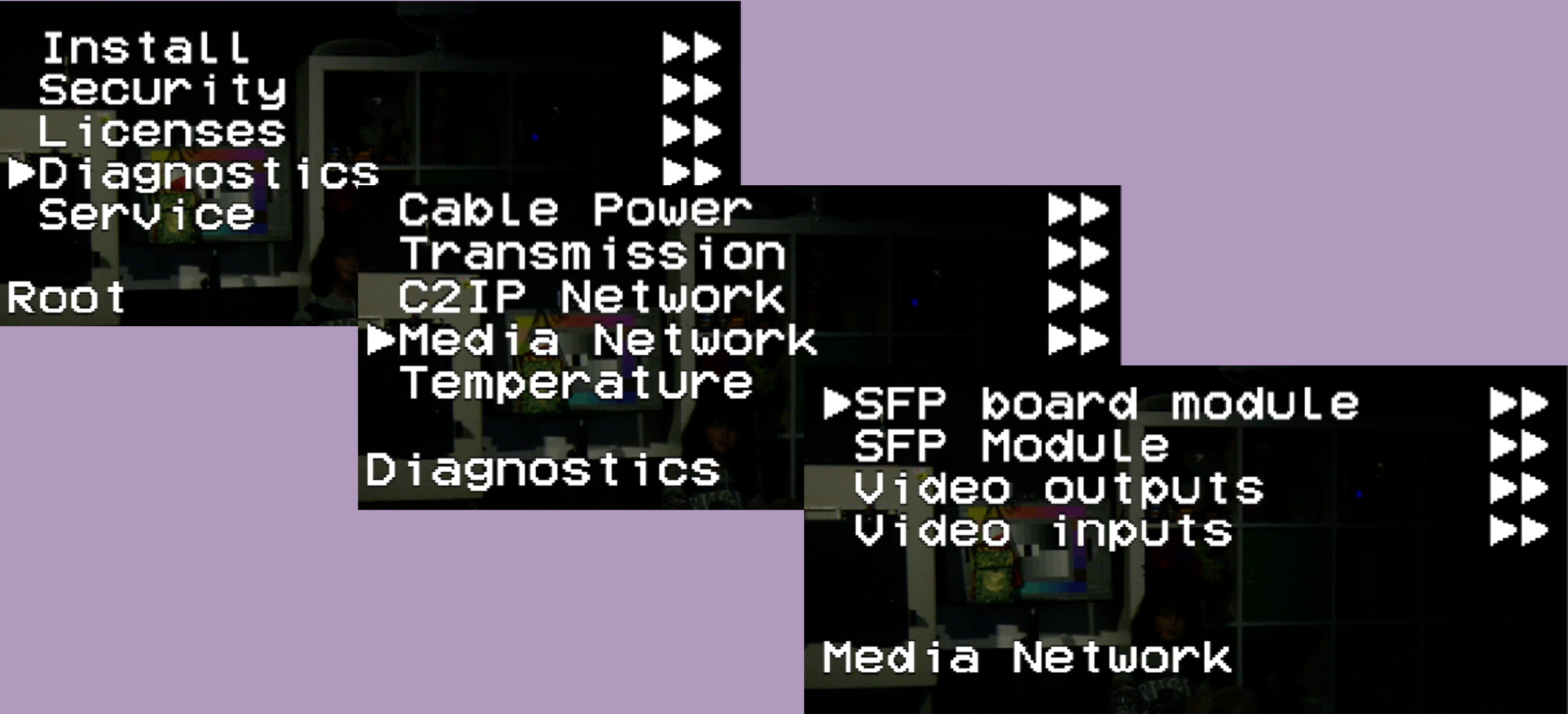


← Ext 1 Video

← Ext 2 Video

← TP

XCU HD/4K IP – Settings with Menu XCU



—————► Details FSP modules
—————► Details Video In/Out



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**



IP

Grass Valley Cameras XCU UXF details

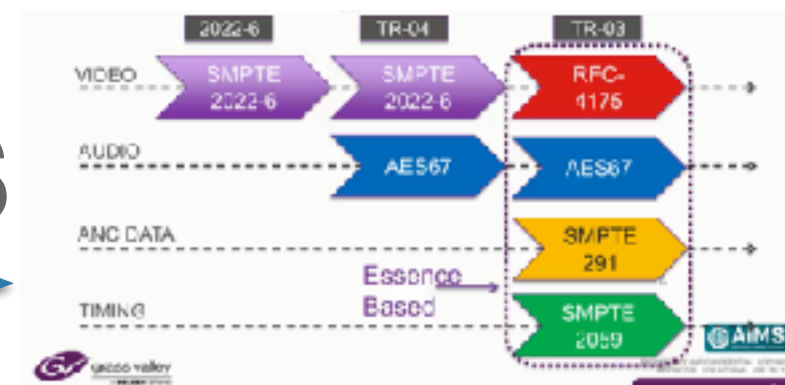


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New IP XCU : Why ?



- ❖ 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

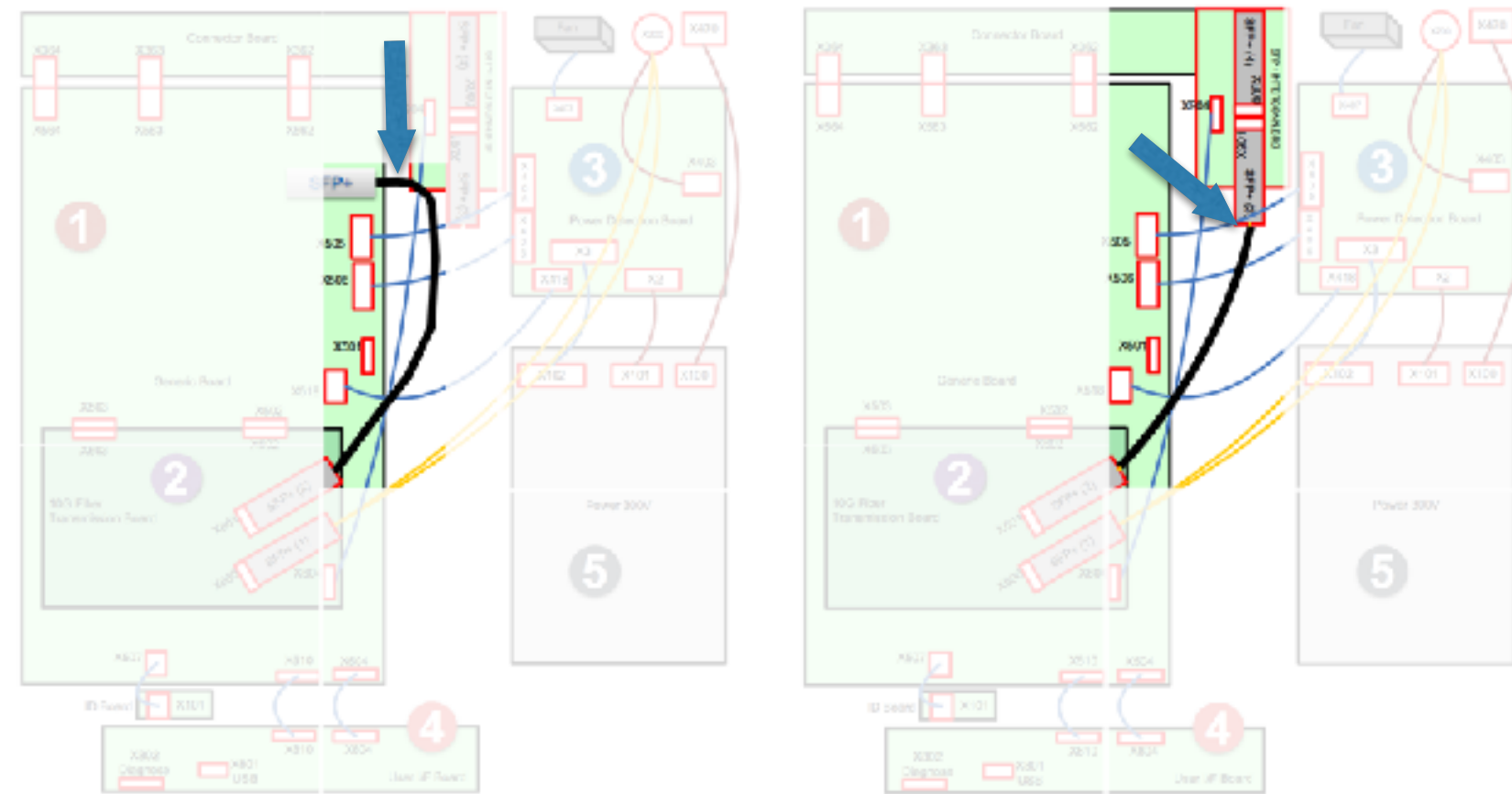
- ❖ HD/4k XF IP XCU (Today's IP XCU ; supporting 86 / 86N)
 - ☑ First OB's / studio's equiped with HD/4k XF IP XCU (ArenaTV / BCE / etc.)
 - ☑ 4k demand is increasing (e.g. Sky is pushing the market)
 - ☑ HD/4k XF IP XCU supports 2022-6 standard.....

but.....

New IP XCU : Why ?



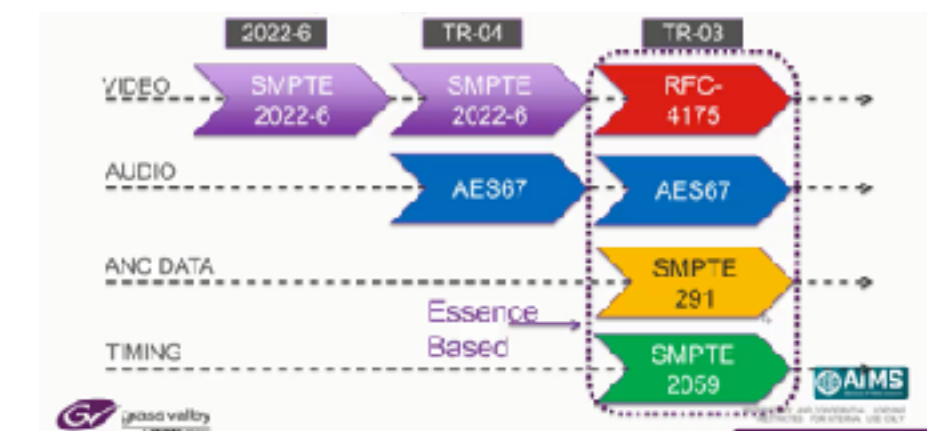
- ❖ HD/4k XF IP XCU is GREAT today but has HW/SW limitations for future IP-demands



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)



Introduction plan

NAB '17

IP

- ✓ 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



Differences UNIVERSE <-> UNIVERSE UXF



UNIVERSE



UNIVERSE UXF



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

- ❖ 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*

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



HD/4k XF IP



ENTERPRISE UXF



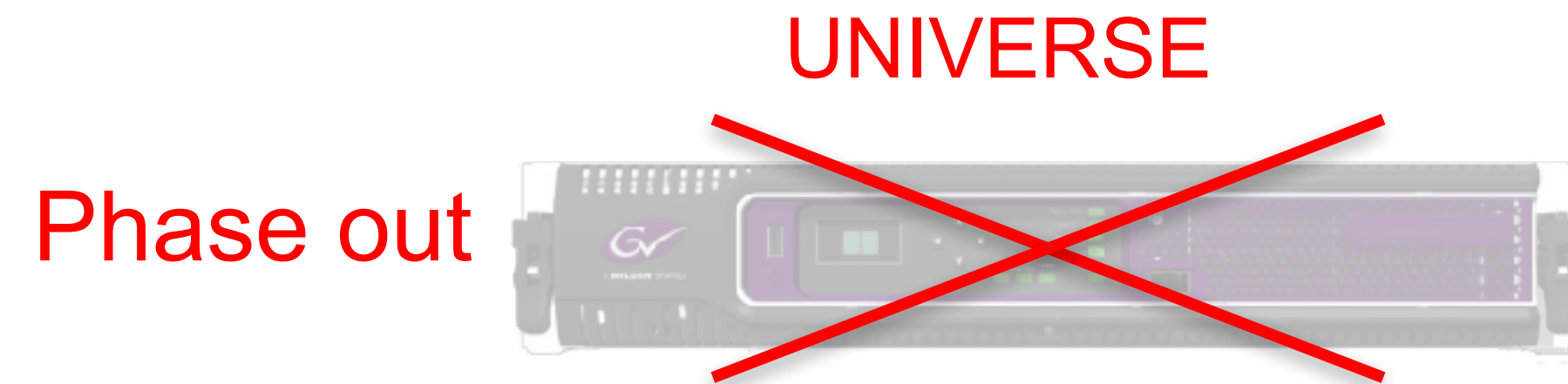
- ❖ Limited SDI connectivity
- ❖ HD/3G/4K/HDR support
- ❖ Direct IP support (XF Fiber)
- ❖ Cradle (Separate 1x10Gb IP port)
- ❖ Limited IP for HD/3G/4K/HDR (2022-6)
- ❖ Embedded Audio over IP (2022-6)
- ❖ Embedded I-comm over IP (2022-6)
- ❖ No PTP (BNC ref.)
- ❖ No Redundancy

- ❖ 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*

Introduction plan

NAB '17

IP



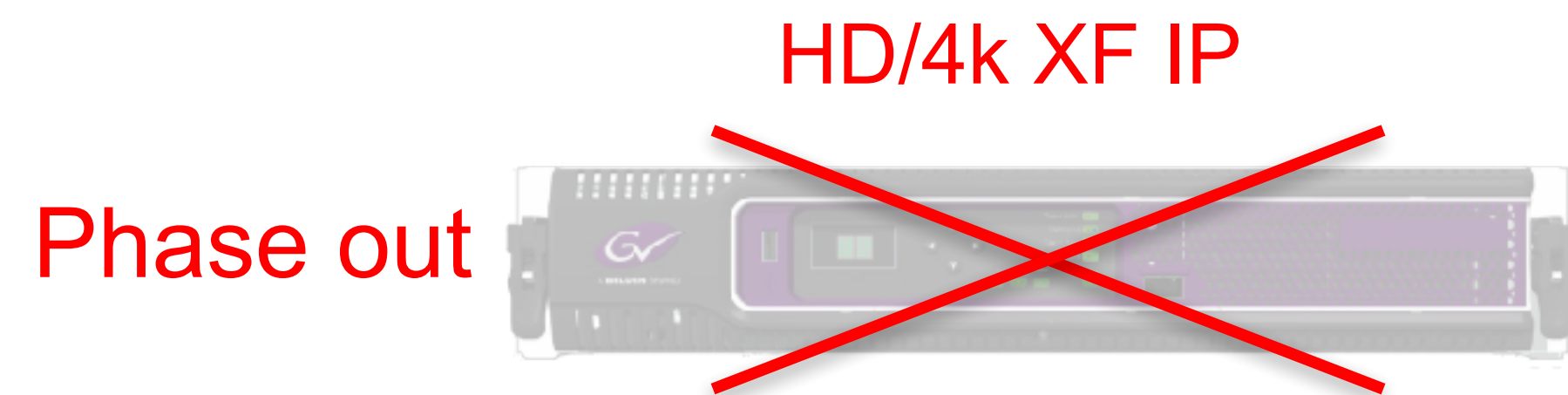
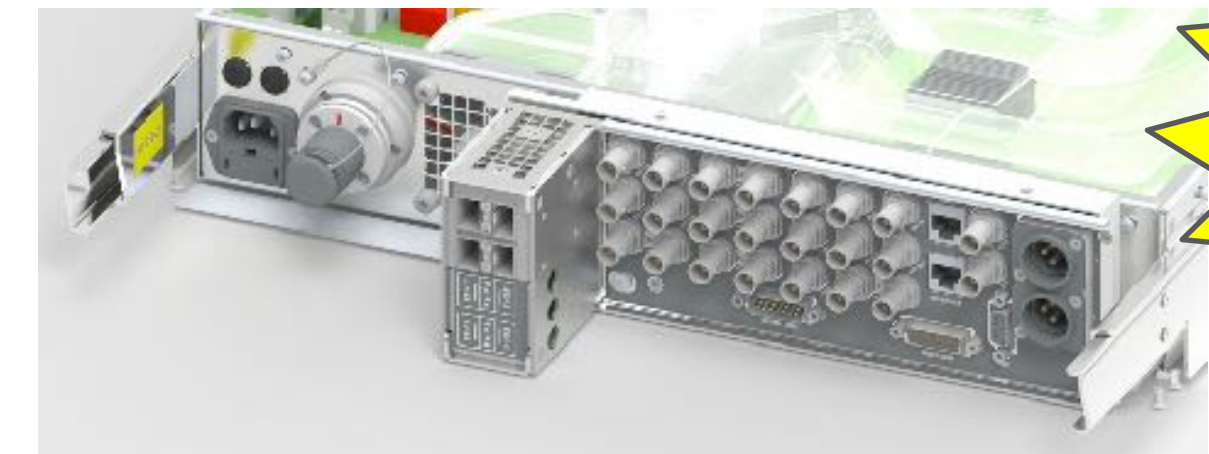
Remains available
for 3G Fiber/Triax

