Camera Training Center
Breda The Netherlands

Febr 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**

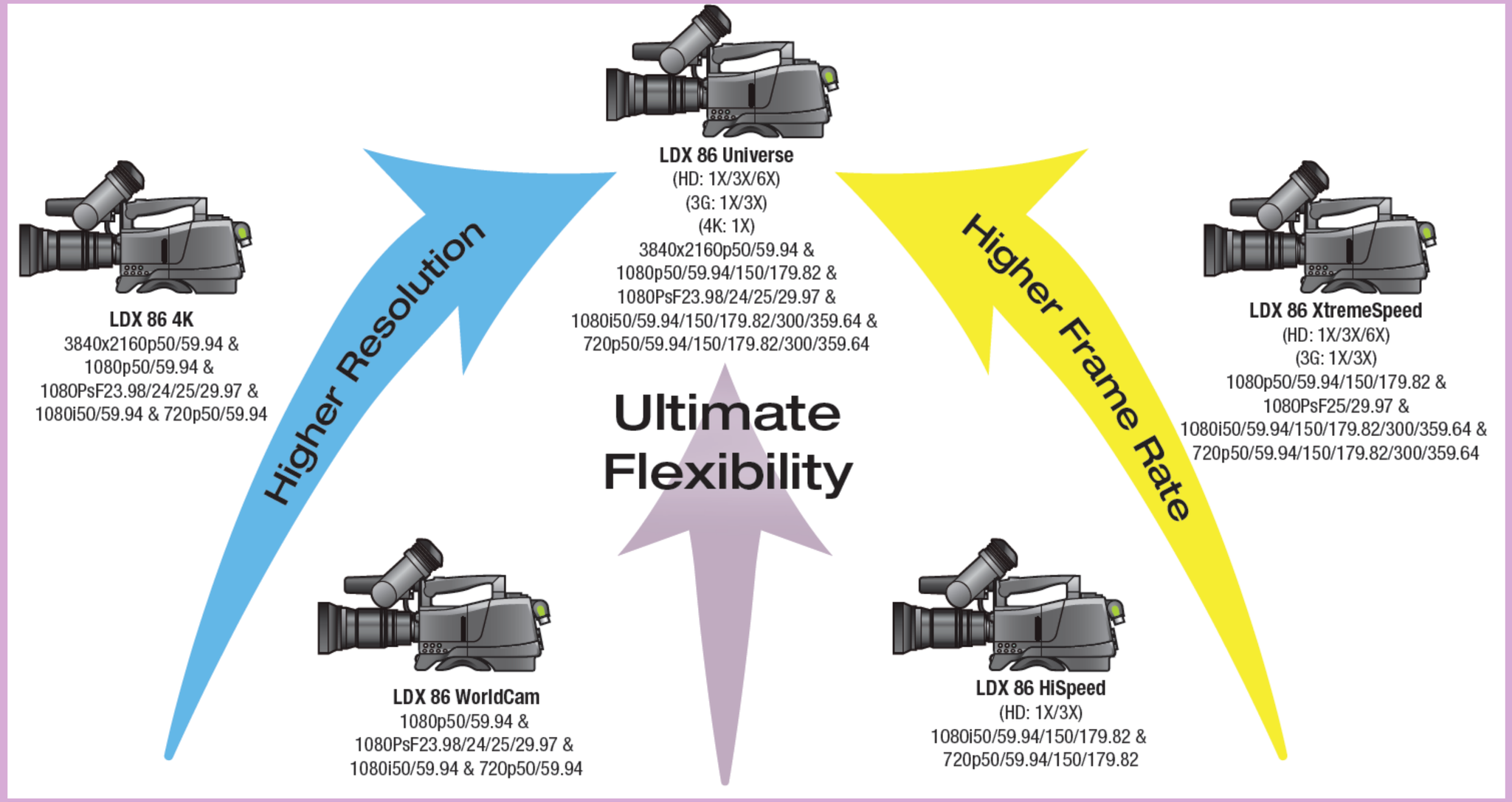
grass valley

A **BELDEN** BRAND

LDX 86 series

grass valley
A BELDEN BRAND

LDX86 HD/4K XS



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 XtremeSpeed
- **LDX 86 4K , XDR, CG explained**
- **Technical inside LDX XtremeSpeed**
- *Basic Service and Diagnostics (session 7)*
- **Looking inside (Head,Adaptor,XCU)**
- *Basics Dyno and Summit (session 9)*

