Camera Training Center
Breda The Netherlands

grass valley
A BELDEN BRAND

LDX 86^{N} Series

Welcome to the era of multi-format

LDX 86^{Native} Service Introduction

August 2016

FUTURE-READY

DPM ULTRA

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**

For questions use: janpaul.campman@grassvalley.com

grass valley
A BELDEN BRAND

LDX 86 series

Service Introduction LDX 86 Native

In this session:

- Introduction LDX 86 Native
- **Technical inside LDX 86 - 86N**
- *Basic Service and Diagnostics (session 7)*
- **Looking inside (Head,Adaptor,XCU)**

LDX 86 series

grass valley
A BELDEN BRAND

LDX 86 now available in 2 flavours

LDX 86 and LDX 86 N

grass valley
A BELDEN BRAND

LDX 86 and LDX 86 N

Available with Licenses as :

- 4K not native
- High Speed 3x or 6x
- XDR
- Standard video modes
- Direct IP

Available with Licenses as :

- 4K NATIVE
- High Speed 3x or 6x
- XDR
- Standard video modes
- Direct IP

grass valley
A BELDEN BRAND

LDX 86 and LDX 86 N

LDX 86

Better pixels

when they make sense

LDX 86^{N}

Native 4K pixel

when resolution count

grass valley
A BELDEN BRAND

LDX 86N Series – *”The Power of Choice”*

NEW

DPM ULTRA

Incredible **flexibility** and **utilization**

Native 4K Imager maximizes capture options

Unmatched real-world, storytelling capability

grass valley
A BELDEN BRAND

LDX 86^{N} Series – High-level overview

- Introduced at NAB 2016 – First Commercial Shipment July ’16

- New Xensium^{HAWK} imager with DPM^{Ultra}
  Based on Xensium^{FT} with 2.5µ image cell
- Improved optical alignment accuracy
  Making an important step forward in a key process
- Additional 5µ optical low-pass filter
  Delivering sublime HD when in HD modes
- Improved soft-focus filter
  Matching the HD/4K characteristics and requirements

grass valley
A BELDEN BRAND

LDX 86^{N} Series – High-Level Overview

- **Same ultra-high sensitivity and Global shutter in HD as the LDX 86 Series**
  A big plus
- **Same GV-eLicenses as for LDX 86 Series**
  Exact same typenumbers, same prices.
  This supports the multi-format era message as we stimulate 5µ and 2.5µ usage in the same productions
- **Same XF Transmission adapter**
  Exact same mode, typenumber, hardware.
  TICO compression is done in the head for native 4K transmission
- **Optimized viewfinder processing**
  Making sure the images are in-focus is key to the success of 4K

grass valley
A BELDEN BRAND

LDX 80 / 86 / 86N Optimized solutions for all challenges

Your Challenges — Your Solution

Requirement	Importance			Solution				
	HD/3G 2K only Triax / Fiber	4K Close-up 2K or 4K (XCU) 10G Fiber	4K Wide 2K/4K Native 10G fiber	LDX 80 Series in HD/3G	LDX 86 Series in HD/3G	LDX 86 Series in 4K	LDX 86^{N} Series in HD/3G	LDX 86^{N} Series in 4K
CMOS Imaging Technology				YES	YES	YES	YES	YES
Full Digital Imagers				YES	YES	YES	YES	YES
High Dynamic Range				YES	YES	YES	YES	YES
Global Shutter				YES	YES	YES	YES	NO
Highest Sensitivity in All Formats				YES	YES	YES	YES	NO
Native Acquisition				YES	YES	NO	YES	YES
Highest Resolution Possible				YES	YES	NO	YES	YES

LDX 80 Series the ultimate HD/3G camera system

LDX 86 Series for highest sensitivity and flexibility

LDX 86^{N} Series when resolution counts most

grass valley
A BELDEN BRAND

LDX 80 / 86 / 86N Optimized solutions for all challenges

Your Challenges — Your Solution

Requirement	Importance			Solution				
	HD/3G 2K only Triax / Fiber	4K Close-up 2K or 4K (XCU) 10G Fiber	4K Wide 2K/4K Native 10G fiber	LDX 80 Series in HD/3G	LDX 86 Series in HD/3G	LDX 86 Series in 4K	LDX 86^{N} Series in HD/3G	LDX 86^{N} Series in 4K
CMOS Imaging Technology				YES	YES	YES	YES	YES
Full Digital Imagers				YES	YES	YES	YES	YES
High Dynamic Range				YES	YES	YES	YES	YES
Global Shutter				YES	YES	YES	YES	NO
Highest Sensitivity in All Formats				YES	YES	YES	YES	NO
Native Acquisition				YES	YES	NO	YES	YES
Highest Resolution Possible				YES	YES	NO	YES	YES

LDX 80 Series the ultimate HD/3G camera system

LDX 86 Series for highest sensitivity and flexibility

LDX 86^{N} Series when resolution counts most

grass valley
A BELDEN BRAND

LDX 86 N

In-house developed imagers and optical alignment

Existing XF Transmission adapter

NEW
LDX 86^{N} Series heads

XDR, WideGamut, ...

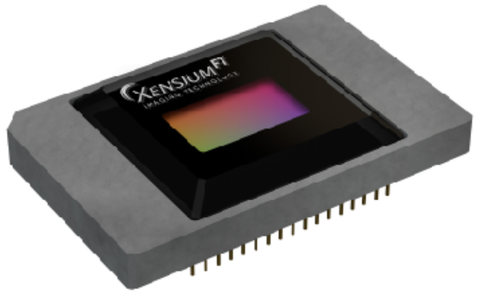
Existing XCU XF Fiber

Supporting 26 video-modes
1080i50/59.94/150/179.82/300/359.64
720p50/59.94/150/179.82/300/359.64
1080p50/59.94/150/179.82
1080psF23.98/24/25/29.97
3840x2160p23.98/24/25/29.97/50/59.94

grass valley
A BELDEN BRAND

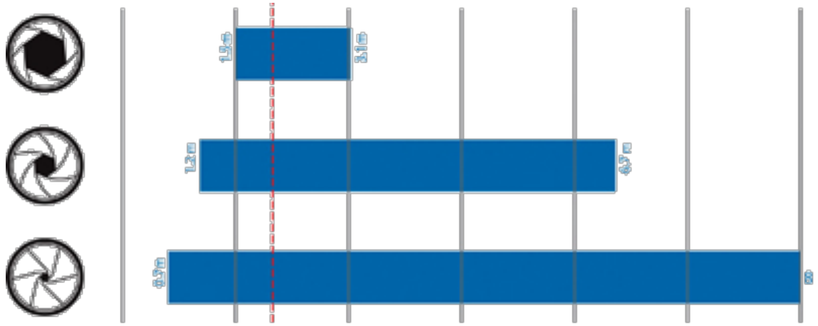
LDX 86 - Imaging with highest possible sensitivity

Xensium FT Imagers with large **5µm x 5µm** pixel for highest sensitivity and dynamic range in all formats



FT CMOS imagers with 5T pixels for global shutter operation avoiding rolling shutter artifacts

High sensitivity allows operating the lens in the best possible range and getting a large depth of field under all conditions



LDX 86^{N} - Imaging with highest possible resolution

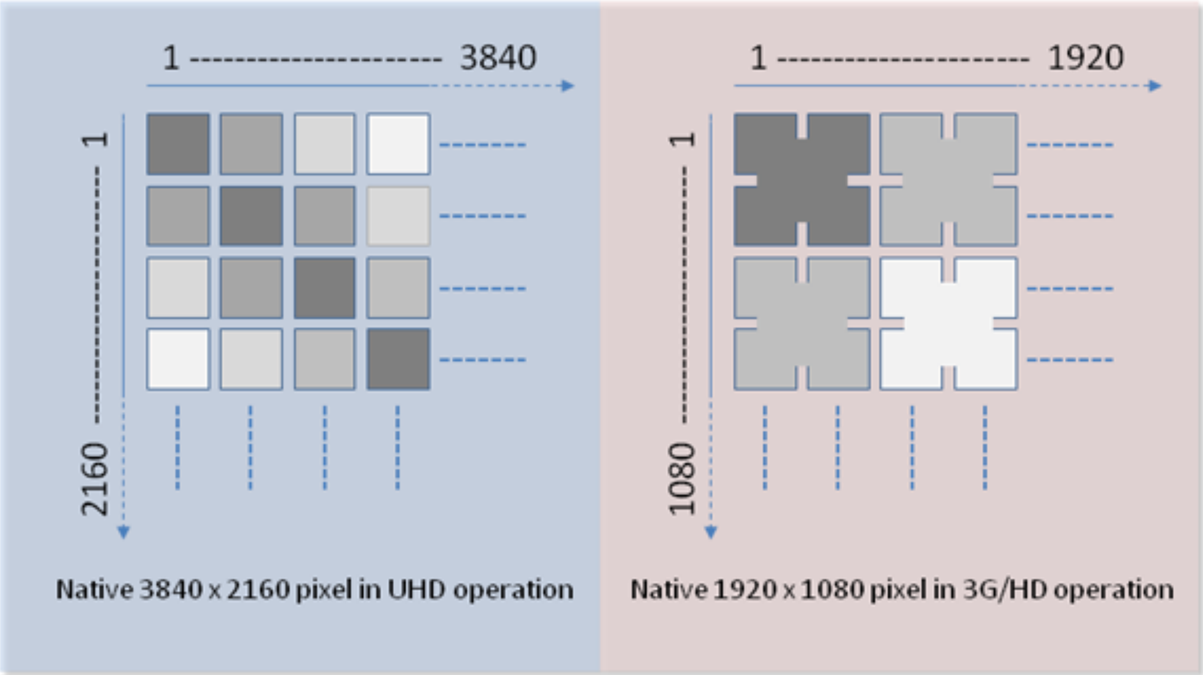
Xensium^{HAWK} Imagers with native UHD pixel (3840 x 2160) with **2.5µm x 2.5µm** for highest possible resolution