Cradle



Intro

Cradle UXF



Camera Support



XF Fiber

ENTERPRISE UXF



UNIVERSE UXF

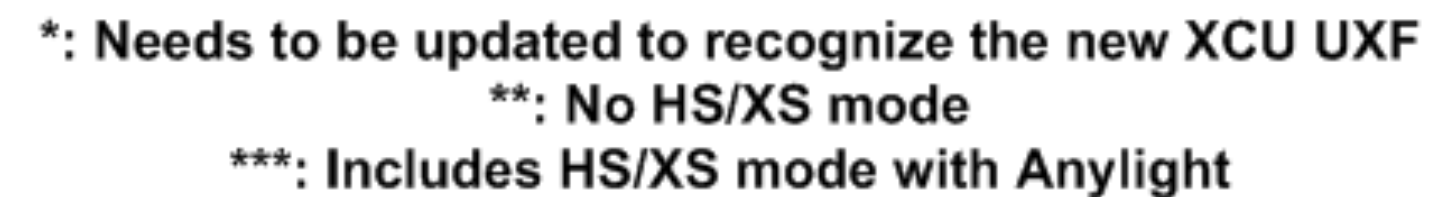


LDX86 + UNIVERSE adapter
LDX86N + UNIVERSE adapter
LDX80/82 + UNIVERSE adapter

❖ XF fiber transmission is supported by ;

- UNIVERSE adapter
- ENTERPRISE UXF XCU
- UNIVERSE UXF XCU

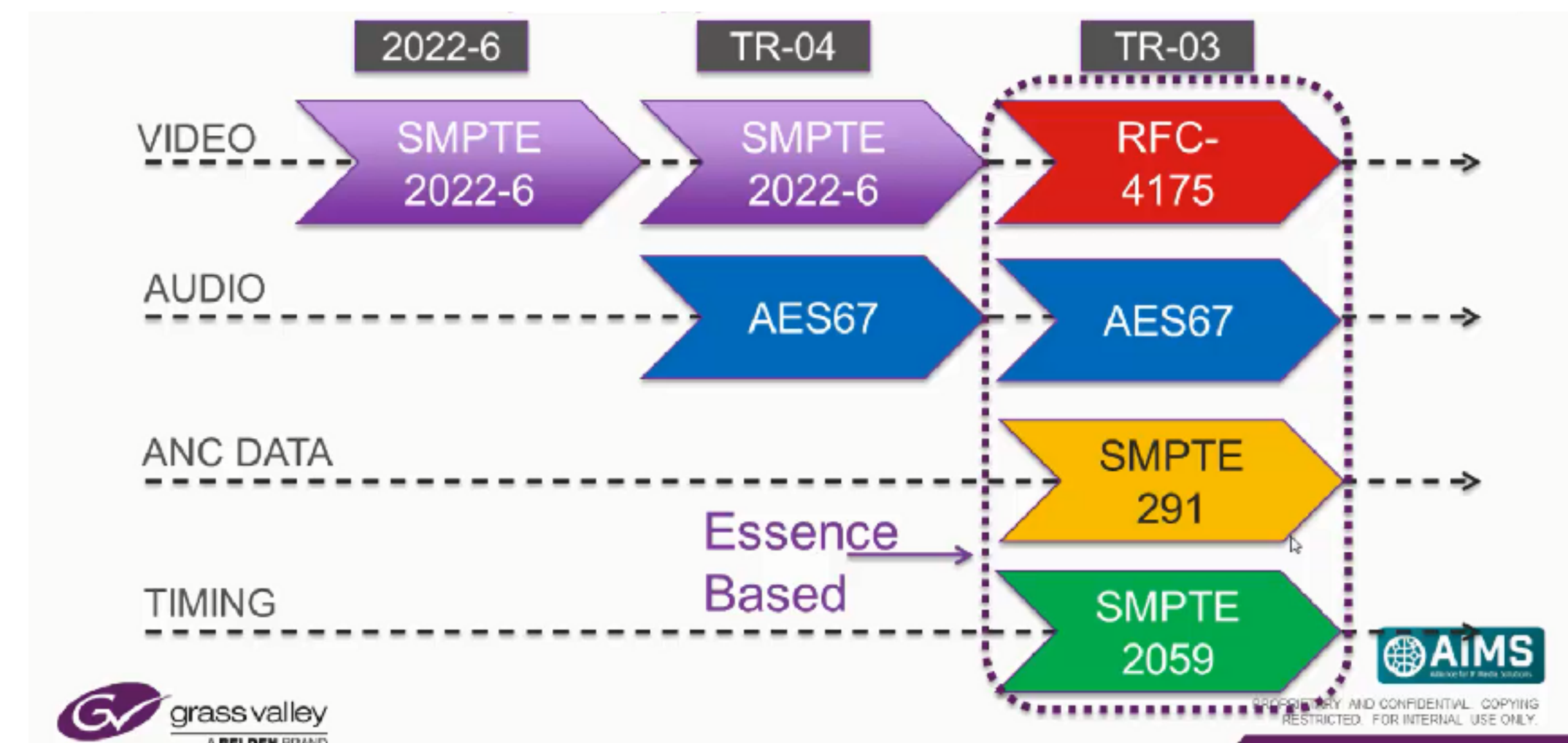
XF Fiber transmission supports video formats ; HD/3G/4K/HDR/HD-HS/HD-XS



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



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



UXF ; interface to the IP network



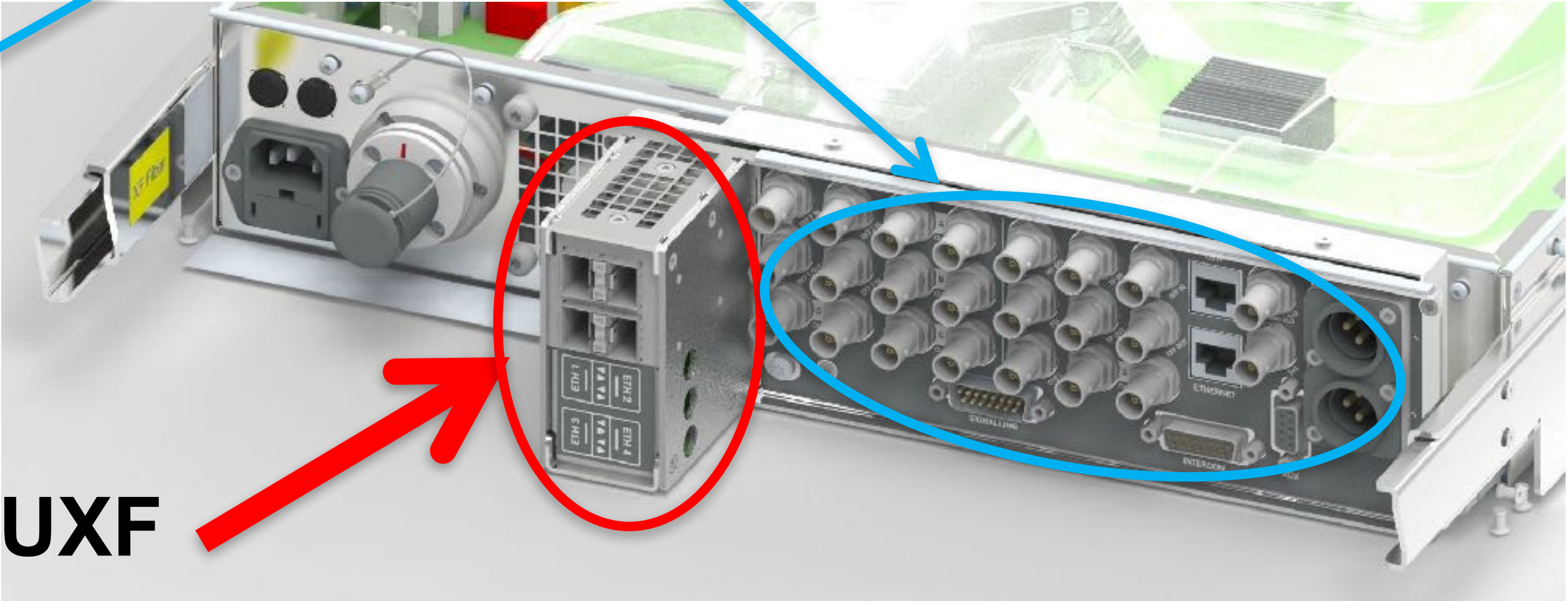
Cradle type	XCU type	IP connection	SDI connection
UXF Cradle	UNIVERSE UXF	Yes	Yes
UXF Cradle	UNIVERSE	No	Yes
Cradle	UNIVERSE UXF	No	Yes
Cradle	UNIVERSE	No	Yes

Cradle



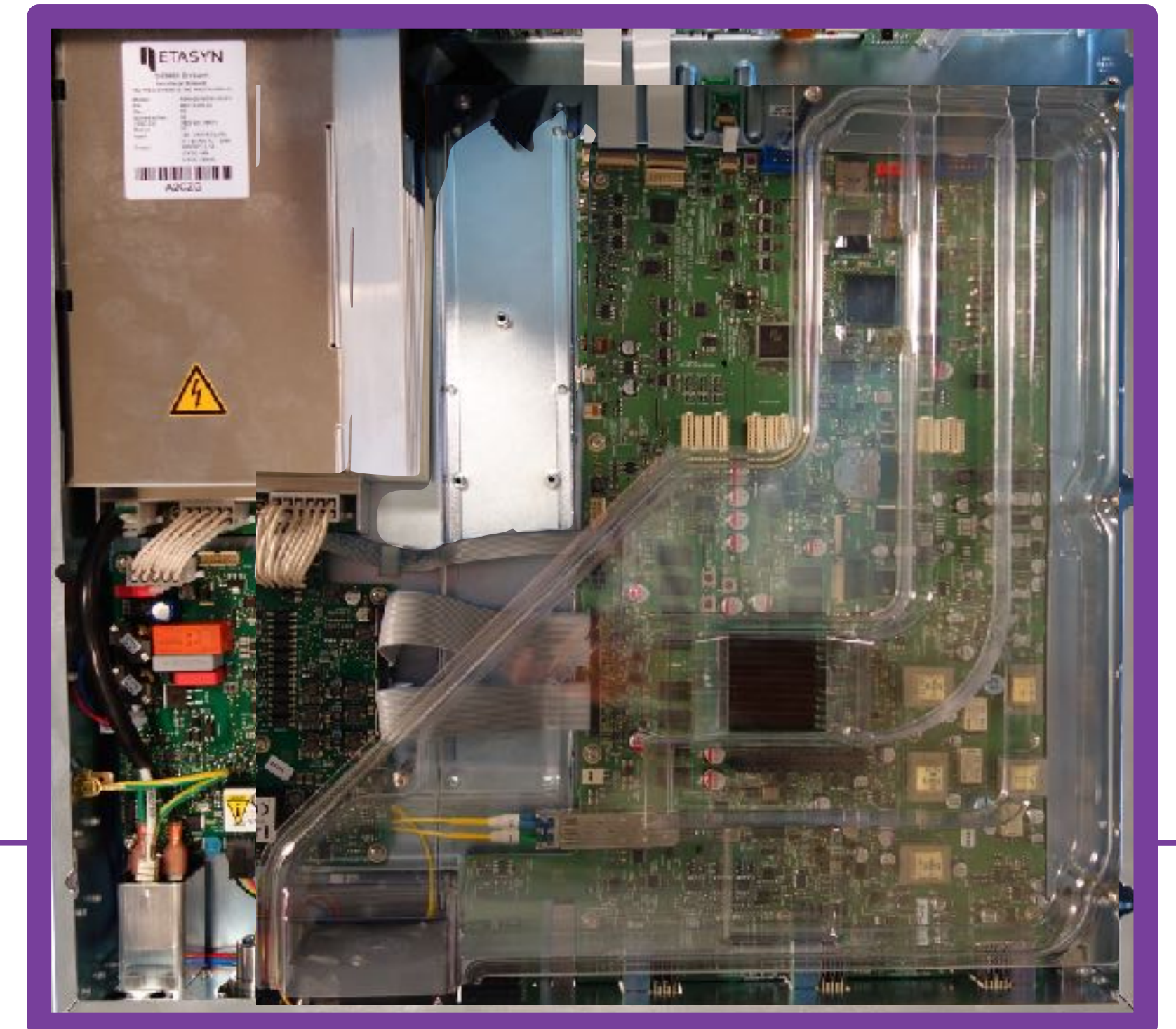
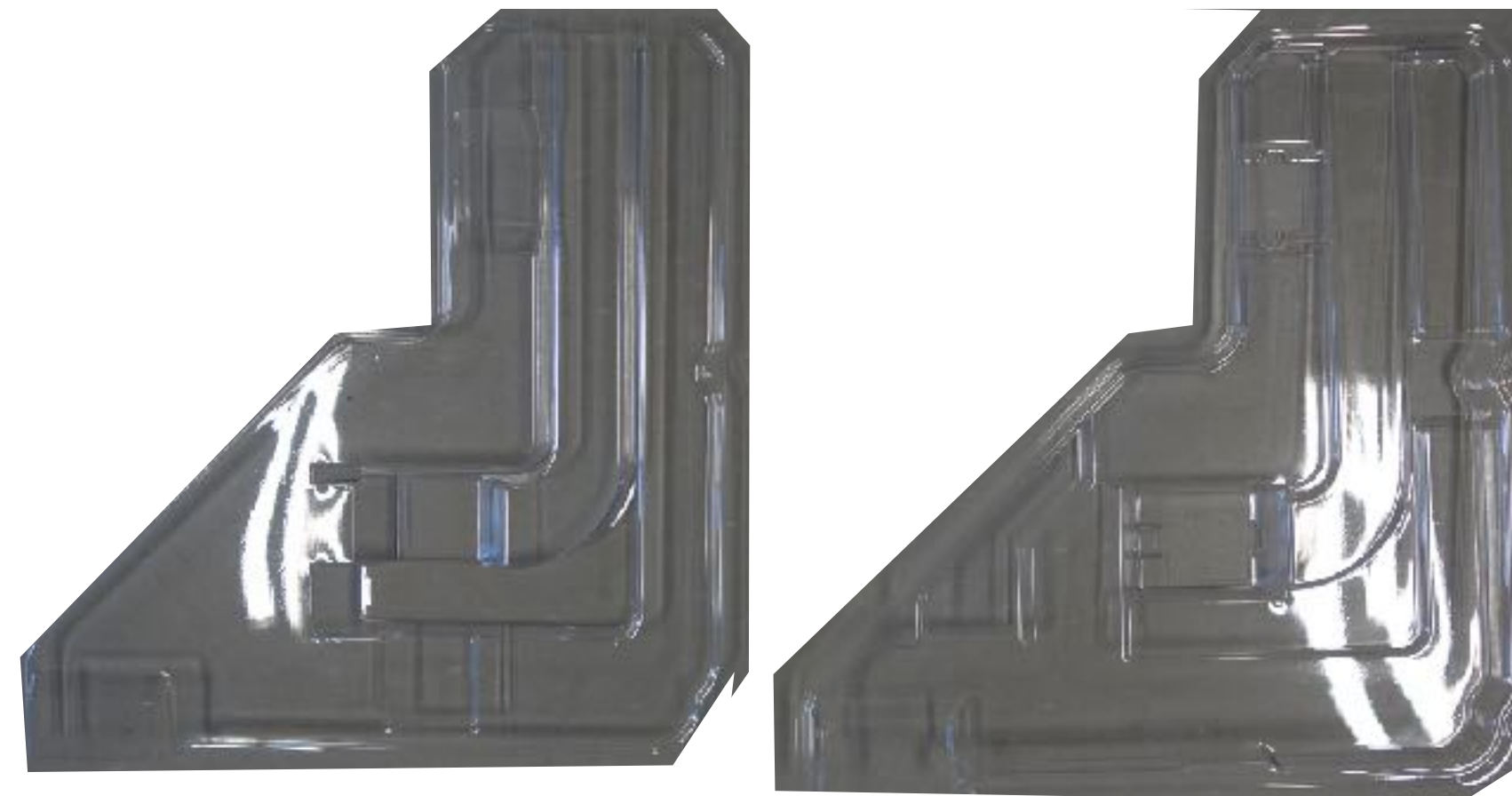
SDI (BNC)
Baseband