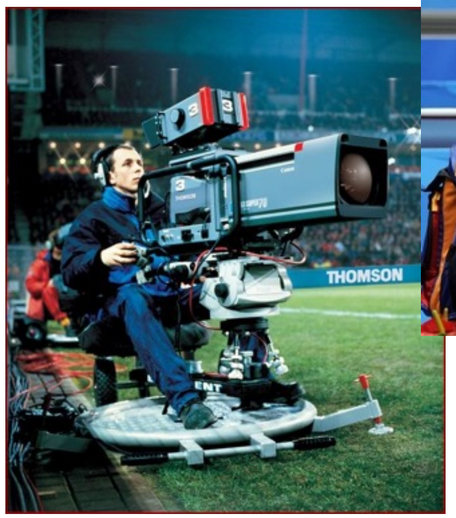
LDX XtremeSpeed series

The Next Step In SlowMotion

Truly speeding up the HighSpeed workflow

grass valley
A BELDEN BRAND

History



1998 ; LDK23

- (1st SD Super Slow Motion Camera)

2000 ; LDK23MKII

- Including Flicker compensation
- Set the defacto standard for Super Slow Motion

2004 ; LDK6200

- 1st HD Slow Motion Camera

2008 ; LDK8300

- 1st HD Super Slow Motion Camera
- Set the defacto standard for Super Slow Motion

2014 ; LDX86

- 1st HD Extreme Motion Camera

grass valley
A BELDEN BRAND

Sport Applications – The Speed Definitions

Super Slow Motion

Straight-Forward workflow

Interviews with customers

Statements from customers using today's Ultra Motion cameras

- ☑ "3x speed cameras (SSM) are rented every soccer weekend"
- ☑ "Cost to rent Ultra Motion cameras must not exceed 2x the rental cost for 3x speed cameras" (1.900,- Euro/day)
- ☑ High cost for Ultra Motion are mainly due to high cost for EVS XT3
- ☑ "Light conditions in each stadium determine the max frame rate……. 300fps is pretty normal."
- ☑ Large depth-of-field is required to make sure the slomo-replay is always in focus….!
- ☑ "Ultra Motion cameras are too complex to offer them on a Dry Hire basis"
- ☑ "Ultra Motion cameras, need experienced Ultra Motion operators"

grass valley
A BELDEN BRAND

Our offering ; Customer Benefits

1st Ultra motion camera with straight-forward workflow

- ☑ Instant replay (never miss a moment)
- ☑ You're not limited by the internal camera memory size (banks)

Setting a new standard for Ultra Motion acquisition

- ☑ Perfect matching other LDX series cameras
- ☑ High Sensitive Imagers (LDX series)
- ☑ "AnylightXtreme" (artificial light compensation)

1st handheld Ultra Motion camera

- ☑ Get closer to the action. Unique shots with ENG lenses
- ☑ Mobile Ultra Motion cameraman. Move where the action is

LDX XtremeSpeed = the Sports Director's choice

grass valley
A BELDEN BRAND

Our offering ; Customer Benefits (more)

Continuous recording on server

- Never miss a spectacular moment due to playing back a previous stunning replay

Full compatibility with standard XCU cradles

- Convert any camera position to an XtremeSpeed position with the XCU XtremeSpeed
- Cradle connections remain the same for I-com, audio, control, returns, etc.