DPM^{Ultra} allow to combine inside the imager four UHD pixels into full performance 3G/HD pixels

Highest resolution in all UHD formats for all the demanding wide angle shots with many small details

DPM^{Ultra}

A unique solution for native pixel performance in UHD and in 3G/HD

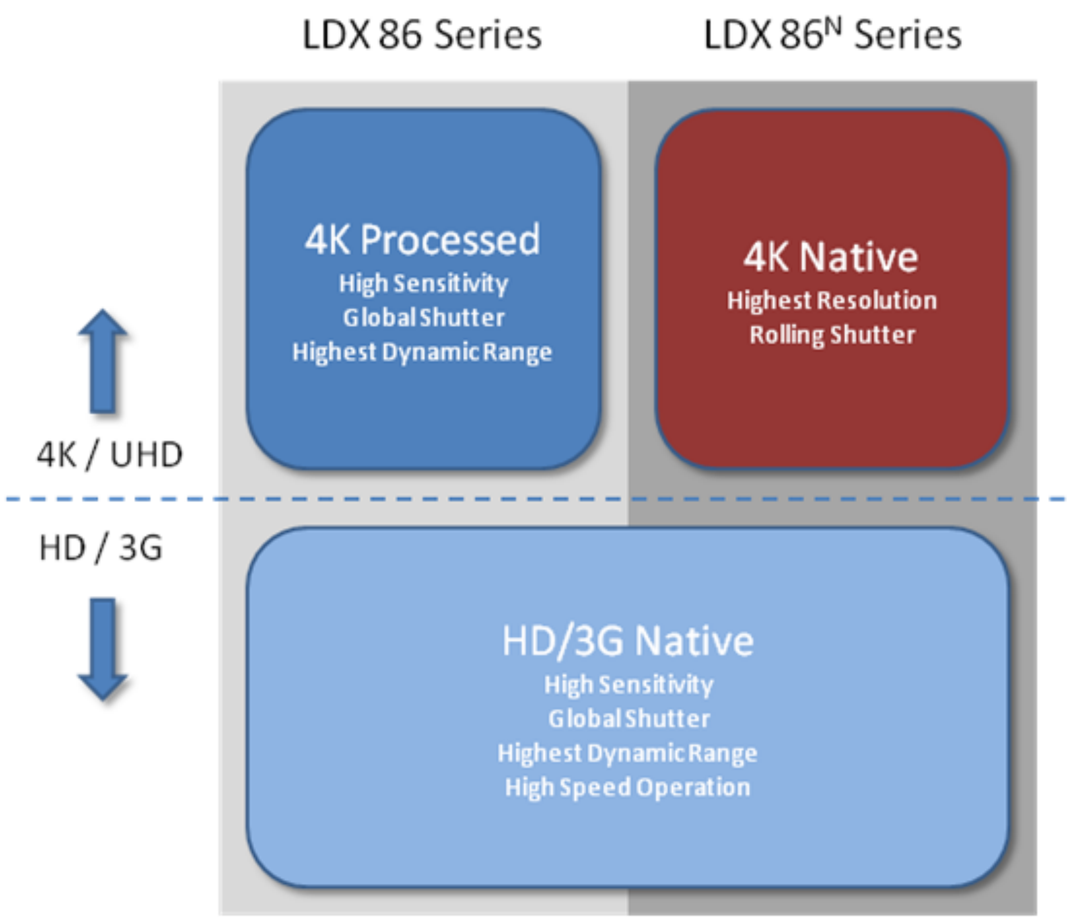


LDX 86 / 86^{N} – Best performance in all applications

LDX 86 with large **5µm x 5µm** pixel for highest sensitivity, global shutter and highest dynamic range in all formats

LDX 86^{N} with native **2.5µm x 2.5µm** pixel for highest resolution in all UHD formats and full performance in all 3G/HD formats

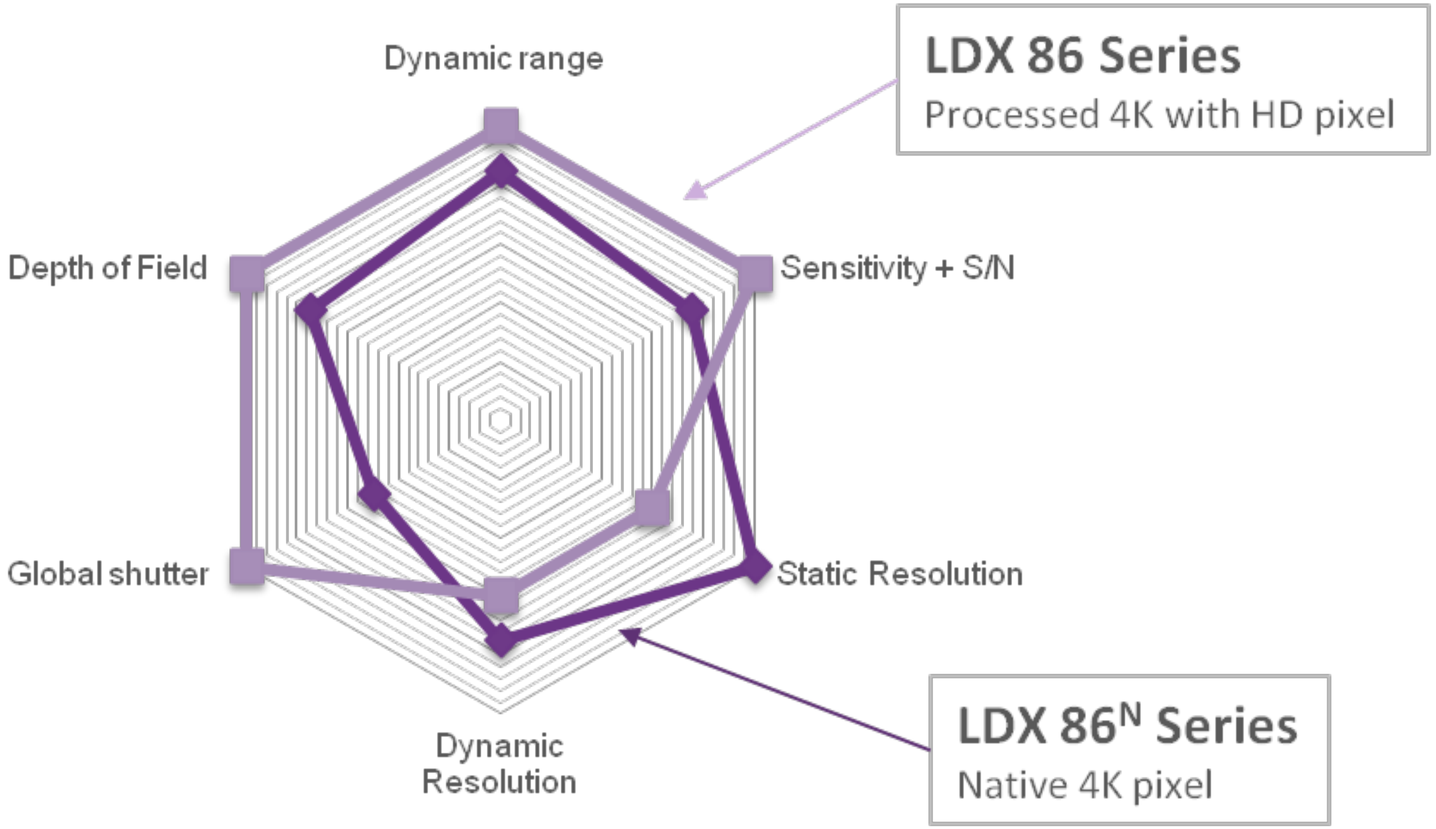
For UHD operation choose highest sensitivity or highest resolution depending on the requirements but no need for any compromise in any 3G/HD applications



Strength comparison - Native 4K versus Processed 4K

Use the technology which fit best to the specific requirements

- For wide angle shooting position typically resolution is most important
  - To see all the small details in the image
- For telephoto shots over large distance typically Sensitivity is of highest importance
  - Being able to reach a large depth of field



LDX86 family

The 86 family is extended with new with new functionality, resulting in new system parts. These are (in addition to LDX86HS and LDX86XS):

- **LDX86 Worldcam** **(0086 305 00000)**: single speed video modes only.
- **LDX86 4K** **(0086 322 00000)**: additional 4K video modes
- **LDX86 Universe** **(0086 326 00000)**: all video modes including HS and XS
- **XF Universe adapter** **(0031 226 00200)**: all video modes
- **XCU Universe XF** **(0031 126 00200)**: all video modes.