UXF Cradle

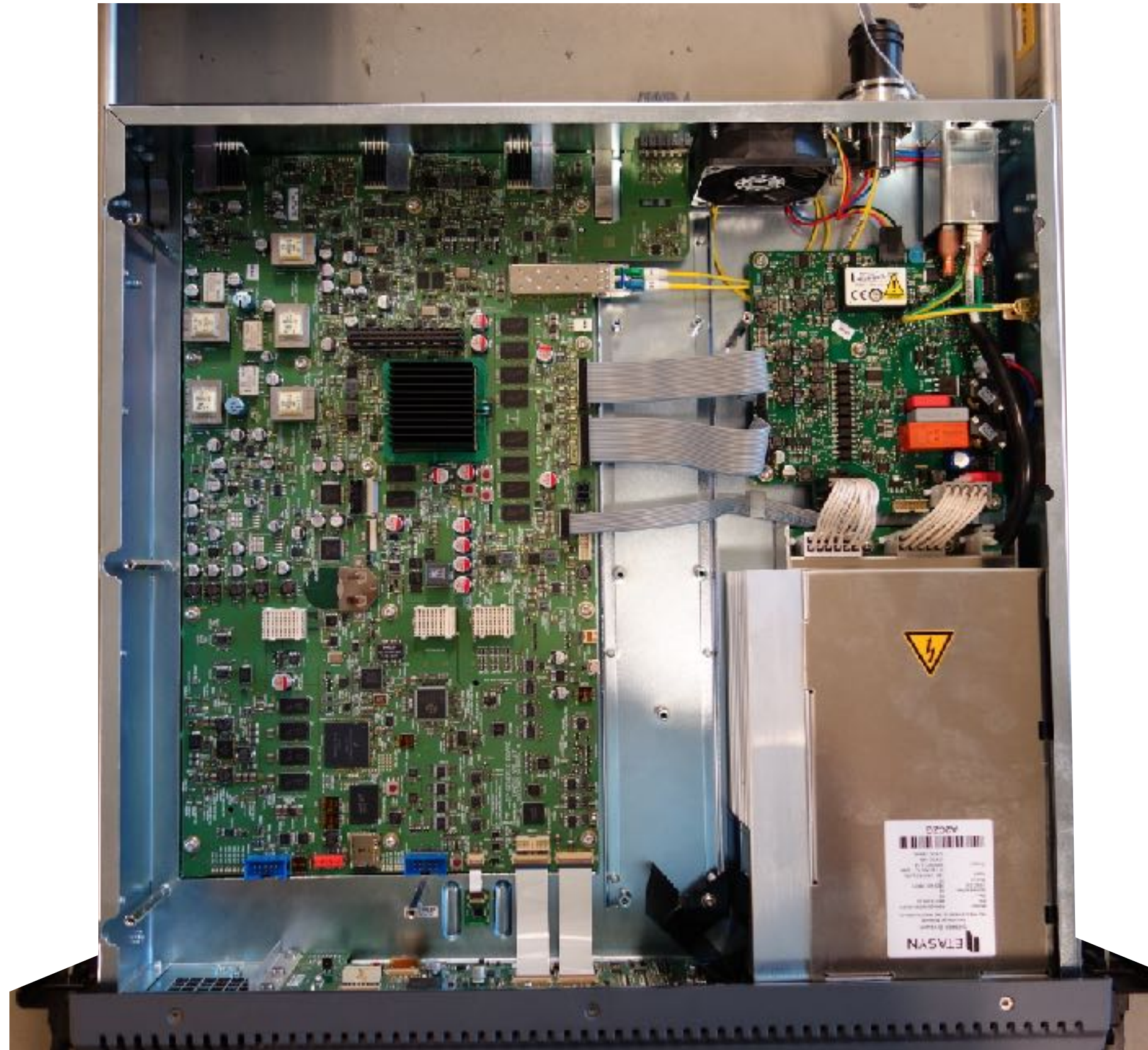


What's is the new and different in the XCU UXF

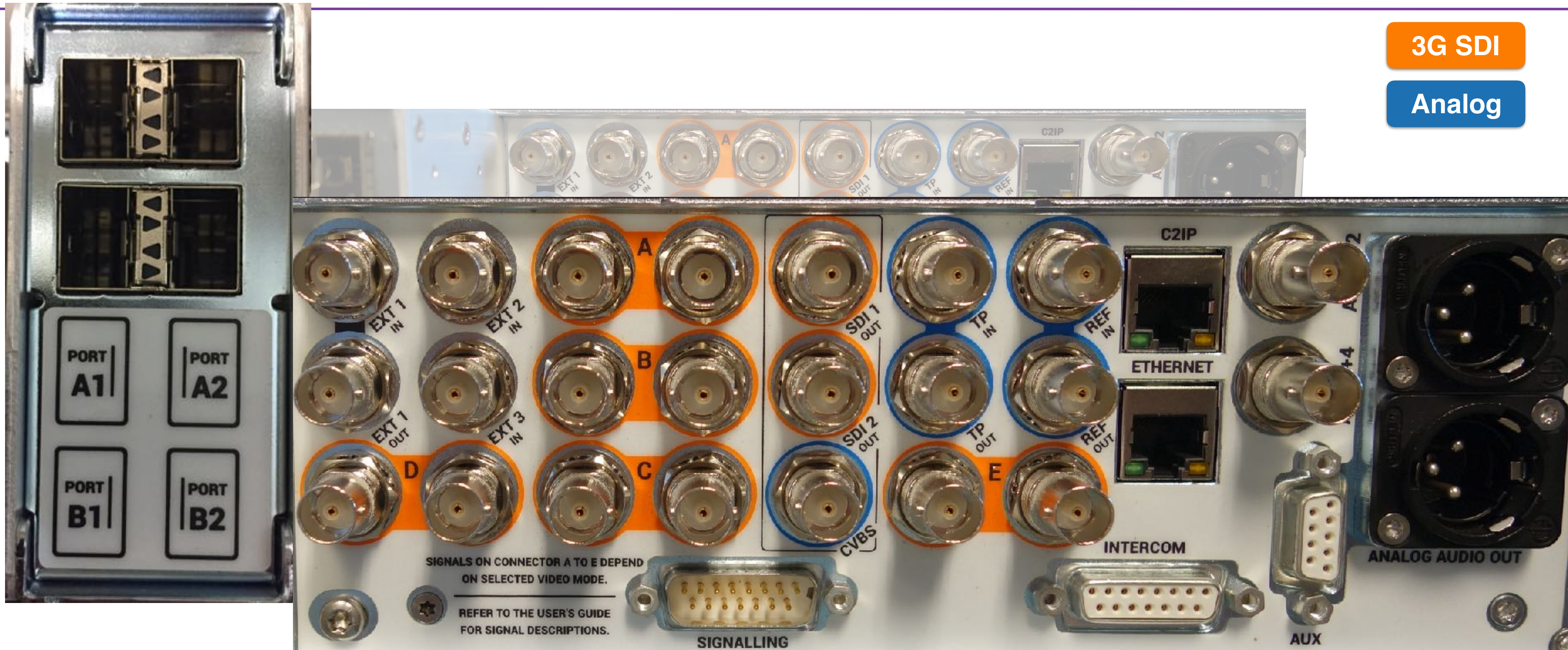
- ☑ Extension for SFP modules on board (see IP generic board)
 - Fan is moved and with better capacity.
 - No space for a DUAL XCU version.
- ☑ Old and new CRADLE compatibility is required. (see previous page)
 - New air guide for enhanced cooling.
 - New Generic board.



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



OUTPUTS (baseband) from the XCU UXF



Connections UXF Cradle (improved)

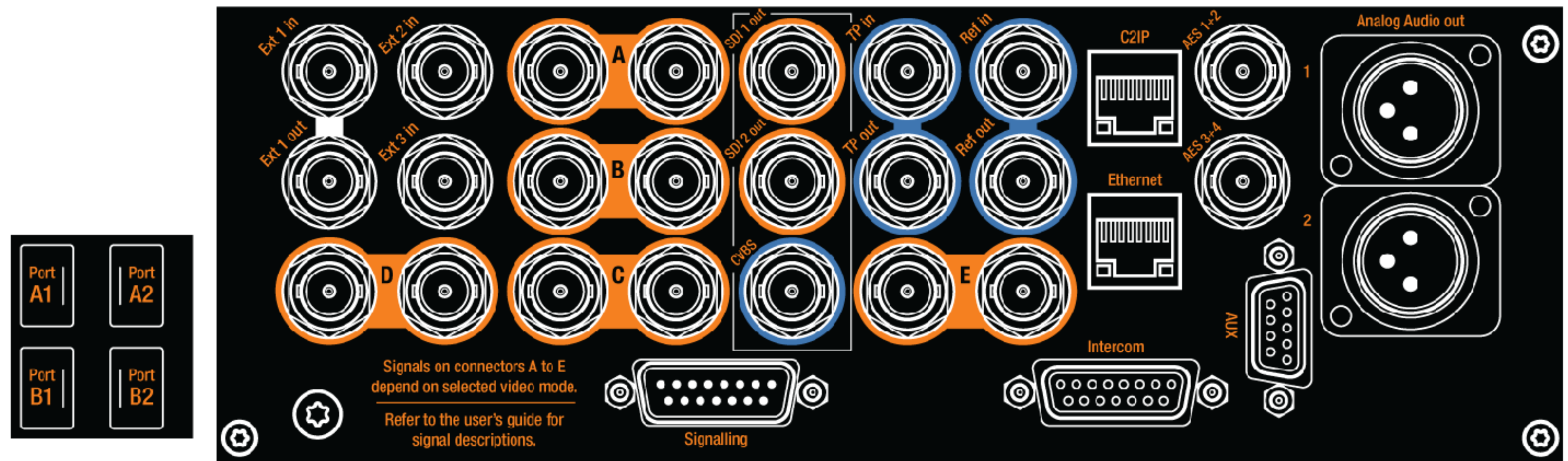


❖ SDI positions remain as is

- 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

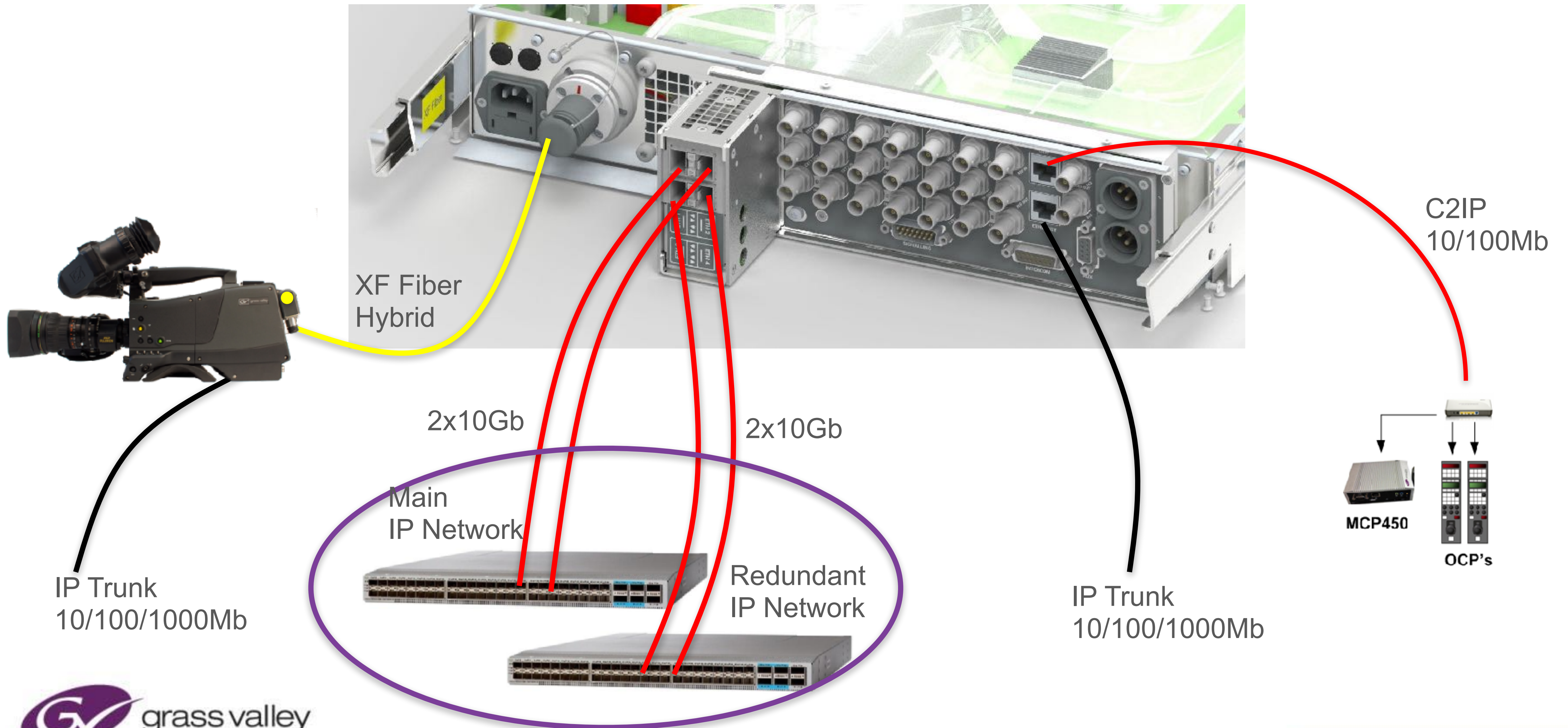
A1 A2 for different signals (live)