Maximum Utilization

- HQ “Live”-output enables to go live-on-air, so not only use as XtremeSpeed camera
- Single Speed mode offers flexibility to use the XtremSpeed camera also as single speed

High Quality infrastructure

- XtremeSpeed uses standard LDX accessories like ViewFinders, SXP’s and OCP’s
- No lens-converters needed

Our offering ; **Server Integration**

- ☑ 1x speed, 1080i, 720p and 1080p at equal sensitivity
- ☑ 3x speed, 1080i150/180 output XCU, full-res captured (LDK8300 modes)
- ☑ 3x speed, 720p150/180output XCU, full-res captured (LDK8300 modes)
- ☑ 3x speed, 1080p150/180 output XCU, full-res captured
- ☑ 6x speed, 1080i300/360 output XCU, full-res captured
- ☑ 6x speed, 720p300/360output XCU, full-res captured
- ☑ ‘combined’ signal for all modes, for truly-matched Live usage

3G Coax 3x phases

3G Coax 1x Live

grass valley
A BELDEN BRAND

Our offering ; New Transmission

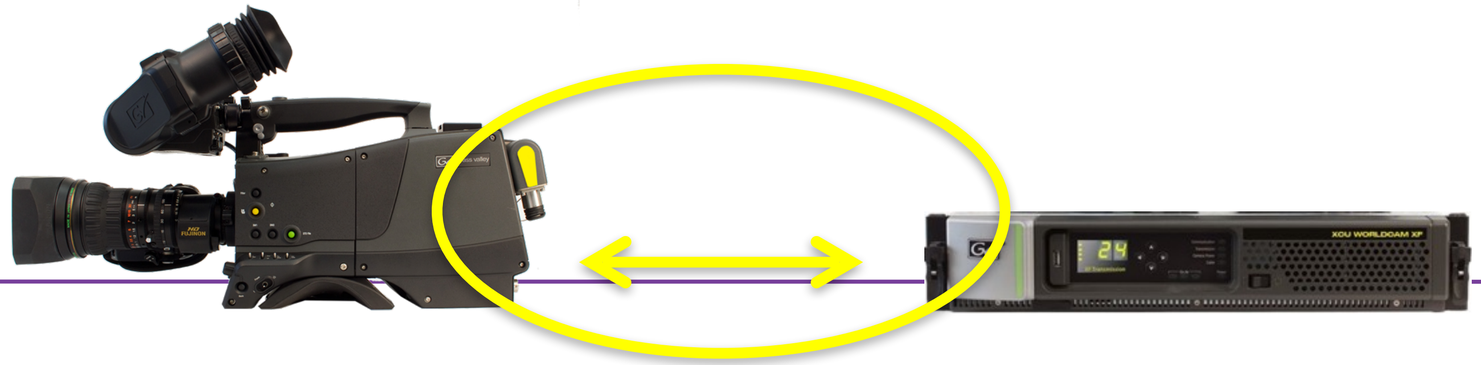
XF Transmission

- New **transmission** system between Camera Adapter and XCU
- **10Gb Fiber** only transmission, using standard SMPTE cables
- **X**treme **F**lexible transmission offers required bandwidth for high frame rates
- Direct Frame Transmission from Camera head to XCU outputs

  NO frame storage in camera head needed
- “Future-proof” transmission system ; Support of different protocols

XF Fiber Adapter

- **3G (4,5Gb) format**
- **10G HDSDI/SDSDI over IP**
  - **Supporting SMPTE 2022-6 based on standard protocol**