- The hardware is identical to the existing LDX86 hardware (camera + adapter + XCU)
- Licenses are available to upgrade the cameras to a higher level (see next slide).
- With an XDR e-license installed the system can deliver XDR signals in all video modes.
- Color space can be switched between REC709 and BT2020 (wide gamut)

LDX86N family

The LDX86N family is based on the 4K native sensor and is available in the following configurations:

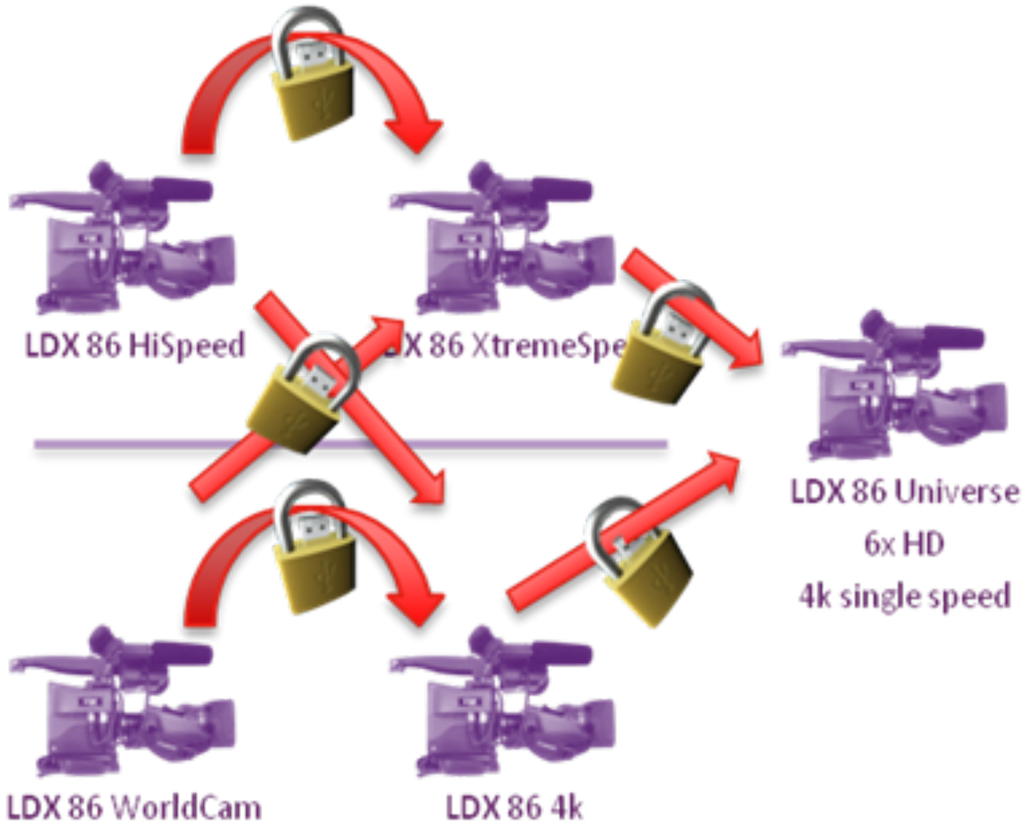
- **LDX86N Worldcam** **(1-0108601-0000)**: single speed video modes only.
- **LDX86N HS** **(1-0108603-0000)**
- **LDX86N XS** **(1-0108606-0000)**
- **LDX86N 4K** **(1-0108604-0000)**: additional 4K video modes
- **LDX86N Universe** **(1-0108608-0000)**: all video modes including HS and XS

The cameras operate in combination with:

- **XF Universe adapter** **(0031 226 00200)**: all video modes
- **XCU Universe XF** **(0031 126 00200)**: all video modes.

- The hardware of the LDX86N is derived from the existing LDX86 hardware (with a **new RPBoard** based on the current design).
- Licenses are available to upgrade the cameras (the same licenses as used for the LDX86).
- With an XDR e-license installed the system can deliver XDR signals in all single speed video modes.
- Color space can be switched between REC709 and BT2020 (wide gamut)

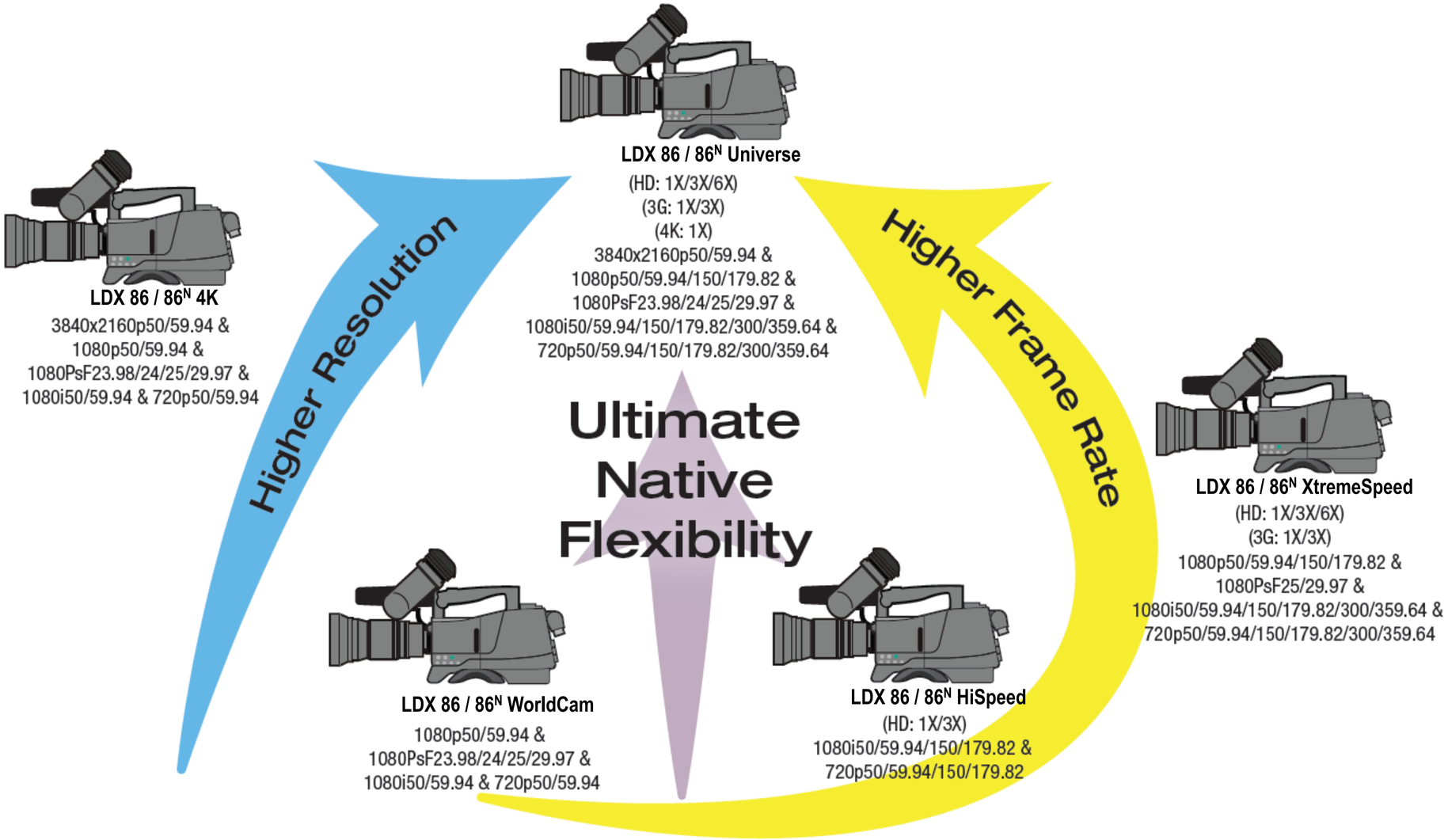
Upgrade posibilities with e-licenses (LDX86 and LDX86N)



8926 156 62001:	XtremeSpeed elicense for HiSpeed - perpetual
8926 156 61001:	XtremeSpeed elicense for HiSpeed - 7 days
0086 922 00009:	4K elicense for 86 WorldCam - Perpetual
0086 925 00009	4K elicense for 86 HiSpeed - Perpetual
0086 926 00009:	Universe elicense for 86 XS - Perpetual
0086 926 00019:	Universe elicense for 86 4K - Perpetual
0086 961 00009:	XS elicense for 86 WorldCam - Perpetual
0086 922 00001:	4K elicense for 86 Worldcam - 7 days
0086 925 00001	4K elicense for 86 HiSpeed - 7 days
0086 926 00001:	Universe elicense for 86 XS - 7 days
0086 926 00011:	Universe elicense for 86 4K - 7 days
0086 961 00001:	XtremeSpeed elicense for 86 WorldCam - 7 days
9-000000000101;	XDR elicense LDX86 series -7 days
9-0000000001-9:	XDR [illegible]se LDX 86 series -Perpetual

grass valley
A BELDEN BRAND

LDX 86 / 86^{N} Series – Offers Ultimate Flexibility



grass valley
A BELDEN BRAND

XCU Series – versions (Univers is needed in combination with LDX86n)