B1 B2 for high speed / or redundancy

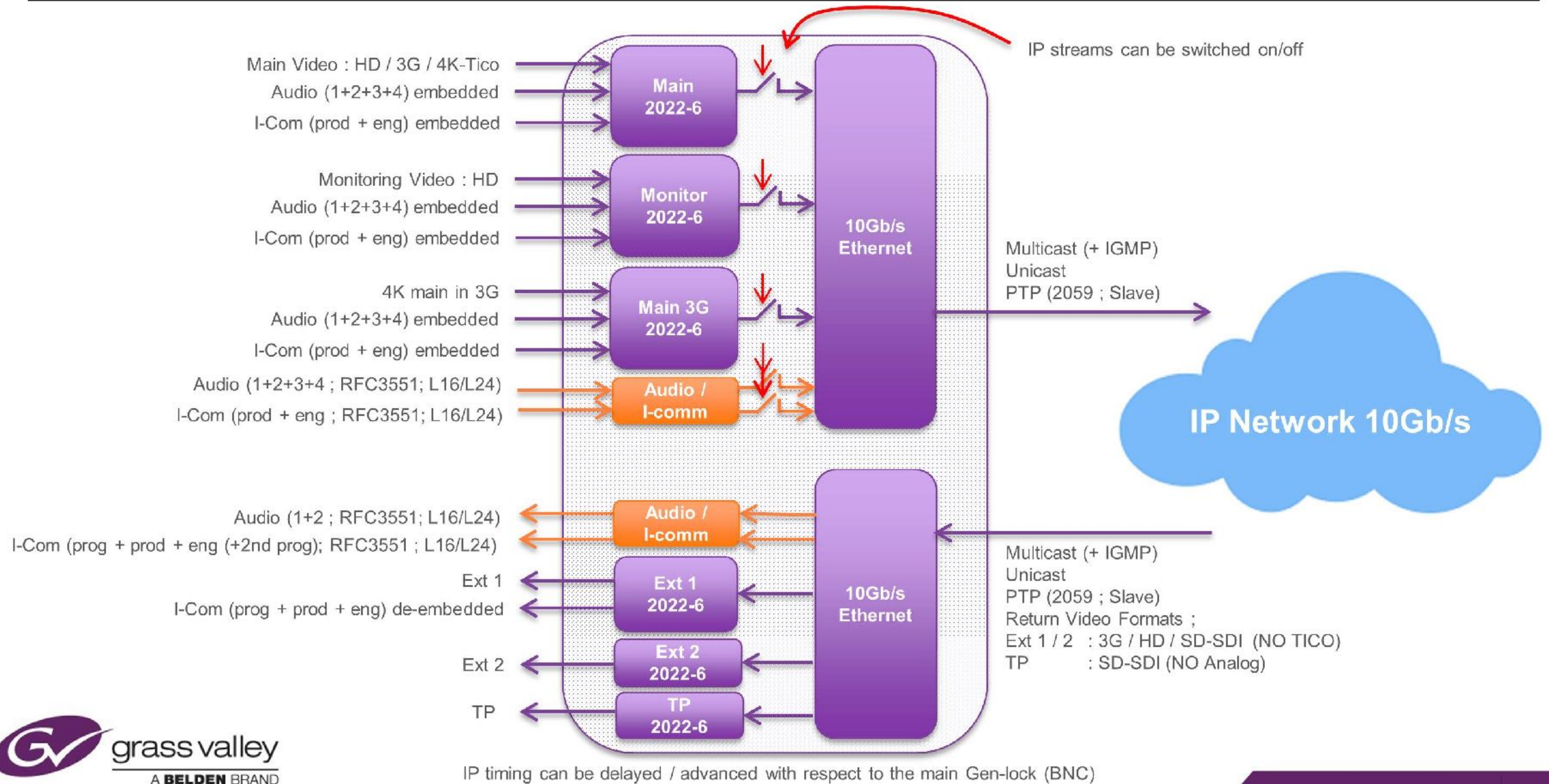
also 12G-SDI will be possible
with a Embrionix module



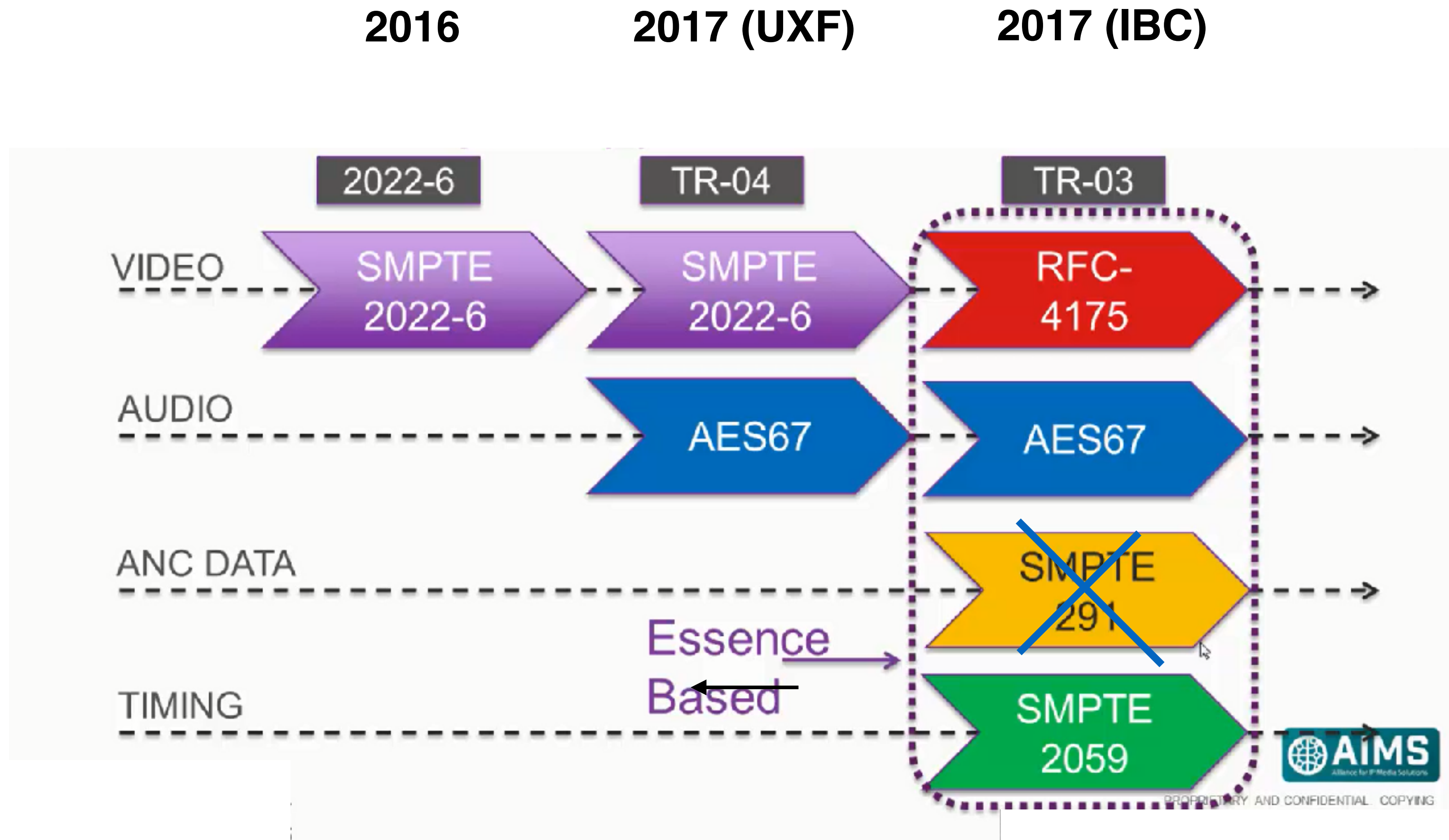
IP-XCU connections



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



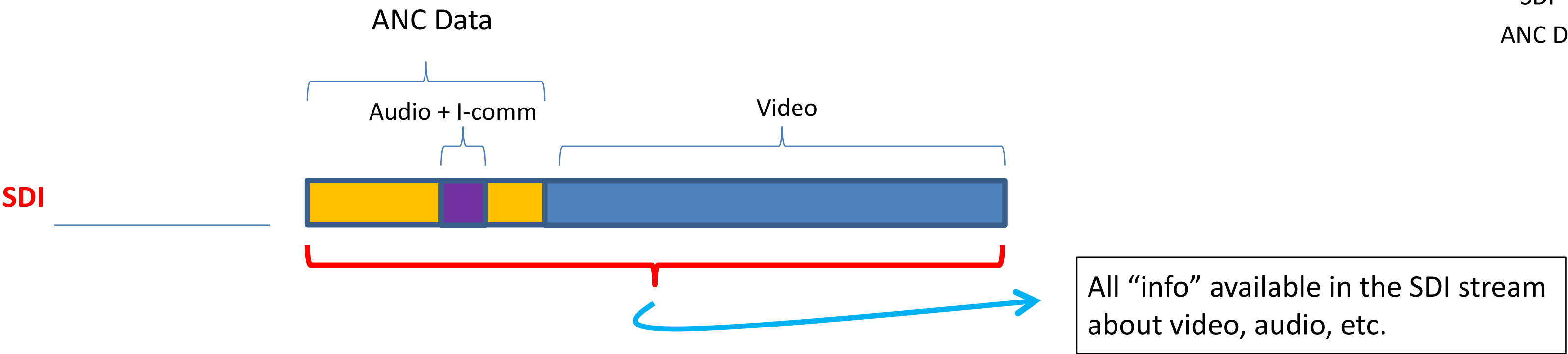
AIMS Roadmap → SMPTE 2110



SDI → SMPTE 2022 -6

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

SDI - World



IP / SDI - World



IP header

Video

Audio AES67

SDP-file

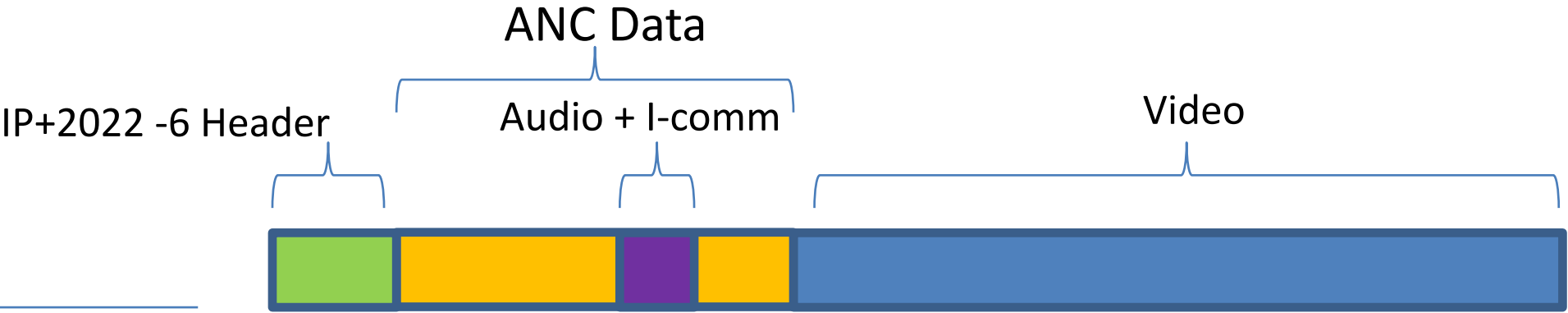
ANC Data

2110 -20

2110 -30

IP / SDI - World

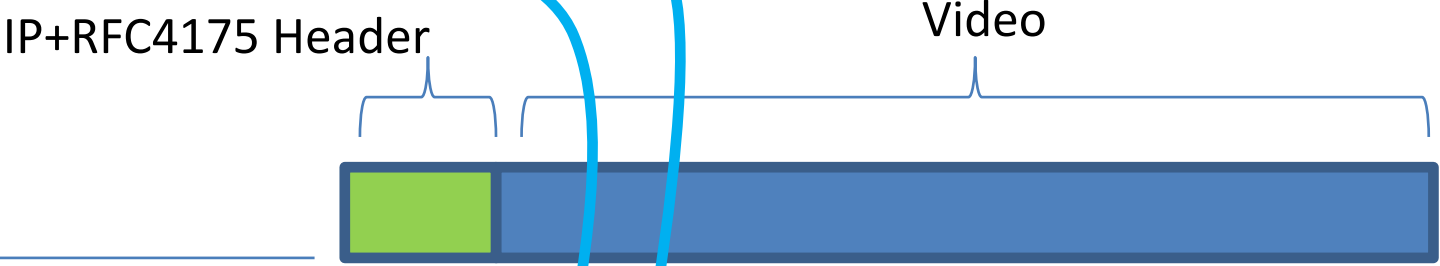
SMPTE 2022 -6



IP – World

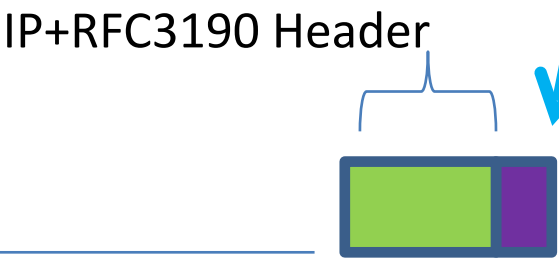
SMPTE 2110

SMPTE 2110 -20



RFC4175 (video)

SMPTE 2110 -30



AES67 (audio)

SMPTE 2110 -30



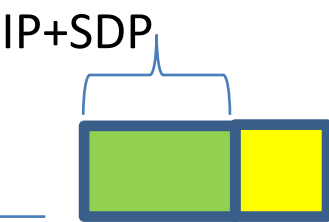
AES67 (I-comm)

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



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

SDI - World

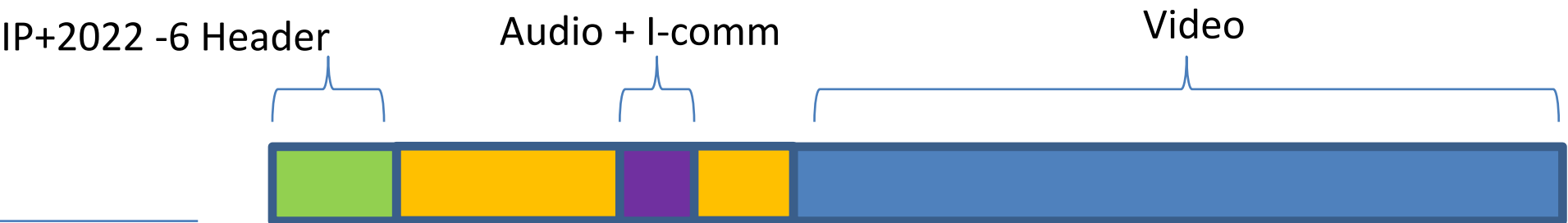
SDI



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

IP / SDI - World

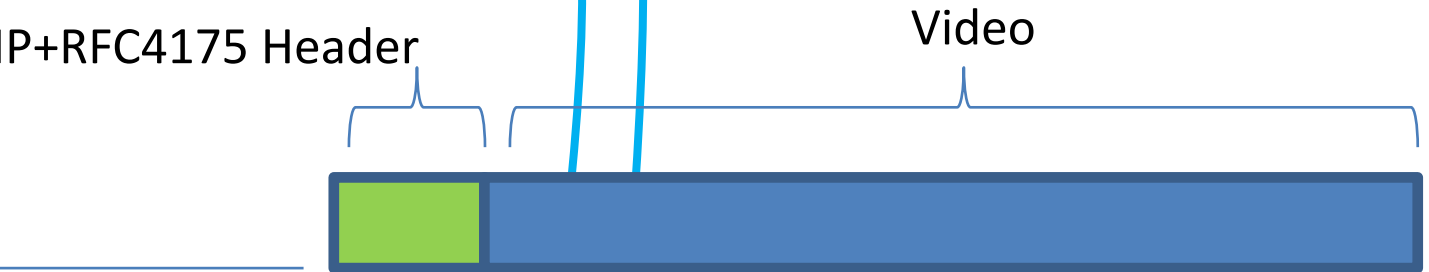
SMPTE 2022 -6



IP – World

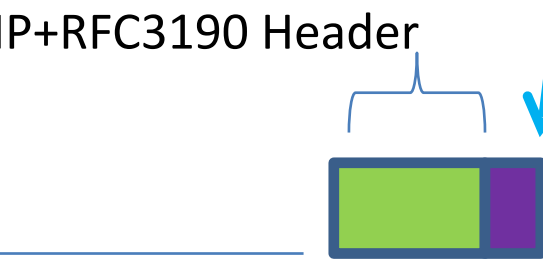
SMPTE 2110

SMPTE 2110 -20



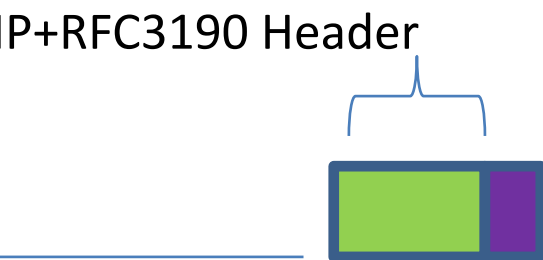
RFC4175 (video)

SMPTE 2110 -30



AES67 (audio)