grass valley
A BELDEN BRAND

Our offering ; New Transmission

XF Transmission

10Gb Fiber only transmission, using standard SMPTE cables

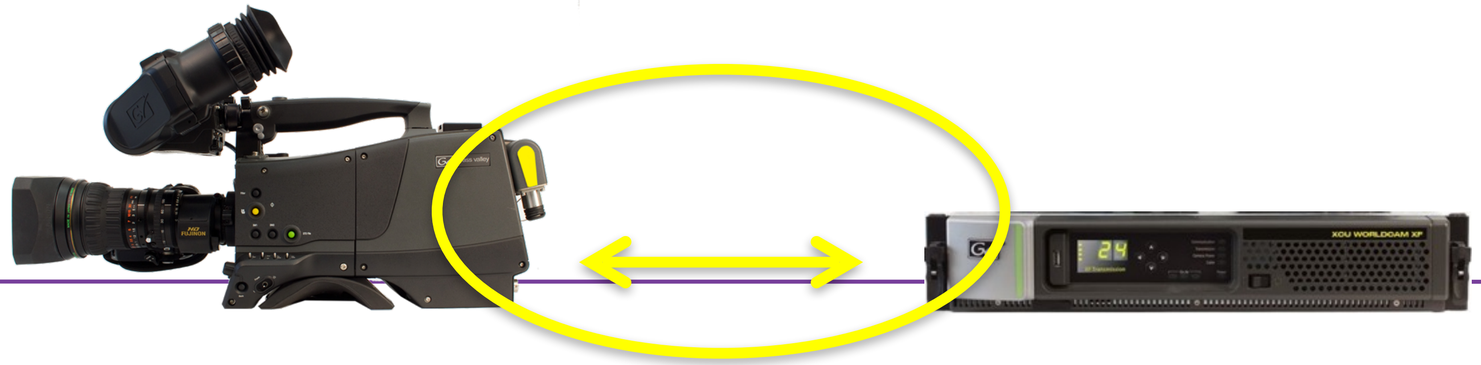
- **Supporting SMPTE 2022-6**

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

Scope

This standard defines a unidirectional IP-based protocol for the transport of real-time video, audio, and ancillary signals. In particular this standard defines a method for the encapsulation of the payloads of a variety of existing SMPTE serial digital video standards.

The term High Bit Rate is used herein to distinguish from other Media-over-IP applications in which compressed signals are transported.
The uncompressed signals in this document are at rates of 270 Mbits/sec and higher.



grass valley
A BELDEN BRAND

Our Partnerships

The LDX XtremeSpeed camera is supported by the two main Live replay server brands (Grass Valley and EVS)

Both supporting 3x1080p, 6x1080i and 6x720p

Summit 3G + Dyno-S

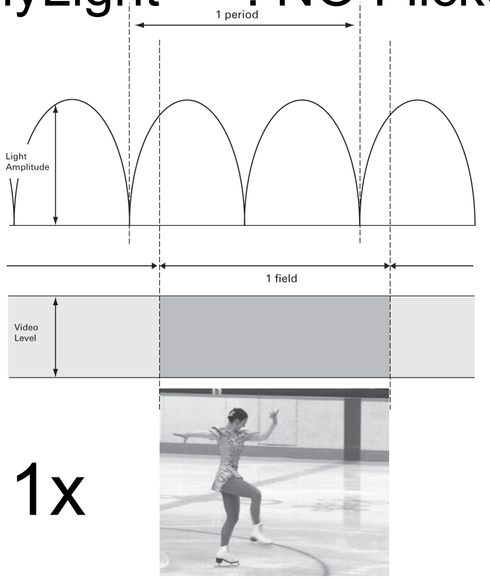
EVS XT3 + LSM

grass valley
A BELDEN BRAND

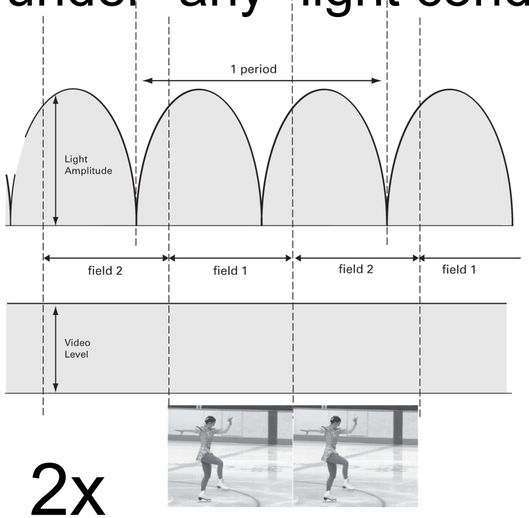
LDX86 HD/4K XS (AnyLight™)