XCU ELITE
XCU4280

Upgrade set available

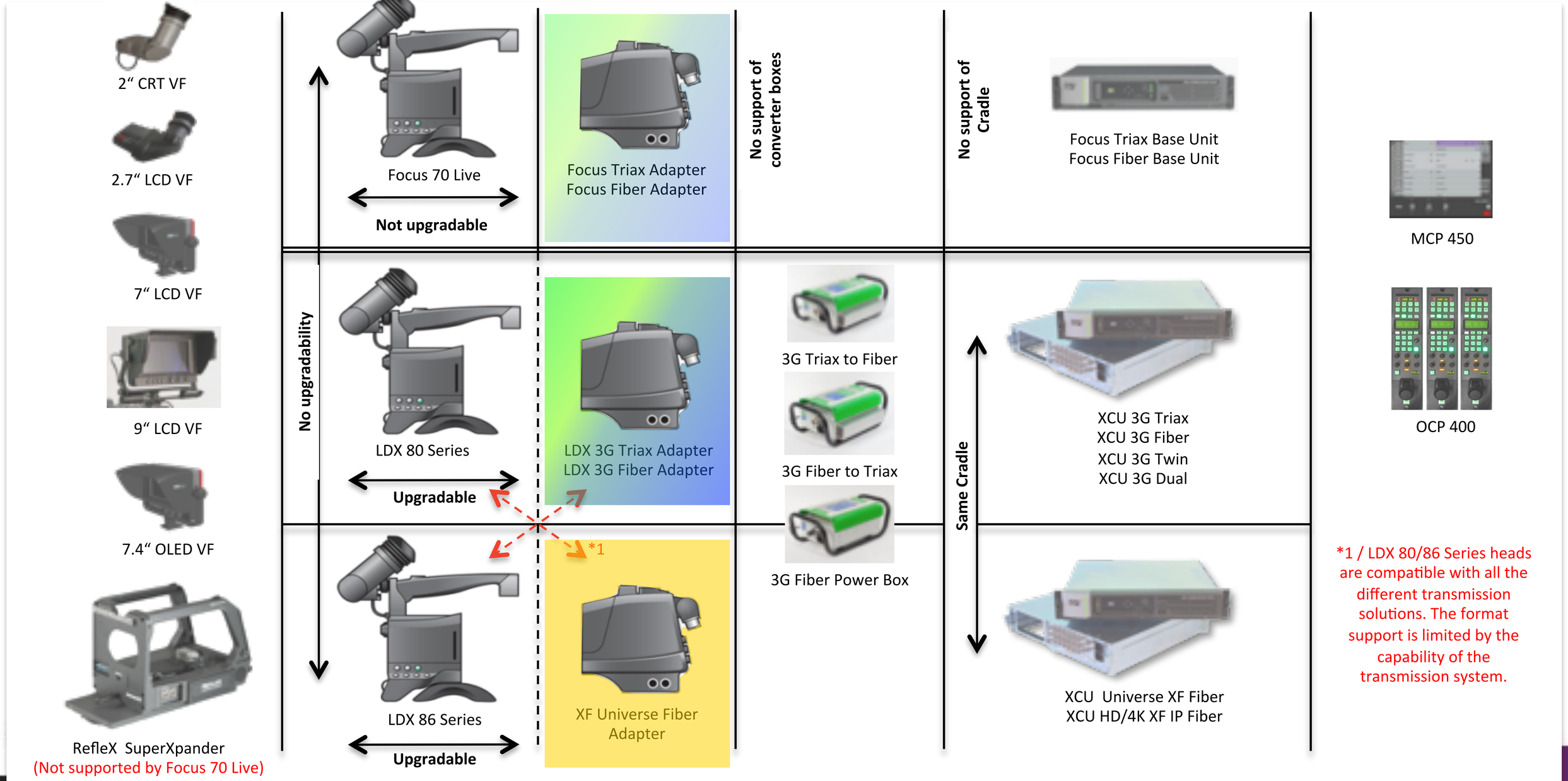
e-Licence needed for
- XS
- 4K
- IP

XCU UNIVERS XF

hardware change (slide 37/38)
(SFP+ cable routing)

XCU HD/4K XF IP

LDXseries GrassValley (Compatibility)



Supported video modes

- The video modes mentioned in the table below are available only in combination with the XF Universe adapter (or LDX5660) and the XCU Universe XF.
- In other combinations the video modes might be limited.

Videomodes	LDX86(n) WorldCam	LDX86HS	LDX86XS	LDX86(n) 4K	LDX86(n) Universe
1080i50,59	X	X	X	X	X
720P50,59	X	X	X	X	X
1080P50,59	X	X	X	X	X
1080PsF23,24,25,29	X	X	X	X	X
1080i150,179		X	X		X
720P150,179		X	X		X
1080P150,179			X		X
1080i300,359			X		X
720P300,359			X		X
4K50,59				X	X
4K23,24,25,29	(X) *			(X) *	(X) *

(x) * not yet implemented

grass valley
A BELDEN BRAND

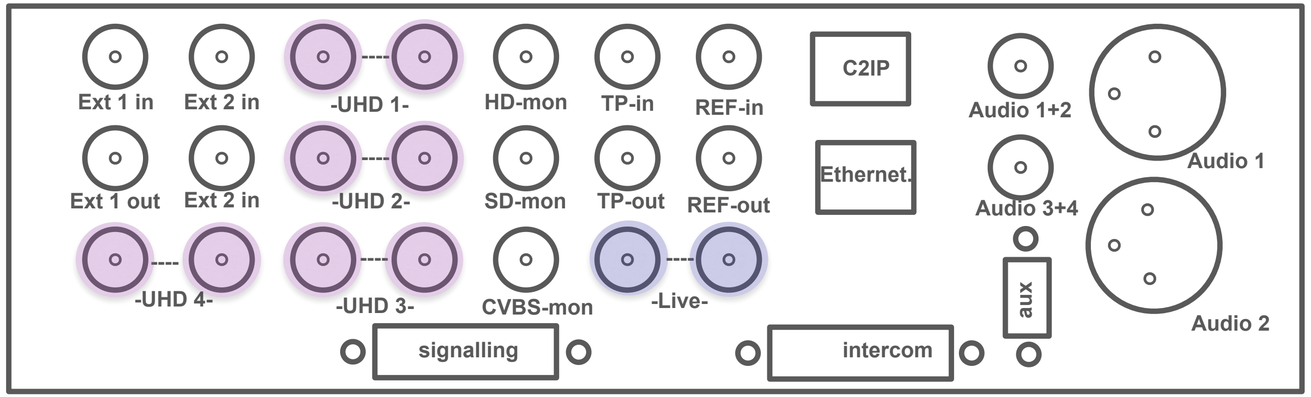
4K video modes for **LDX86**

XCU Univers connections

4K video mode (3840 samples x 2160 lines):

- The acquisition of the camera in **4K video mode is 1080P50/59.94.**
- The transmission from camera to XCU is 1080P in 4:4:4 (YCbCr: 4:2:2 + 0:2:2).
- The **1080P** signals are **up-converted in the XCU** (TX-board).
- The 4K signals are available as 4 x 3Gb/sec outputs at the XCU (UHD1..UHD4: see figure below).
- Output modes are 4 quadrants or 2-sample interleaved (2SI) as explained in the next sheets.
- Separate detail controls are available for 4K signals (in the XCU) and HD-signals.
- The HD-Live signal is available at the former SD-SDI output (no SD-SDI live signal available).

Note: **The text in het figure is not the text on the XCU.**



grass valley
A BELDEN BRAND

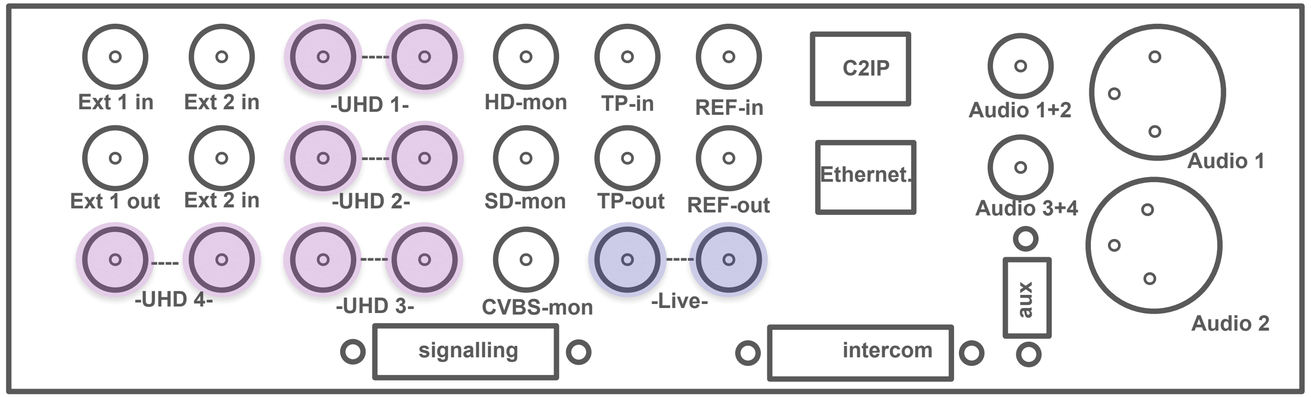
4K video modes for **LDX86N**

XCU Univers connections

4K video mode (3840 samples x 2160 lines):

- With the new **native 4K sensor**, the output of the camerahead has **4K resolution**.
- The signal is **TICO compressed (3Gb/sec)** and is sent to the XCU over the **Main2 channel**.
- A **down converted 1080P** signal is sent to the XCU as the **Main1 signal**.
- The 4K signals are available as 4 x 3Gb/sec outputs at the XCU (UHD1..UHD4: see figure below).
- Output modes are 4 quadrants or 2-sample interleaved (2SI) as explained in the next sheets.
- Separate detail controls are available for 4K signals and HD-signals.
- The HD-Live signal is available at the former SD-SDI output (no SD-SDI live signal available).