SMPTE 2110 -30



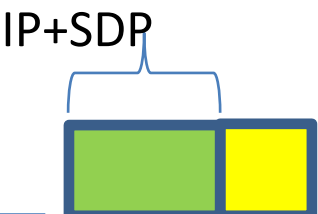
AES67 (I-comm)

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

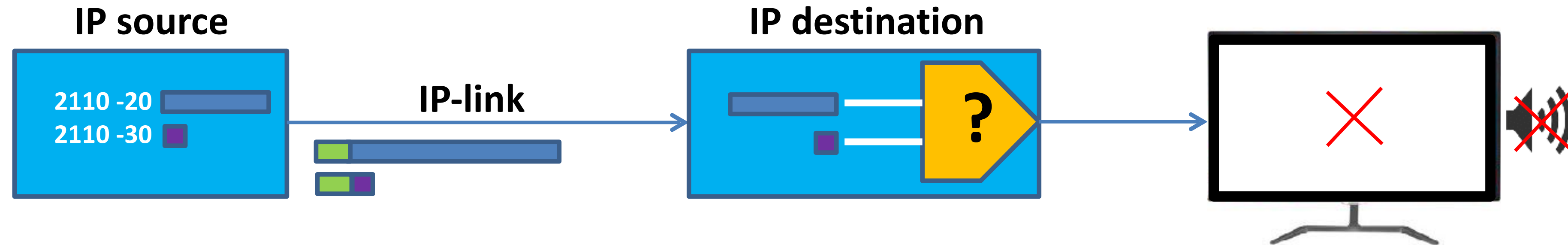
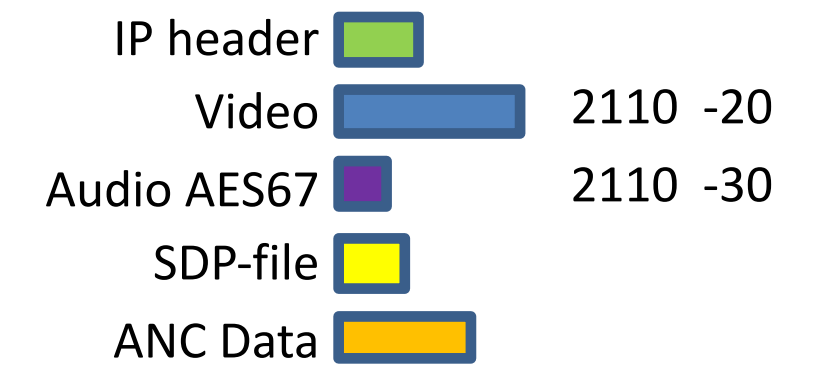
Session Description Protocol



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



In the SMPTE 2110 standard the IP streams are called essence. This means only video but no “descriptive information” like video format, framerate, etc. The same is applicable for the Audio as AES67.

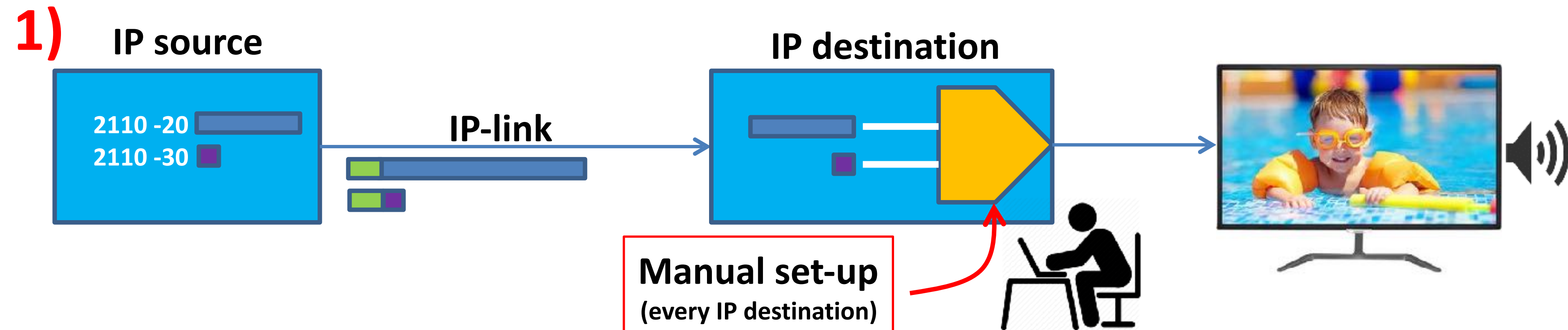
Video is 2110 -20

Audio is 2110 -30

The “descriptive 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.

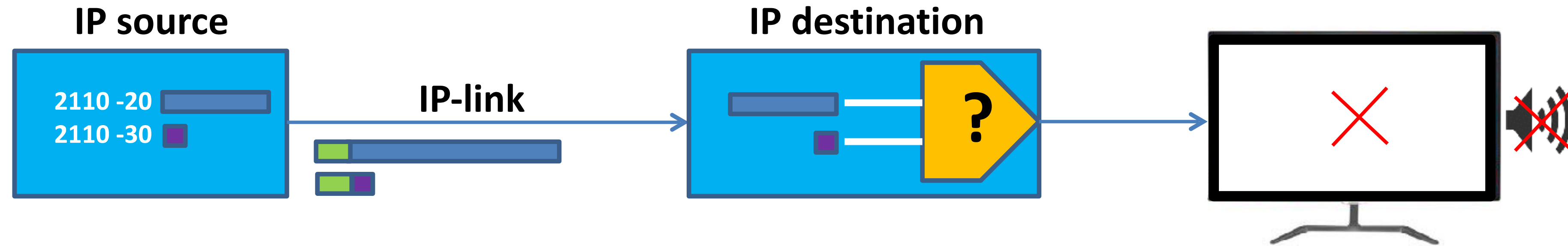
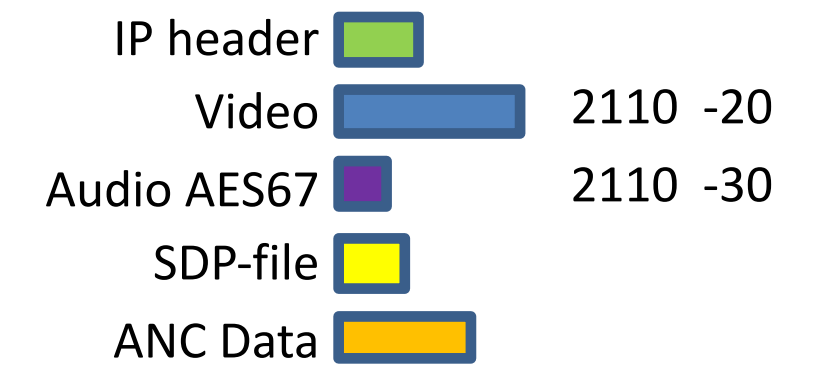
There are 2 ways to get that “other additional information” at the IP-destination

- 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



Why SDP file ?

IP – SMPTE 2110



In the SMPTE 2110 standard the IP streams are called essence. This means only video but no “descriptive information” like video format, framerate, etc. The same is applicable for the Audio as AES67.

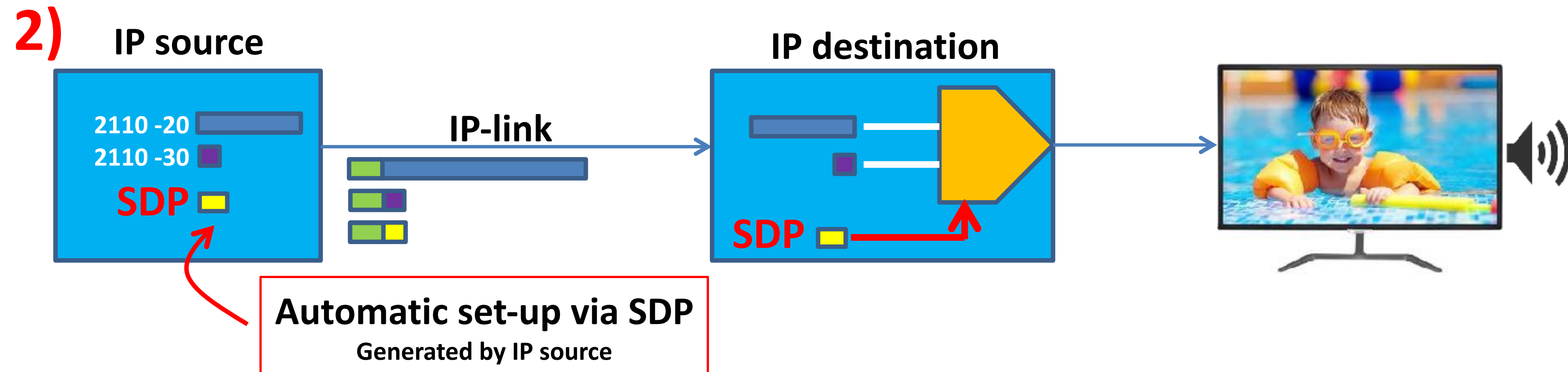
Video is 2110 -20

Audio is 2110 -30

The “descriptive 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

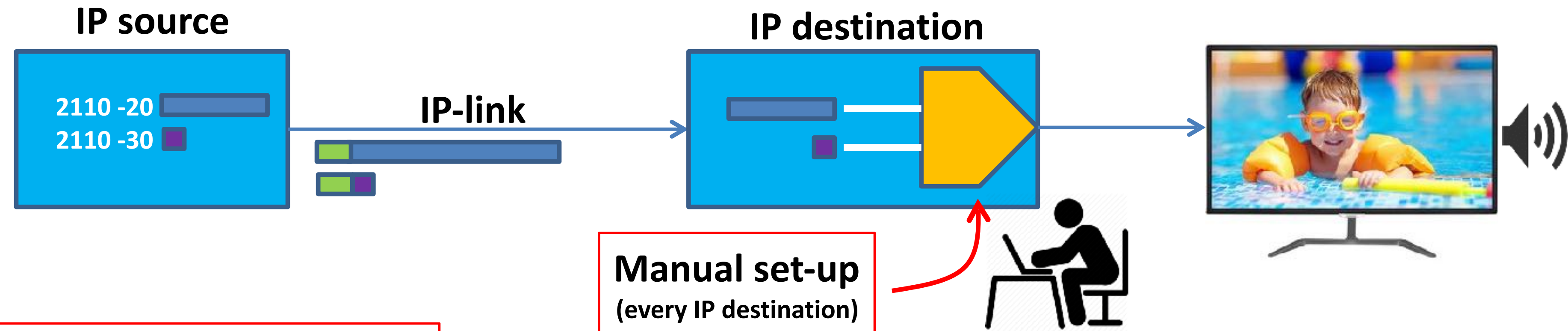
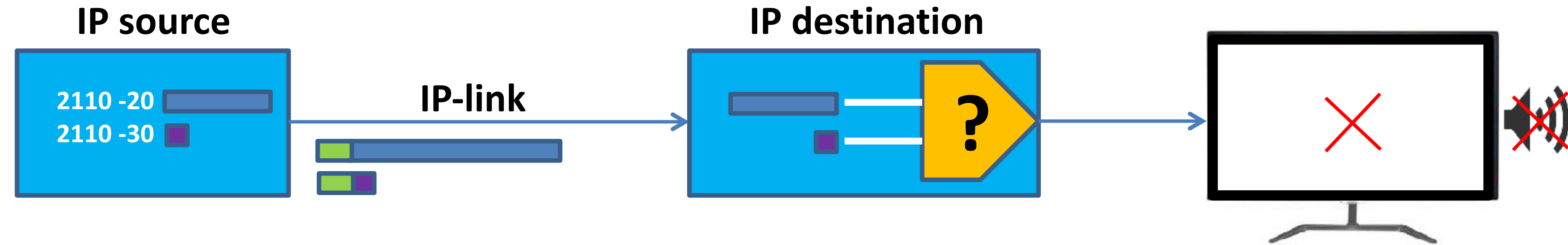
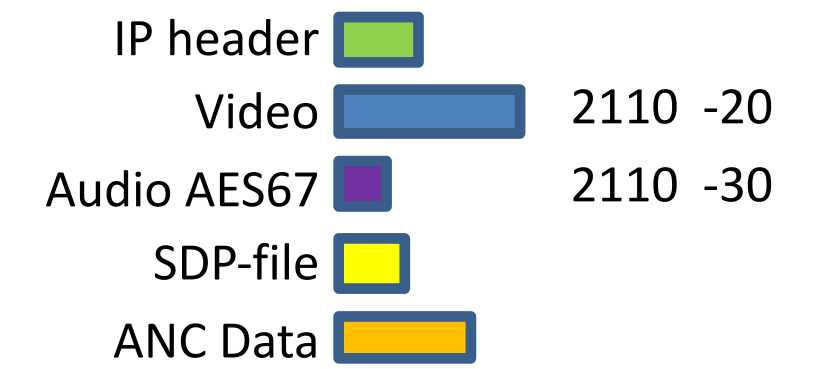
- 1) Manually via local set-up, where you simply tell the destination what it is and therewith how to interpret
- 2) Automatically via SDP file-transfer, sent with the essences



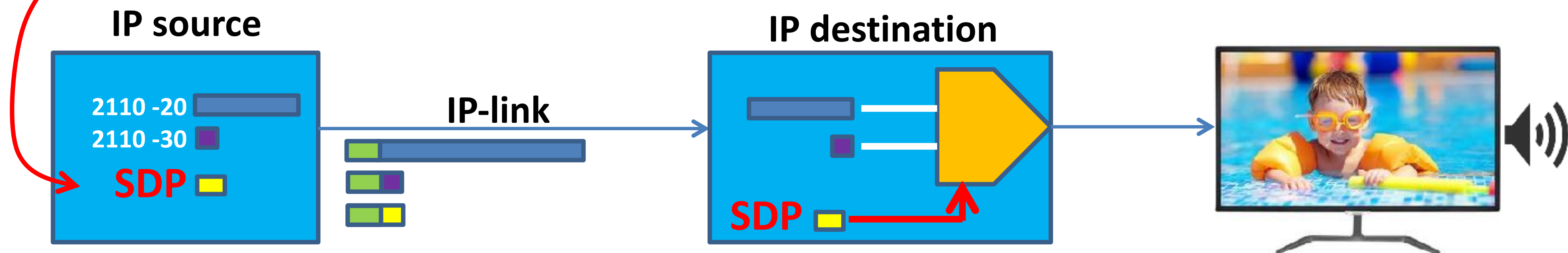
IP – SMPTE 2110

Why SDP file ?