Note: **The text in het figure is not the text on the XCU**.

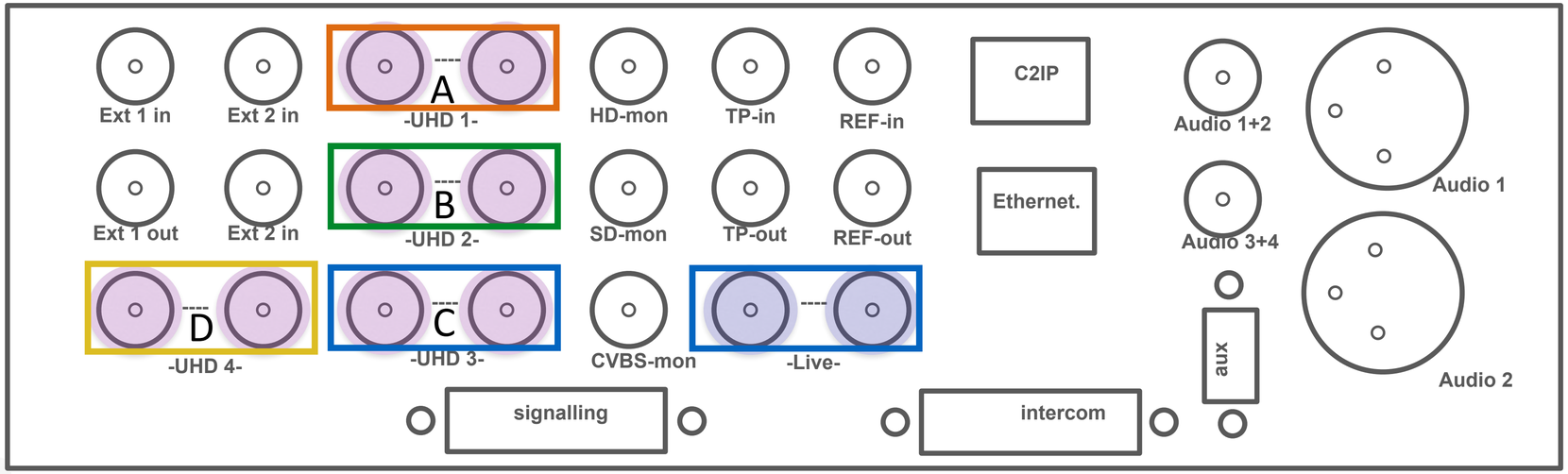


grass valley
A BELDEN BRAND

LDX86 series HD/SDR/4K/HS/XS

XCU Univers connections

XCU Outputs

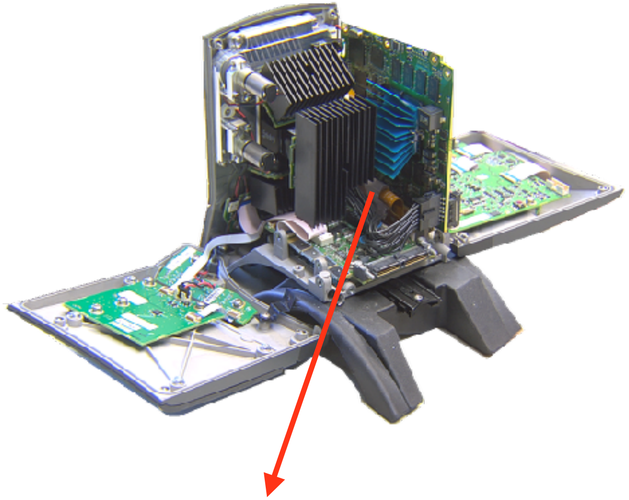


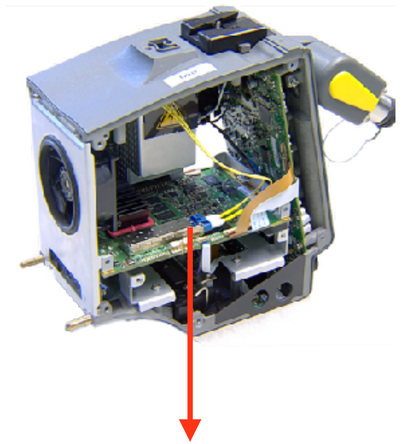
Video Format	Output A	Output B	Output C	Output D	Live-out	Monitoring
720P50/59	1,5Gb/s)	1,5Gb/s)	1,5Gb/s)	1,5 Gb/s)	SD (270Mbit/s)	Live (1.5Gbit/s)
1080i50/59	1,5Gb/s)	1,5Gb/s)	1,5Gb/s)	1,5 Gb/s)	SD (270Mbit/s)	Live (1.5Gbit/s)
1080P50/59	3 Gb/s)	3 Gb/s)	3 Gb/s)	1,5 Gb/s)	SD (270Mbit/s)	Live (1.5Gbit/s)
1080P150/179	Phase 1 (3Gb/s)	Phase 2 (3Gb/s)	Phase 3 (3Gb/s)	Combined (3Gb/s)	Live (3Gbit/s)	Live (1.5Gbit/s)
1080I150/179	Phase 1 (1.5Gb/s)	Phase 2 (1.5Gb/s)	Phase 3 (1.5Gb/s)	Combined (1.5Gb/s)	Live (1.5Gbit/s)	Live (1.5Gbit/s)
1080I300/359	Phase 1+2 (3Gb/	Phase 3+4 (3Gb/s)	Phase 5+6 (3Gb/s)	Combined (1,5Gb/s)	Live (1.5 Gbit/s)	Live (1.5Gbit/s)
720P150/179	Phase 1 (1.5Gb/s)	Phase 2 (1.5Gb/s)	Phase 3 (1.5Gb/s)	Combined (1.5Gb/s)	Live (1.5Gbit/s)	Live (1.5Gbit/s)
720P300/359	Phase 1+2 (3Gb/	Phase 3+4 (3Gb/s)	Phase 5+6 (1,5Gb/	Combined (3Gb/s)	Live (1.5 Gbit/s)	Live (1.5Gbit/s)
4K 50/59 (2SI or 4Q)	Q1 (3Gb/s)	Q2 (3Gb/s)	Q3 (3Gb/s)	Q4 (3Gb/s)	Live (3Gbit/s)	Live (1.5Gbit/s)
XDR	XDR	XDR	XDR	XDR	XDR or SDR	SDR (1.5Gbit/s)

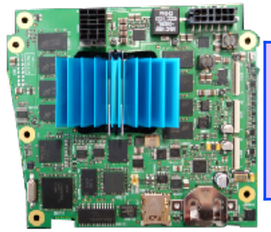
grass valley
A BELDEN BRAND

From Sensor to Output (example for 1080i)

Next slide for all other modes



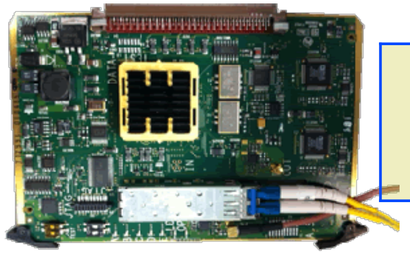




Right Proc. board

HDSDI Head to Adaptor

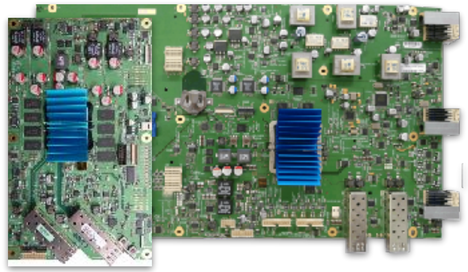
Main 1
Main 2
Main 3
VF OUT



Transmission board

IP over 10G fiber

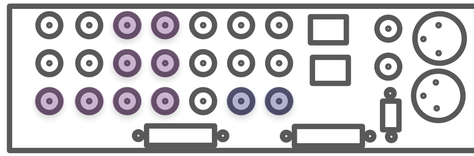
Main 1
Main 2
Main 3



Transmission board
Generic board

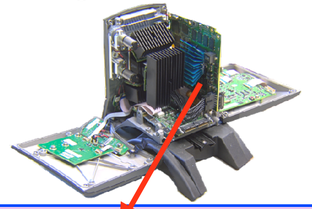
HDSDI XCU to OUTPUT BNC

A HD OUT 2K
B HD OUT 2K
C HD OUT 2K
D HD OUT 2K (live)