Additional info needed for each receiver to “understand” the content of the IP packages

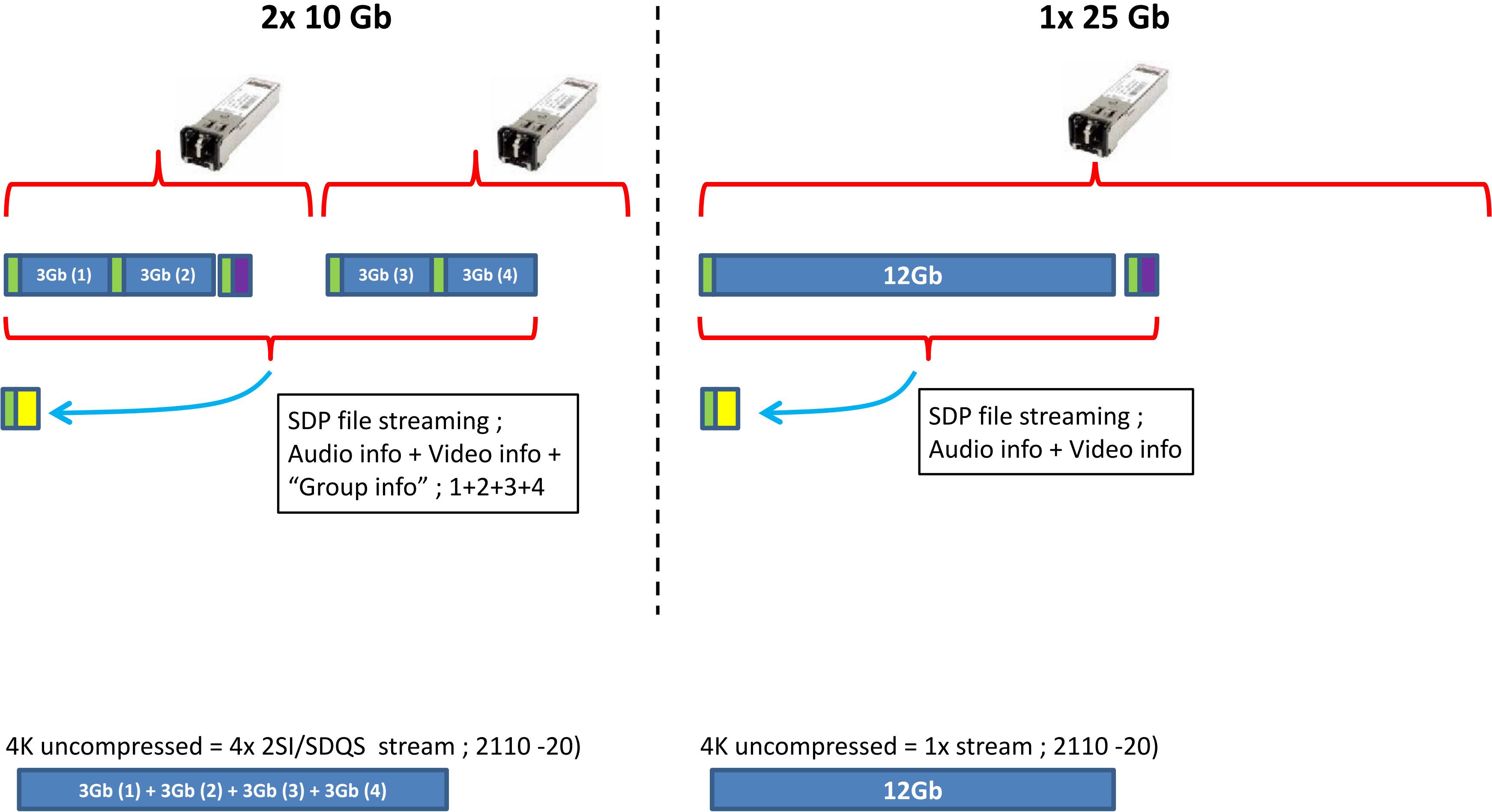


Automatic set-up via SDP
Generated by IP source

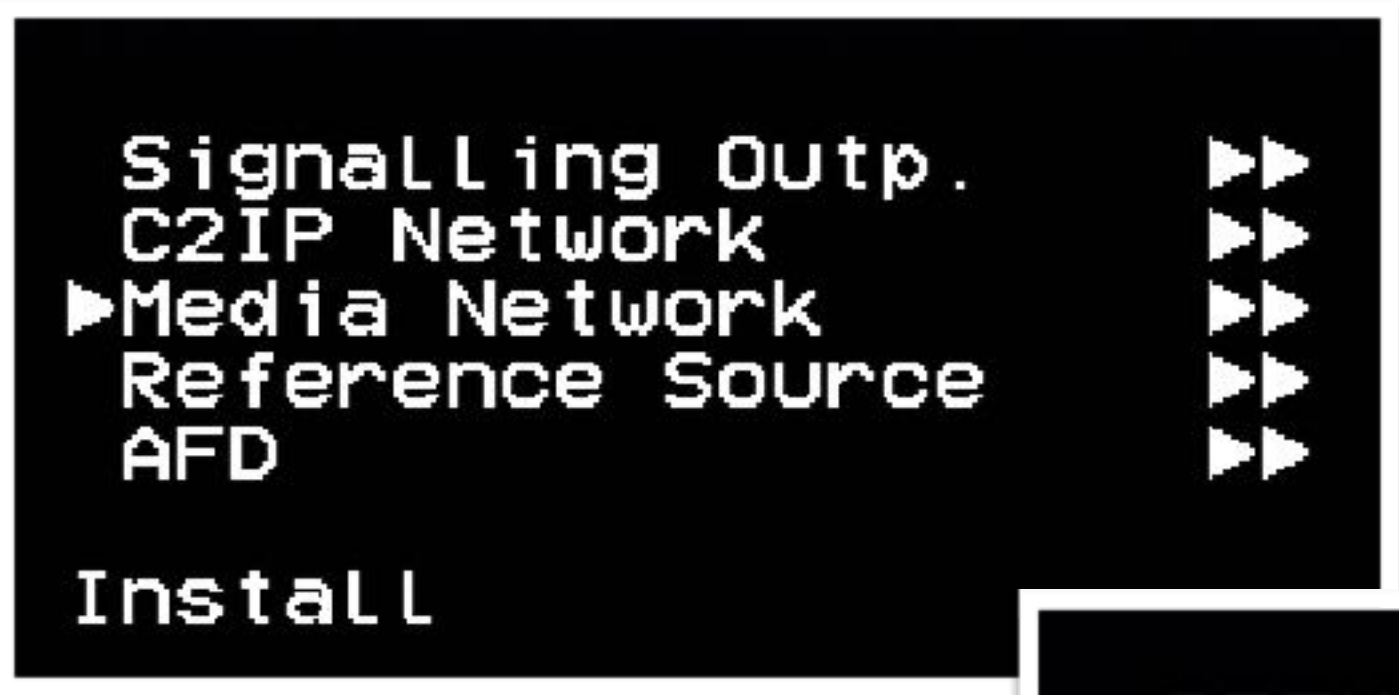


4K uncompressed
SMPTE 2110
(2 options)

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



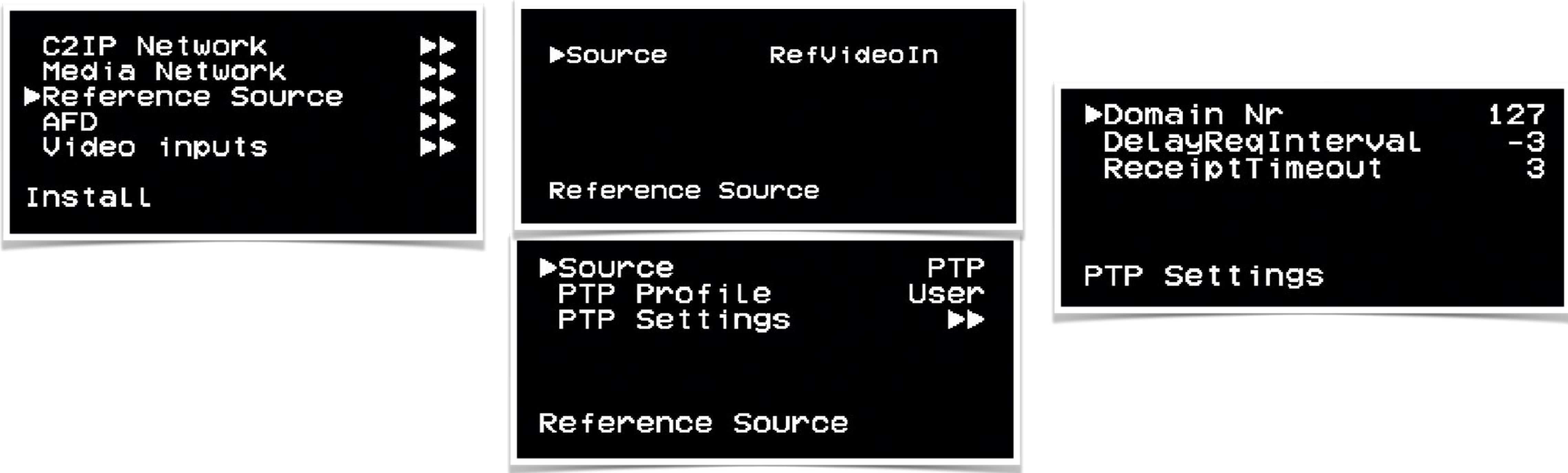
Media Network XCU Menu items (Video Streams) IP settings



=>

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

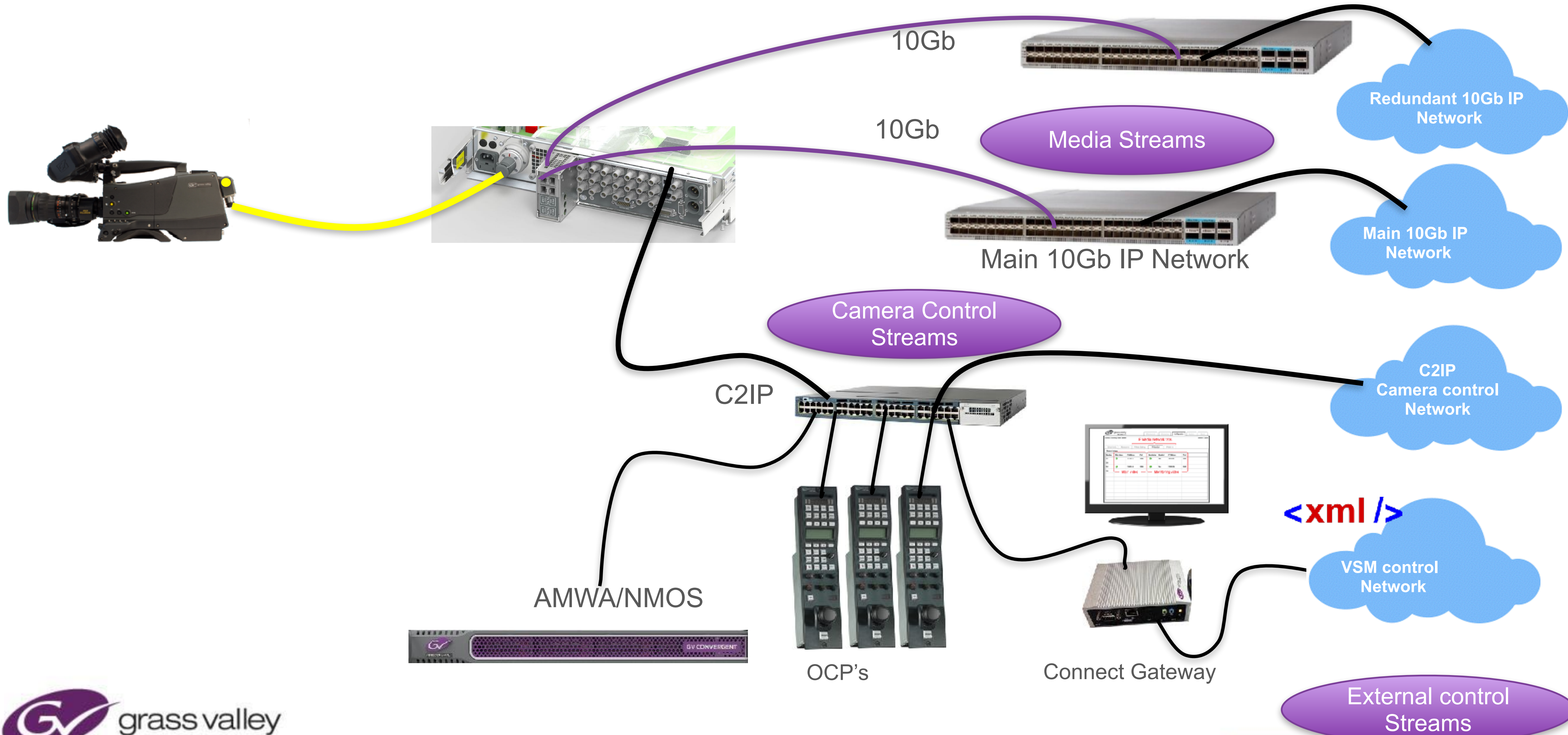
Media Network XCU Menu items (Reference Source)



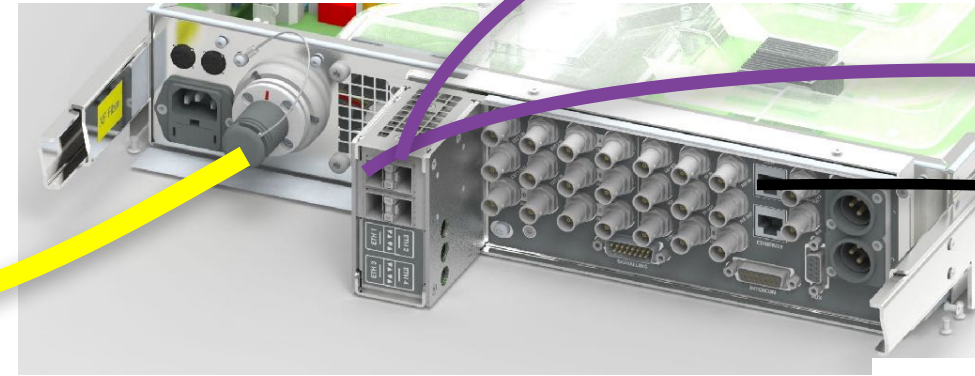
Set-up with Connect gateway

Main 10Gb IP Network

IP



Set-up via Connect gateway



10Gb



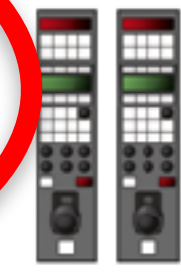
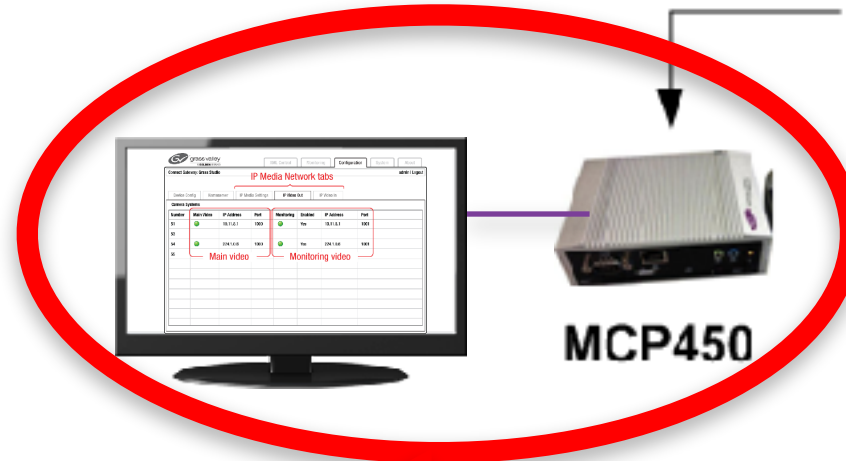
Redundant IP Network

10Gb



Main IP Network

C2IP



OCP's

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Connect Gateway: Grass Studio

admin | Logout

Device Config Nameserver IP Media Settings IP Video Out IP Video In

Camera System Devices

Name	Type	Model	Serial Nr	Alias	DeviceID	Package	Camera
51	Camera Head	LIX 88 W	03380E	MrStage	CamOne	v23.03	CamOne
51	Base Station	XCU IP	034POL	MrStage	XCUOne	v01.05	
51	OCP	OCP 400/10	09FGRF	MrStage	PnOne	v30.00	
52	Camera Head	LIX 88 U	08GYEW	LeftWing	CamTwo	v08.01	
52	Base Station	XCU 4250E	00YUWI	LeftWing	XCUTwo	v10.00	
52	OCP	OCP 400/10	04NEHX	LeftWing	PnTwo	v23.03	
53	Camera Head	LIX 88 W	08VCHU	HandHd	CamThree	v01.03	
53	Base Station	XCU Universe	01PLLS	HandHd	XCUThree	v30.00	
53	OCP	OCP 400	07NEWE	HandHd	PnThree	v31.00	

IP Media Network tabs

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Connect Gateway: Grass Studio

admin | Logout

Device Config Nameserver IP Media Settings IP Video Out IP Video In

Camera Systems

Number	IP Address	Subnet Mask	Default Gateway	Link
51	10.11.5.51	255.255.0.0	10.11.5.1	
53				
54	10.11.5.54	255.255.0.0	10.11.5.1	
55				

IP Media Network tabs

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Connect Gateway: Grass Studio

admin | Logout

Device Config Nameserver IP Media Settings IP Video Out IP Video In

Camera Systems

Number	Ext 1	Port	Multicast	Ext 2	Port	Multicast	TP	Port	Multicast
51		1000	No		1001	No		1002	No
53									
54		1000	No		1001	No		1002	No
55									

External 1

External 2

Teleprompter

IP Media Network tabs

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Connect Gateway: Grass Studio

admin | Logout

Device Config Nameserver IP Media Settings IP Video Out IP Video In

Camera Systems

Number	Main Video	IP Address	Port	Monitoring	Enabled	IP Address	Port
51		10.11.8.1	1000		Yes	10.11.3.1	1001
53							
54		224.1.0.6	1000		Yes	224.1.0.6	1001
55							

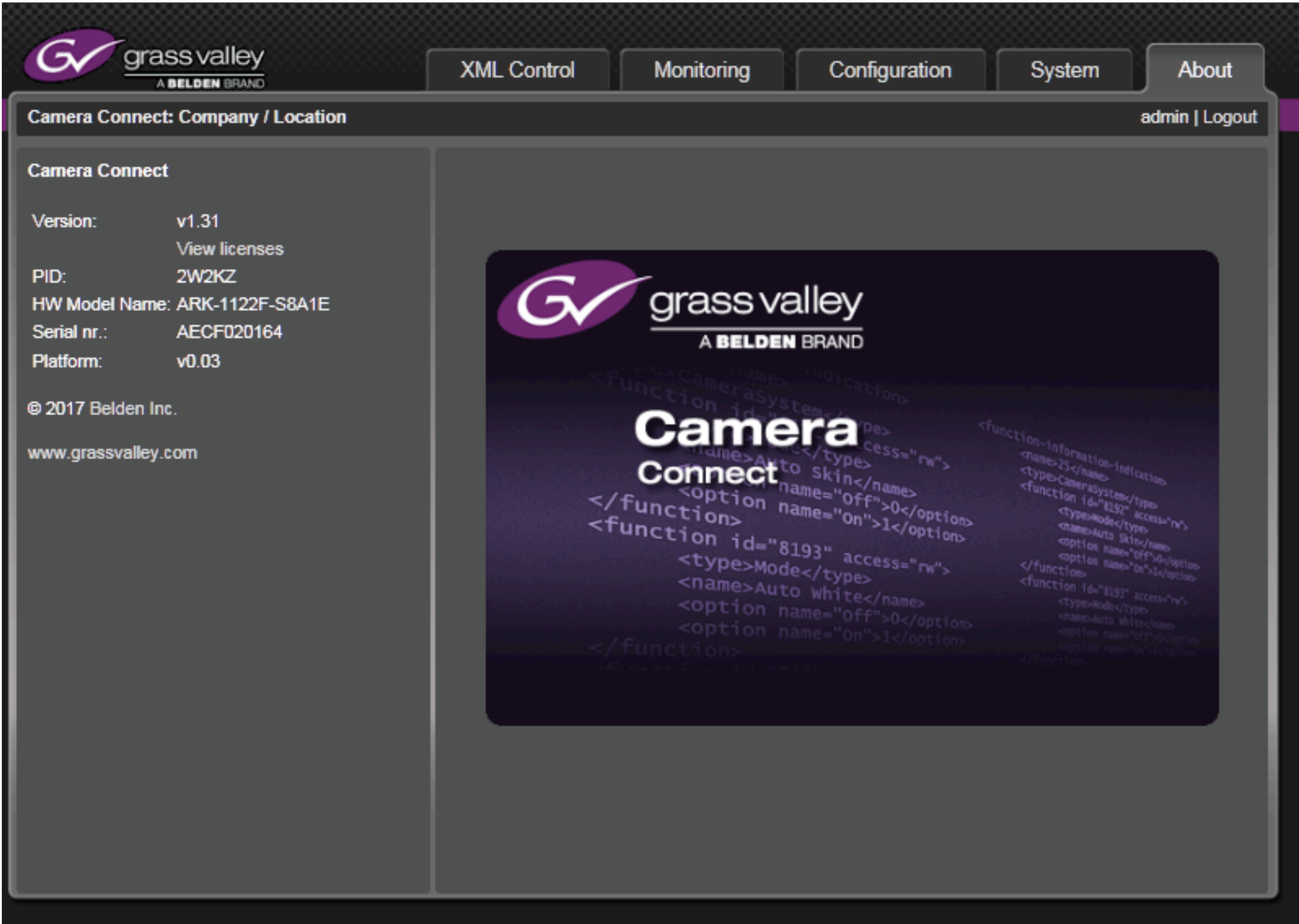
Main video

Monitoring video

<xml />

CAMERA CONNECTED changes

Live session



PTP: Precision Time Protocol

 FUTURE-READY



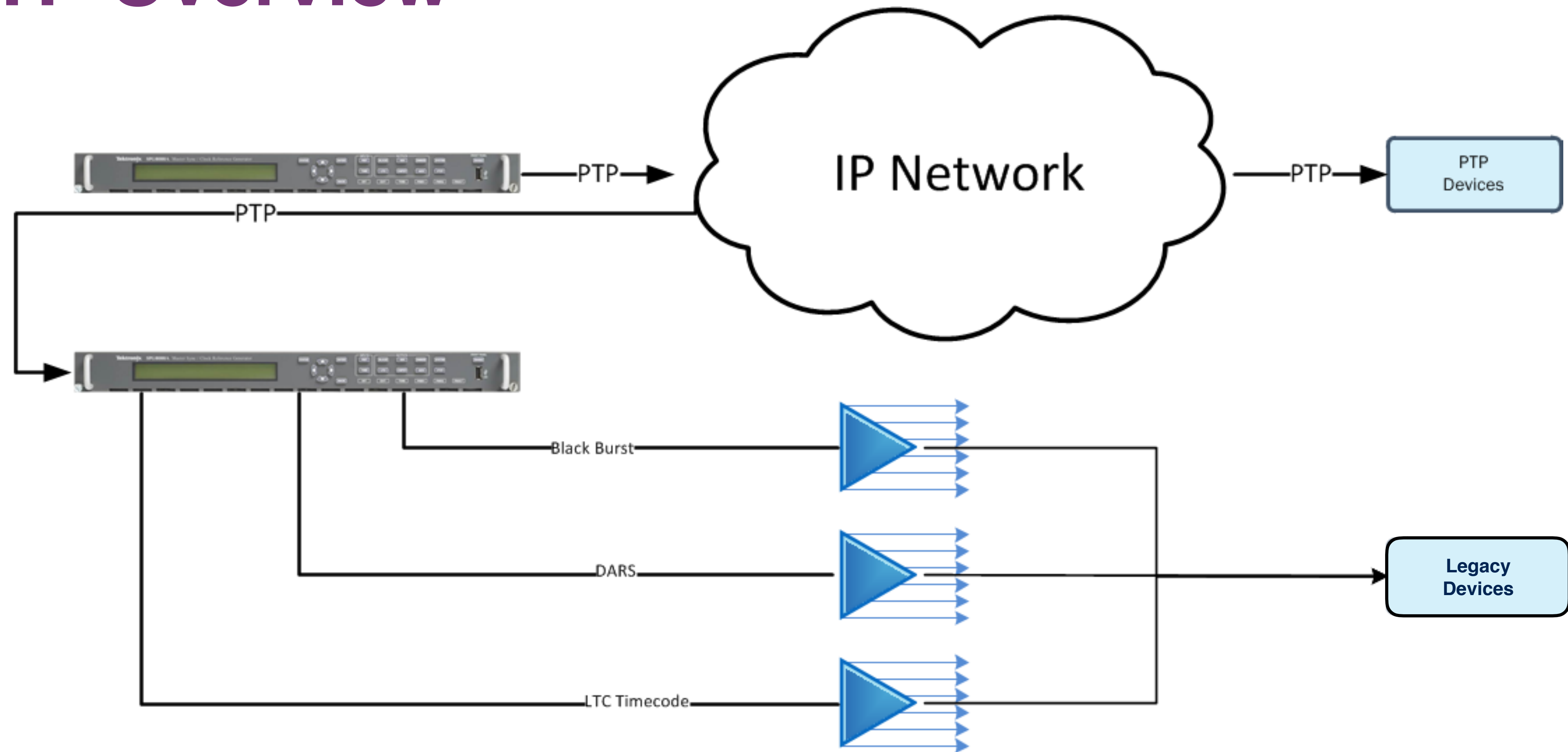
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PTP Overview

- 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.

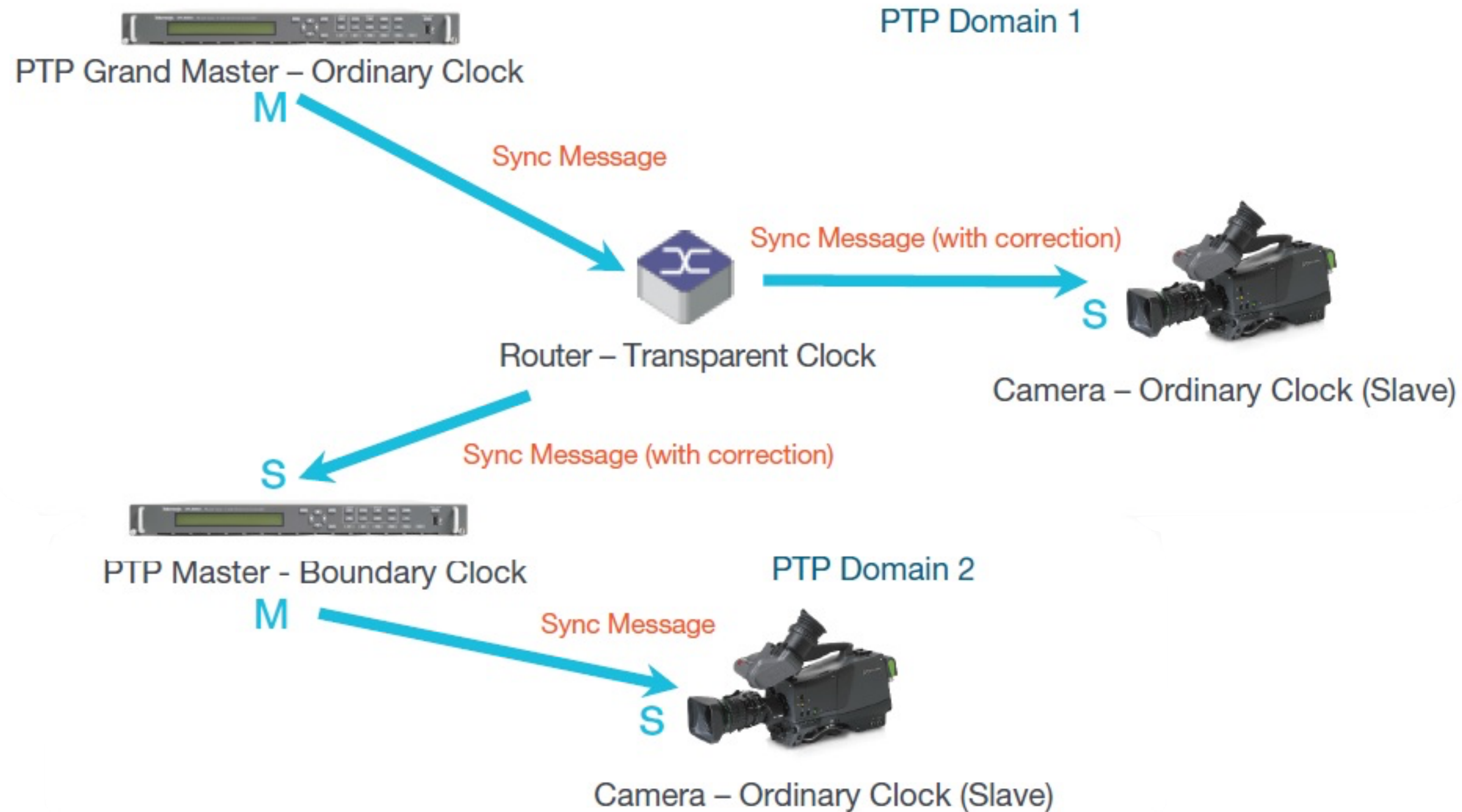
Within a PTP domain, each port of an ordinary or boundary clock follows this process to determine its state:

Examines the contents of all received announce messages (issued by ports in the master state)

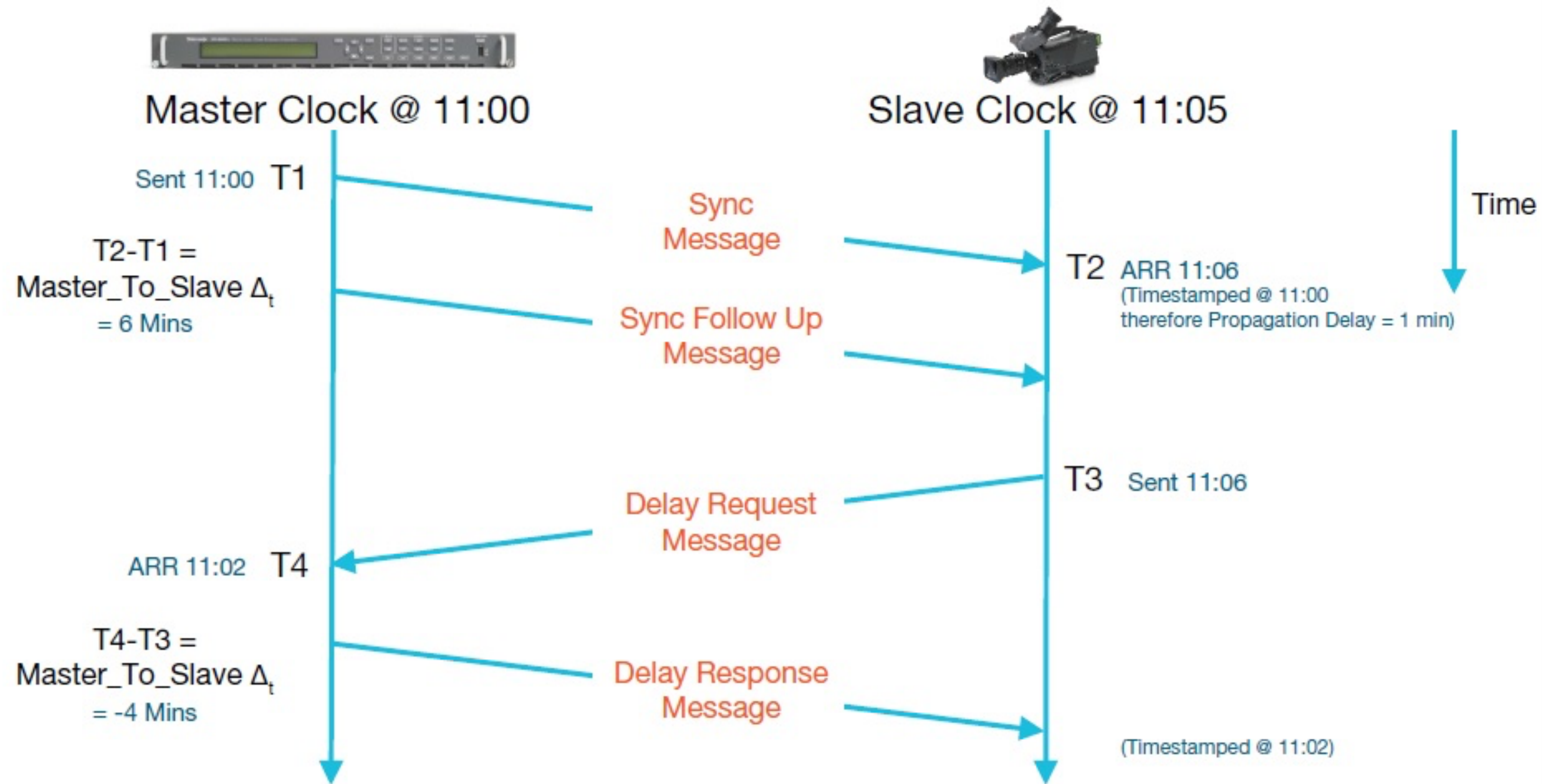
Compares the data sets of the foreign master (in the announce message) and the local clock for priority, clock class, accuracy, and so on