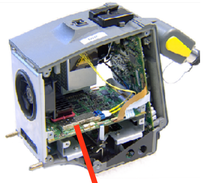


From Sensor to Output

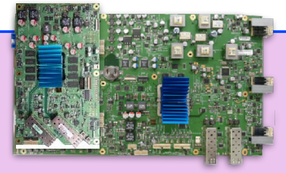
Right Proc. board



Transmission board

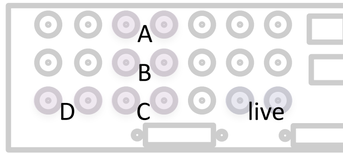


Transmission board
Generic board



			Main 1 => Main 2 => Main 3 => VF OUT	>>>			
SDR	**2K**	**LDX 86 / 86N**	Main 1 4:2:2 (2K) Main 2 4:2:2 (2K) Main 3 n.a. VF 4:2:2 (2K)	>>>	Main 1 \ Main 2 / *Main 3*	10G Hybrid	A HD OUT 2K B HD OUT 2K C HD OUT 2K D HD OUT 2K (live)
SDR	**4K**	**LDX 86**	Main 1 4:2:2 (2K) Main 2 0:2:2 (2K) Main 3 n.a. VF 4:2:2 (2K)	>>>	Main 1 \ Main 2 / *Main 3*	10G Hybrid	A HD OUT 2K **(Q1)** B HD OUT 2K **(Q2)** C HD OUT 2K **(Q3)** D HD OUT 2K **(Q4)** (live)
SDR	**4K**	**LDX 86N**	Main 1 4:2:2 (2K) Main 2 TICO (4K) Main 3 n.a. VF 4:2:2 (2K)	>>>	Main 1 \ Main 2 / *Main 3*	10G Hybrid	A HD OUT 2K **(Q1)** B HD OUT 2K **(Q2)** C HD OUT 2K **(Q3)** D HD OUT 2K **(Q4)** (live)
XDR	**2K**	**LDX 86 / 86N**	Main 1 4:2:2 SDR (2K) Main 2 4:2:2 XDR (2K) Main 3 4:2:2 XDR (2K) VF 4:2:2 (2K)	>>>	Main 1 \ Main 2+3 /	10G Hybrid	A HD OUT 2K (XDR) B HD OUT 2K (XDR) C HD OUT 2K (XDR) D HD OUT 2K (SDR) (live)
XDR	**4K**	**LDX 86**	Main 1 4:2:2 SDR (2K) Main 2 0:2:2 XDR (2K) Main 3 4:2:2 XDR (2K) VF 4:2:2 (2K)	>>>	Main 1 \ Main 2 > Main 3 /	10G Hybrid	A HD OUT 2K **(Q1)** B HD OUT 2K **(Q2)** C HD OUT 2K **(Q3)** D HD OUT 2K **(Q4)** (live)
XDR	**4K**	**LDX 86N**	Main 1 4:2:2 SDR (2K) Main 2 TICO XDR (4K) Main 3 n.a. VF 4:2:2 (2K)	>>>	Main 1 \ Main 2 / *Main 3*	10G Hybrid	A HD OUT 2K **(Q1)** B HD OUT 2K **(Q2)** C HD OUT 2K **(Q3)** D HD OUT 2K **(Q4)** (live)

For IP XCU 4K over TICO



Firmware implementation

- As the firmware for all these functions does not fit in the FPGA,
  several FW-images in camera and XCU are used which are automatically selected by the control software.
- The packages for camera and XCU will update these images if necessary.

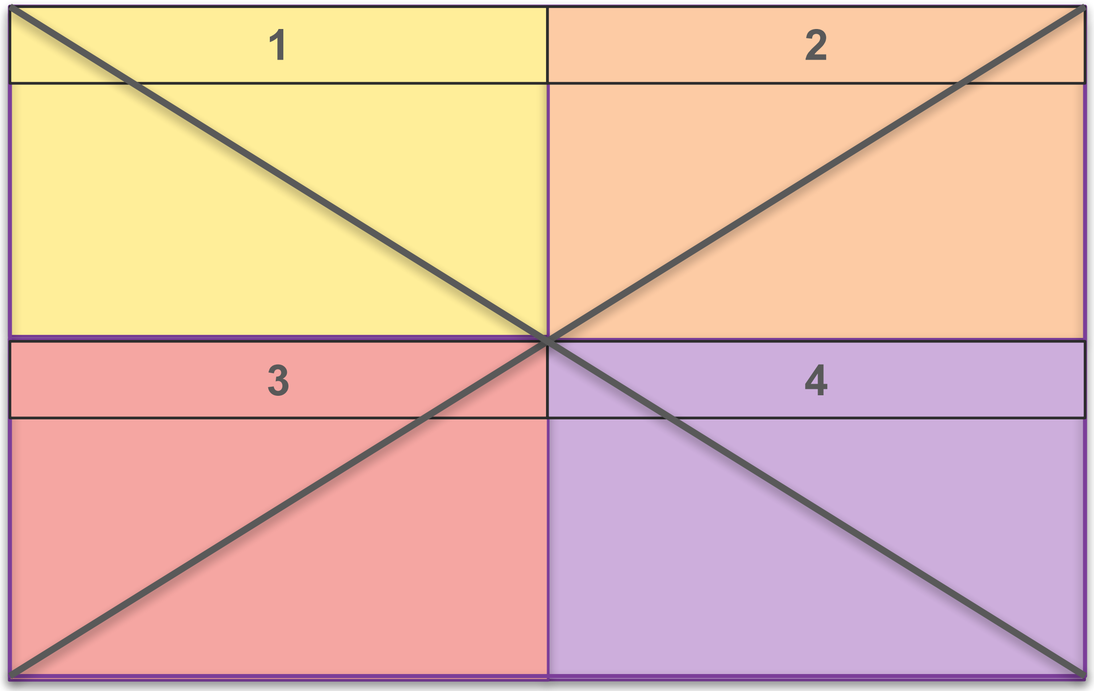
Video mode	Camera image	XCU image (TX + Gen brd).
HS speed modes (3x and 6x)	1a	1
Single speed modes incl. XDR	2a	1
4K video modes (incl XDR, LDX86)	2a	2
4K video modes (SDR, LDX86N)	3a	2
4K video modes (XDR, LDX86N)	3b	2

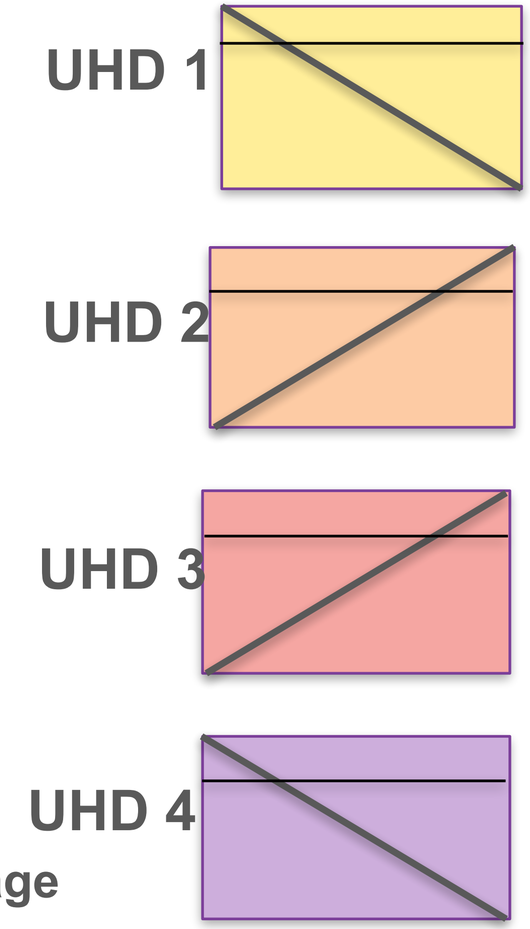
Note: when switching to or from a 4K video mode the transmission and data communication between camera and XCU will be lost for a while, due to a reset of the transmission firmware.

4 quadrants:

4x 1920 x 1080 samples

3840 x 2160 samples

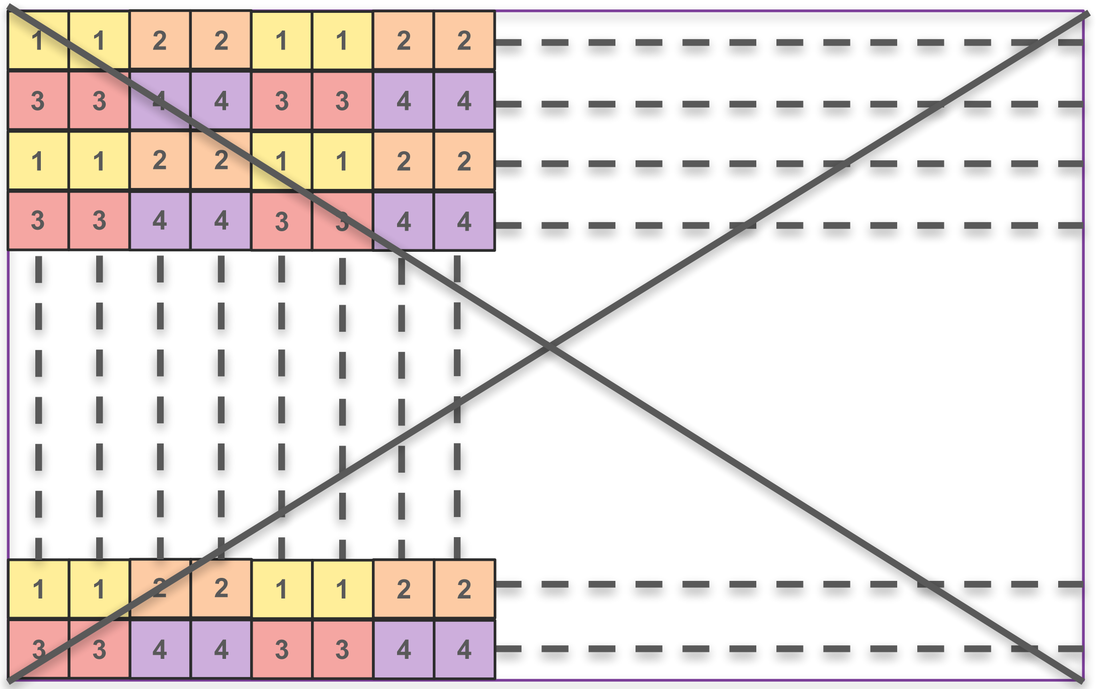




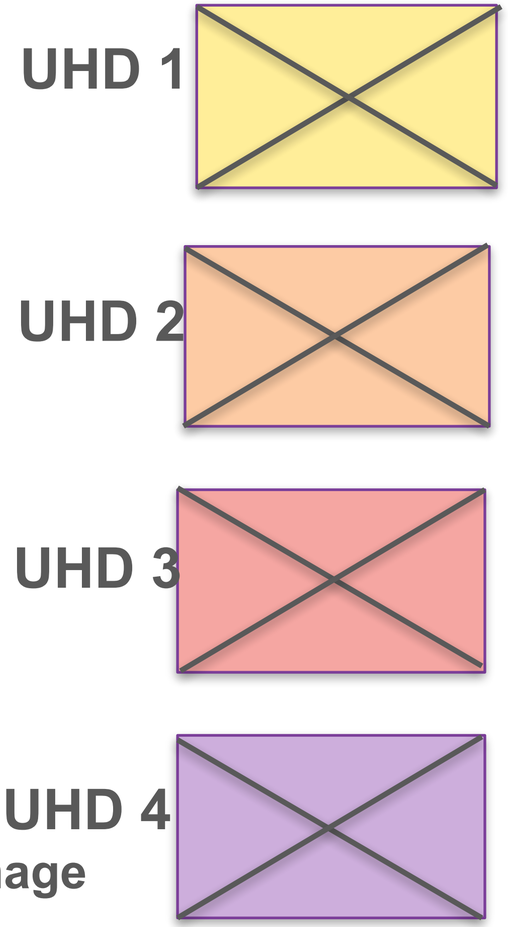
Each output represents ¼ of the total image

2 sample interleaved

3840 x 2160 samples



4x 1920 x 1080 samples



Each output represents the total (sub-sampled) image

Signal routing in 4K video mode (**LDX86N**)and(**IP XCU**)

2 sample interleave

UHD 1 — 3G

UHD 2 — 3G

UHD 3 — 3G

UHD 4 — 3G

LDX XtremeSpeed series

This part gives you some more details about the Basics and Service from the LDX HighSpeed line

In this session:

- **Introduction LDX 86 Native**
- Technical inside LDX 86 - 86N
- *Basic Service and Diagnostics (session 7)*
- **Looking inside (Head,Adaptor,XCU)**

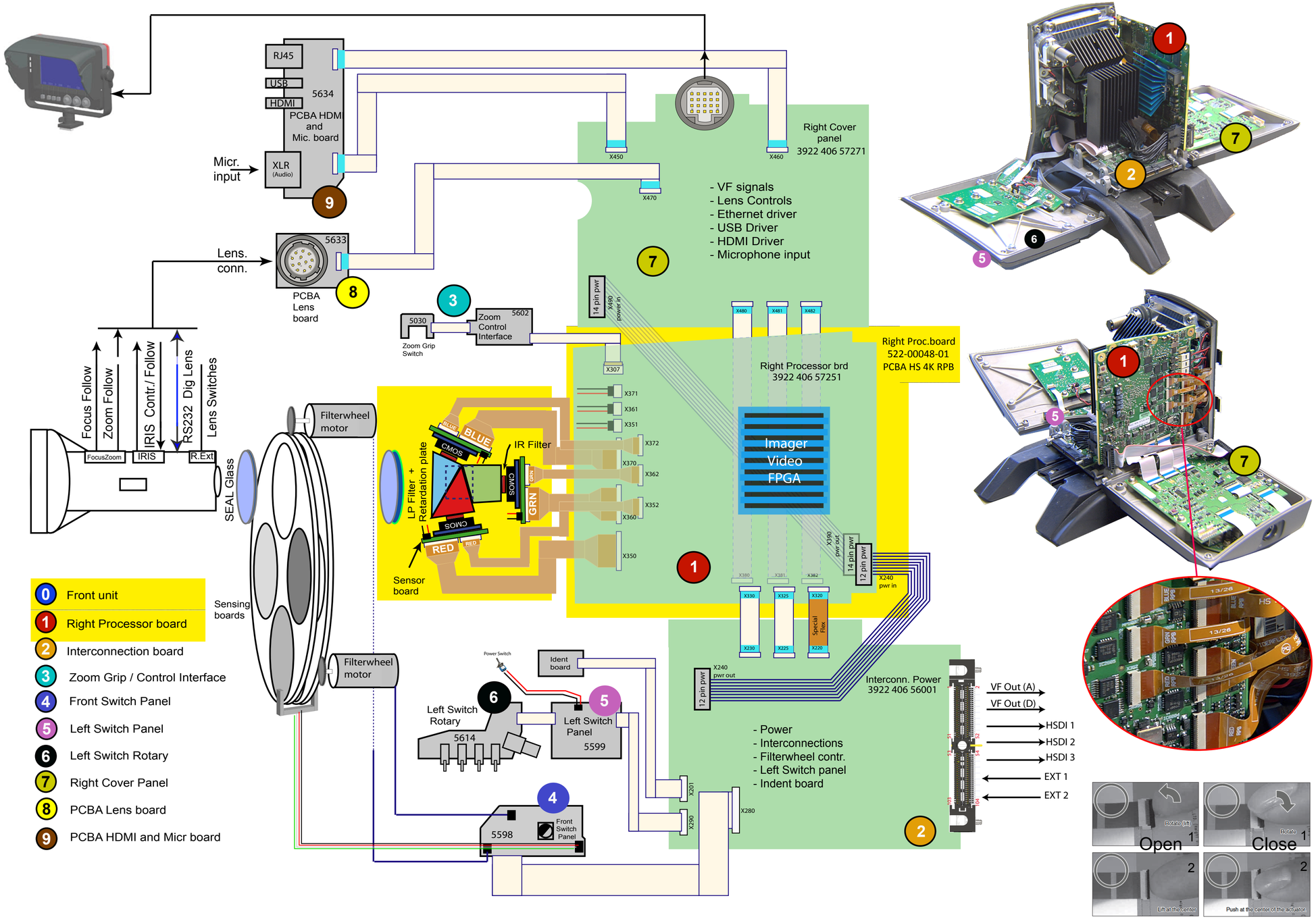
grass valley
A BELDEN BRAND

Changes

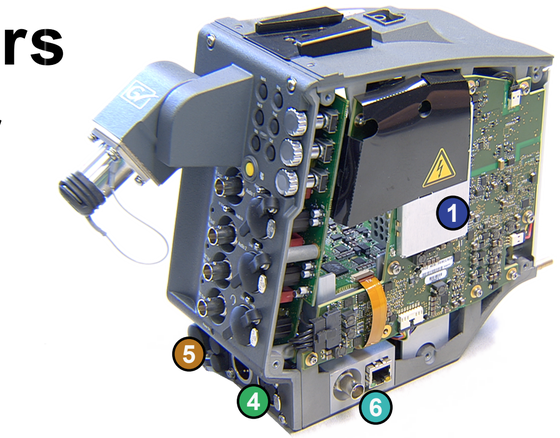
LDX 86

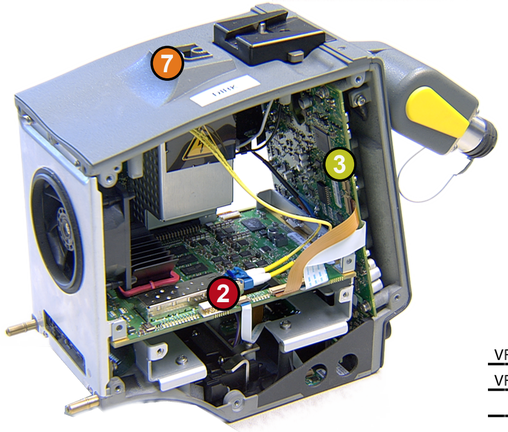
LDX 86N

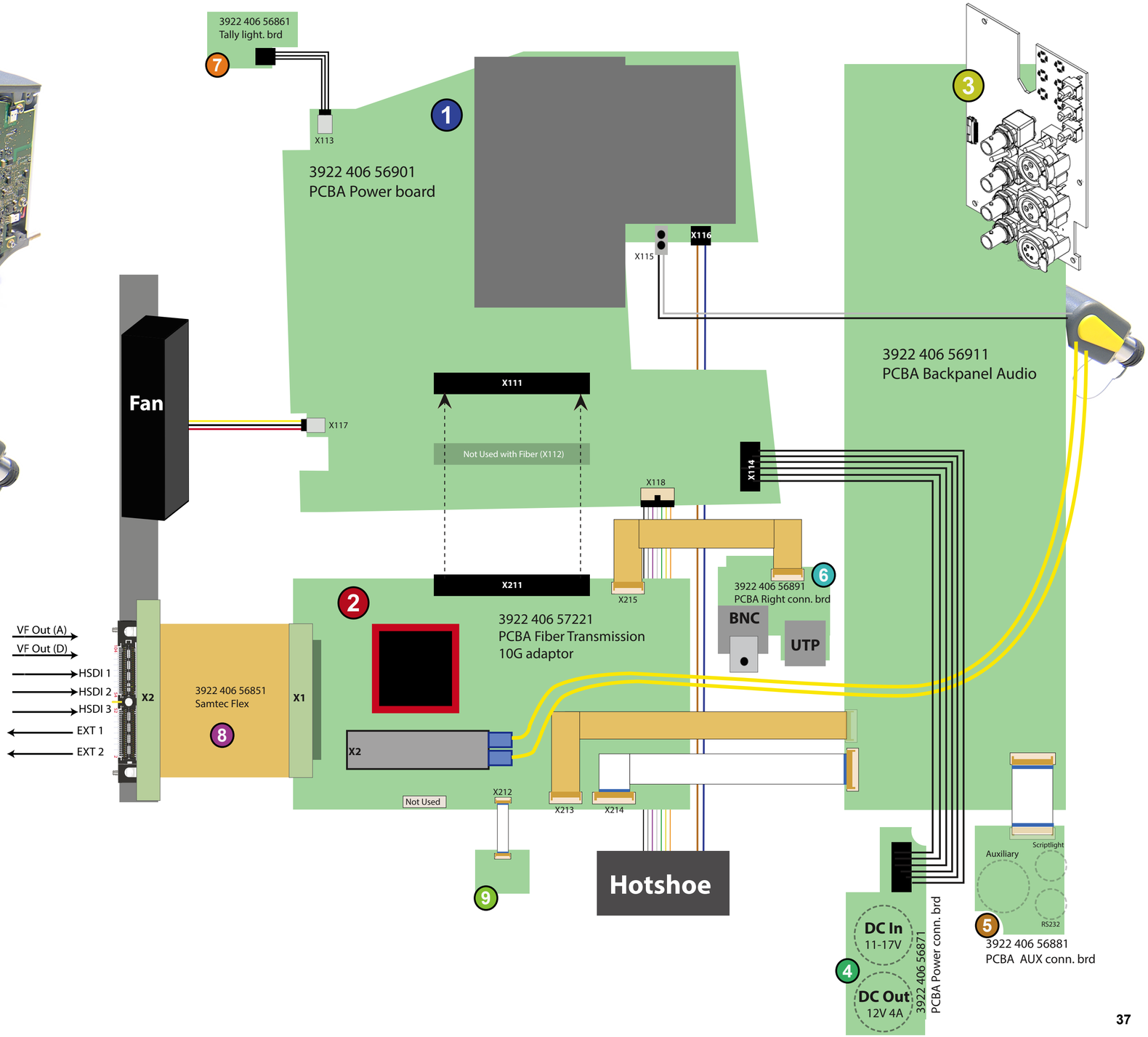
Hardware modified



LDX Univers Adaptor



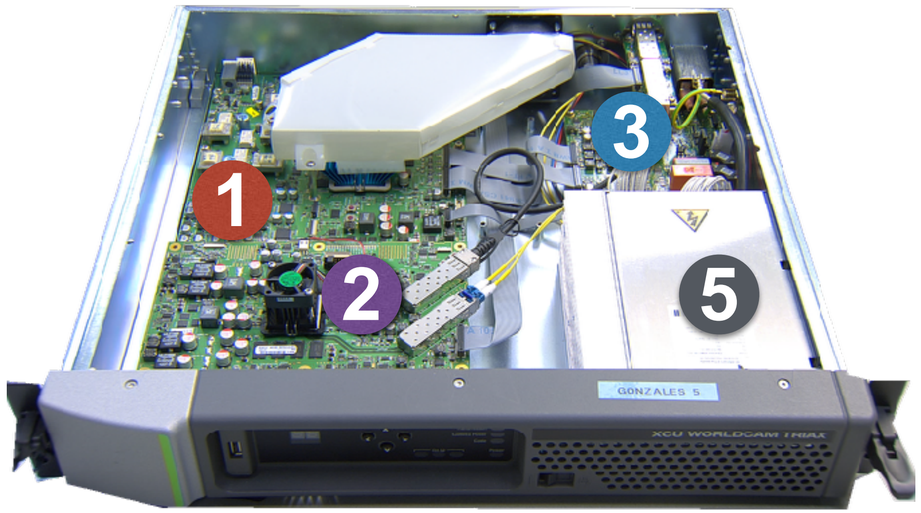


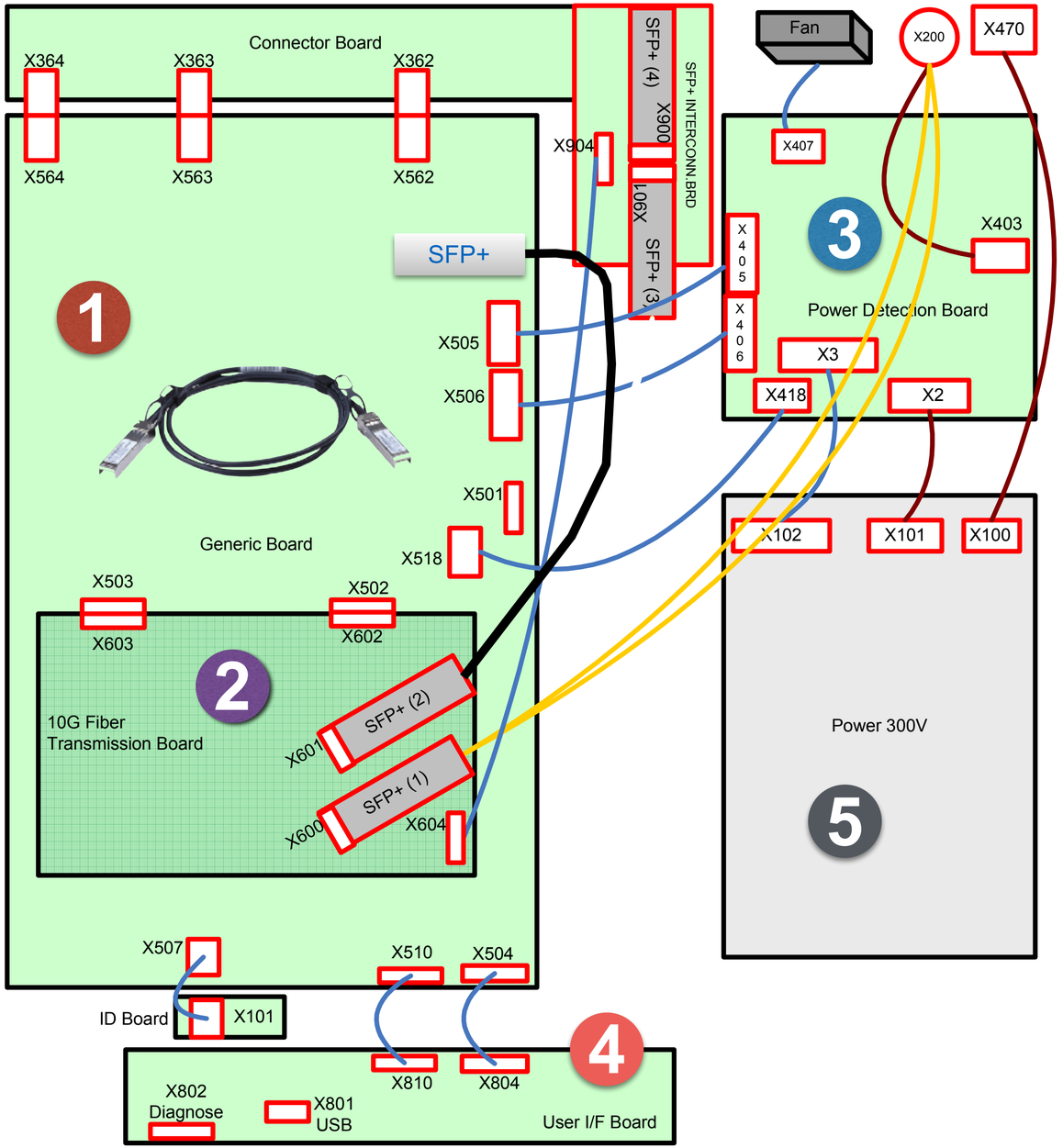


1. PCBA Power board
2. PCBA Fiber Trans. 10G adaptor
3. PCBA Backpanel Audio
4. PCBA Power conn.board
5. PCBA AUX conn. brd
6. PCBA Right conn. brd
7. Tally light board
8. SamTec Flex
9. Indentification board

grass valley
A BELDEN BRAND

LDX Univers XCU / 4K (BNC)





1: Generic board
2: Transmission board
3: Power detection board
4: User I/F board
5: Power 300V

Service Introduction LDX 86 Native

In this session:

- **Introduction LDX 86 Native**
- **Technical inside LDX 86 - 86N**
- *Basic Service and Diagnostics (session 7)*
- Looking inside (Head,Adaptor,XCU)

StartVideo

SUMMARY

DPM ULTRA

Seamless HD and 4K

Mixed operation

Use every technology to its full potential

Matching

Creating the best possible story without distractions

grass valley
A BELDEN BRAND

Thank You

DPM ULTRA

Seamless HD and 4K

Mixed operation

Use every technology to its full potential

Matching

Creating the best possible story without distractions

grass valley
A BELDEN BRAND