Determines its own state as either master or slave

PTP Process



PTP Process

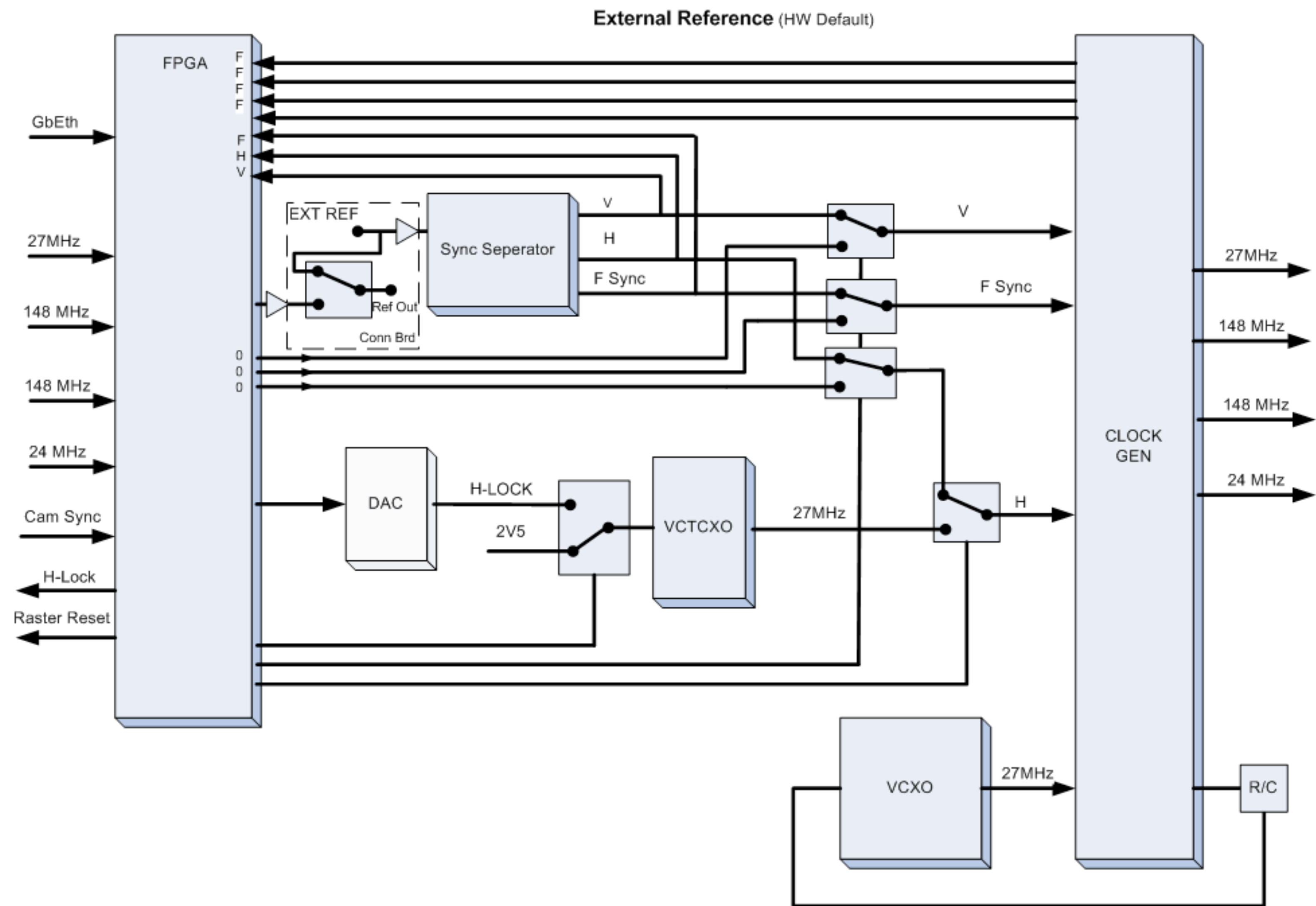


PTP Master-Slave Messages

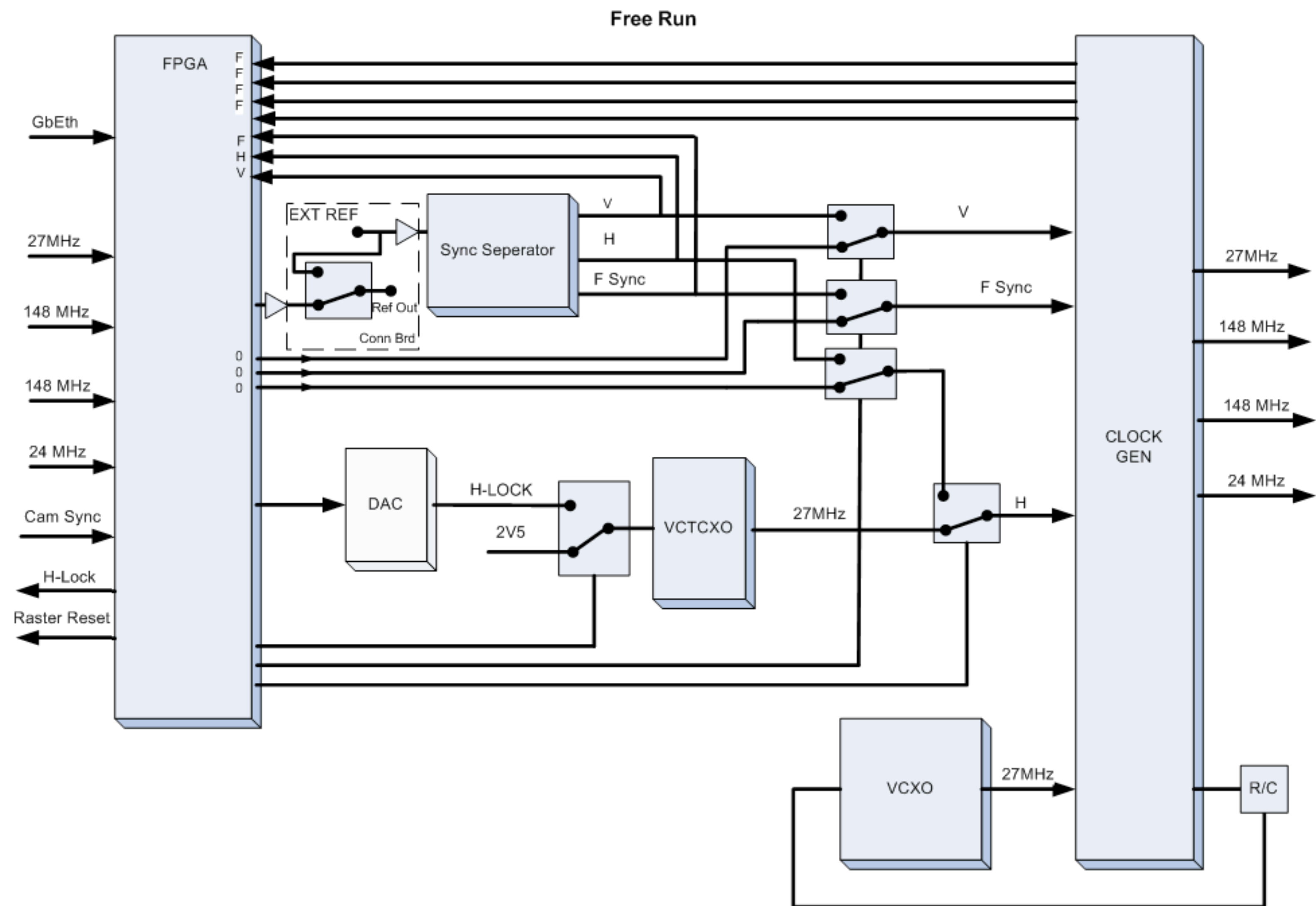
$$\text{Offset} = (\text{Master_To_Slave } \Delta_t - \text{Slave_To_Master } \Delta_t) / 2 = 5 \text{ Mins}$$

$$\text{Oneway Delay} = (\text{Master To Slave } \Delta_t + \text{Slave To Master } \Delta_t) / 2 = 1 \text{ Min}$$

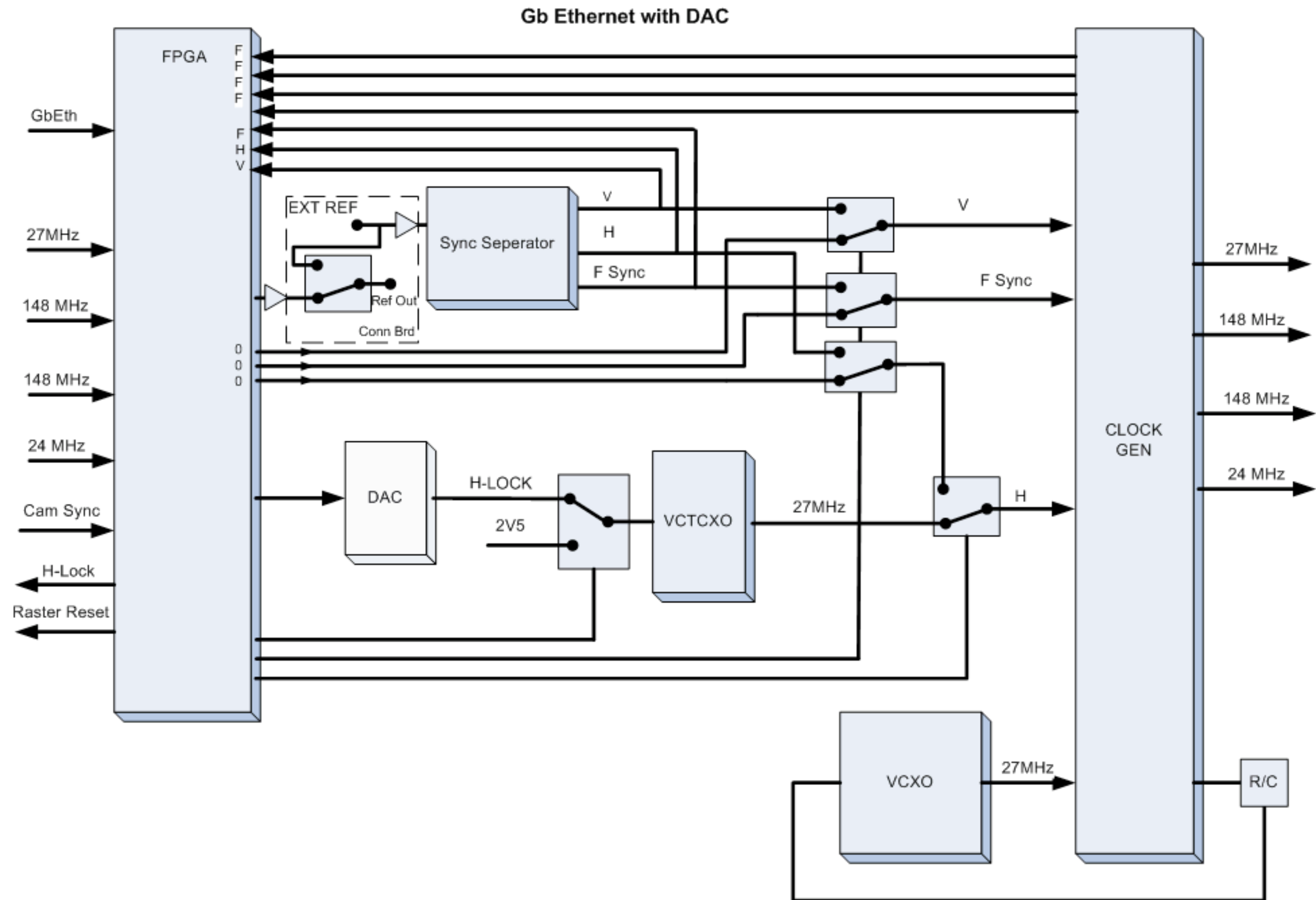
PTP Overview Ext Ref (BB or TL)



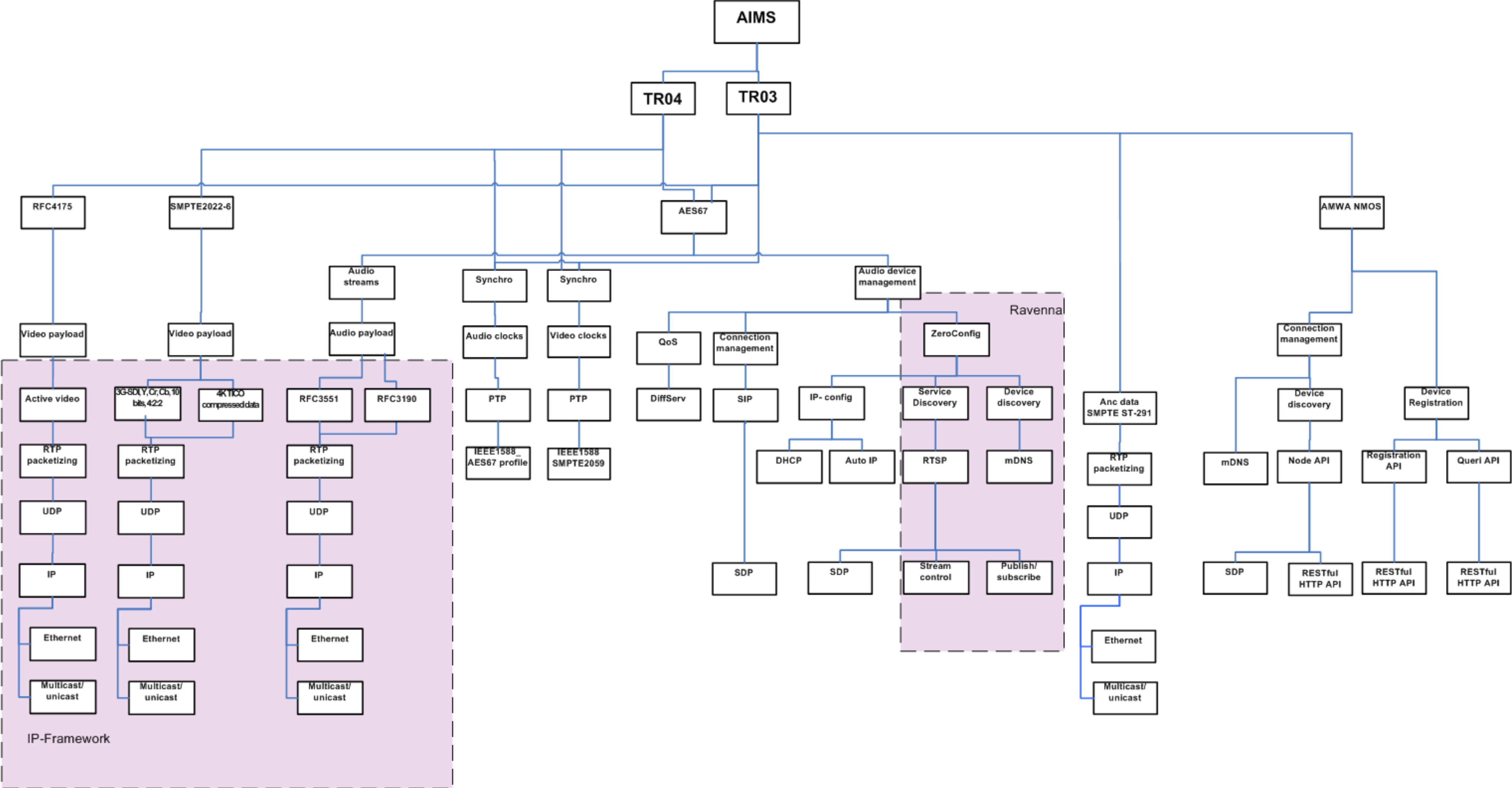
PTP Overview Ext Ref (Free Run)



PTP Overview Ext Ref (PTP)



AIMS IP layer overview



Thanks for your attention.