Artificial Light Flickering During Replay

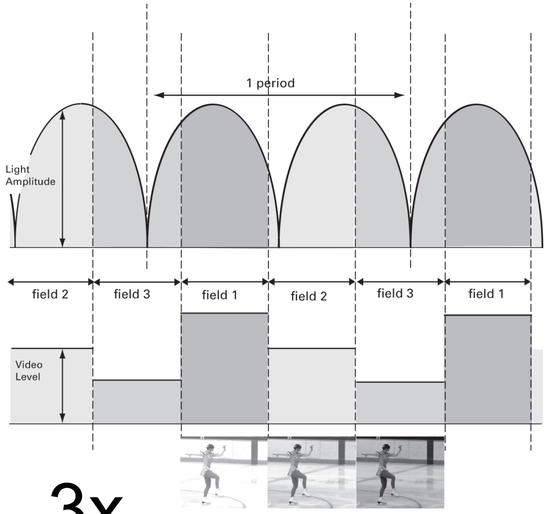
- No artificial light flickering occurs during replays of 1x and 2x speed recordings
- Artificial light introduces flickering between frames when 3x speed recordings are played back at normal speed (see drawings 1x, 2x and 3x)
- “AnyLight™” has proven its value in the market for LDK8300 replays
- “AnyLight™” : NO Flickering under “any” light condition



1x



2x

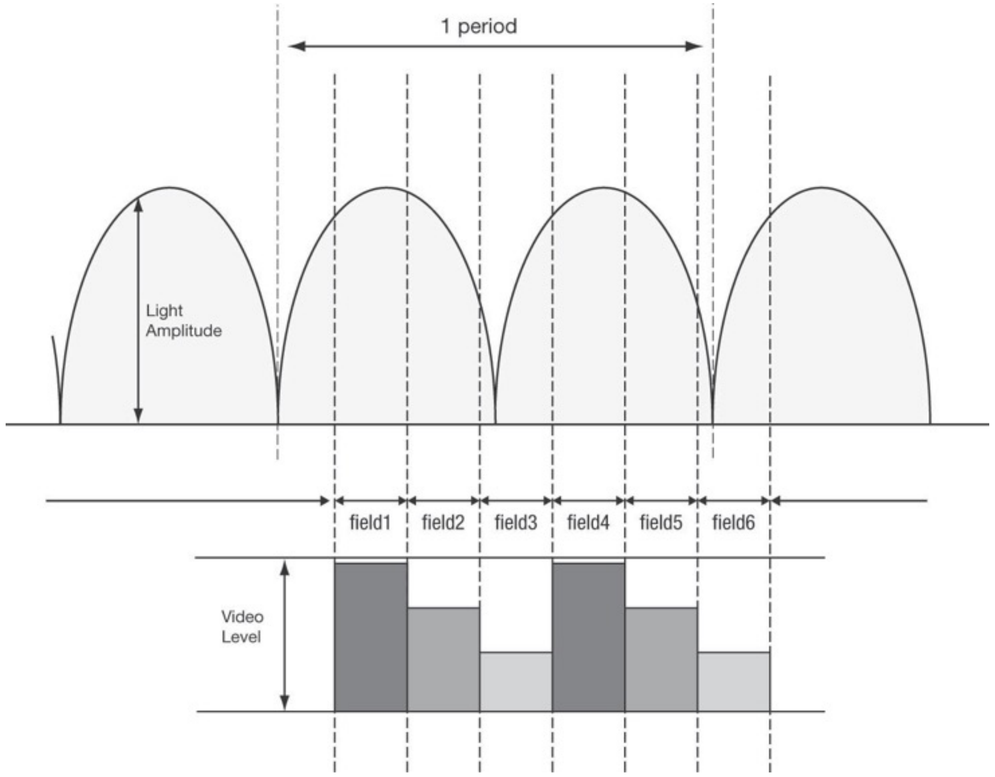


3x

grass valley
A BELDEN BRAND

LDX86 HD/4K XS (AnyLight™)

Artificial Light Flickering During Replay



LDX XtremeSpeed captures video frames upto 6x faster as the light-cycle frequency.

“AnyLightXtreme” is the further improved LDK8300 “AnyLight” compensation !

“AnyLightXtreme^{tm}“ is developed for upto 6x speed capturing, showing NO Atificial Light Flickering during the replays.

- 5 selectable levels to match light conditions

Competition:

Basic Reduction(AGC; Automatic Gain Control)

Flickering remains visible during replays

grass valley
A BELDEN BRAND

LDX XtremeSpeed series

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

In this session:

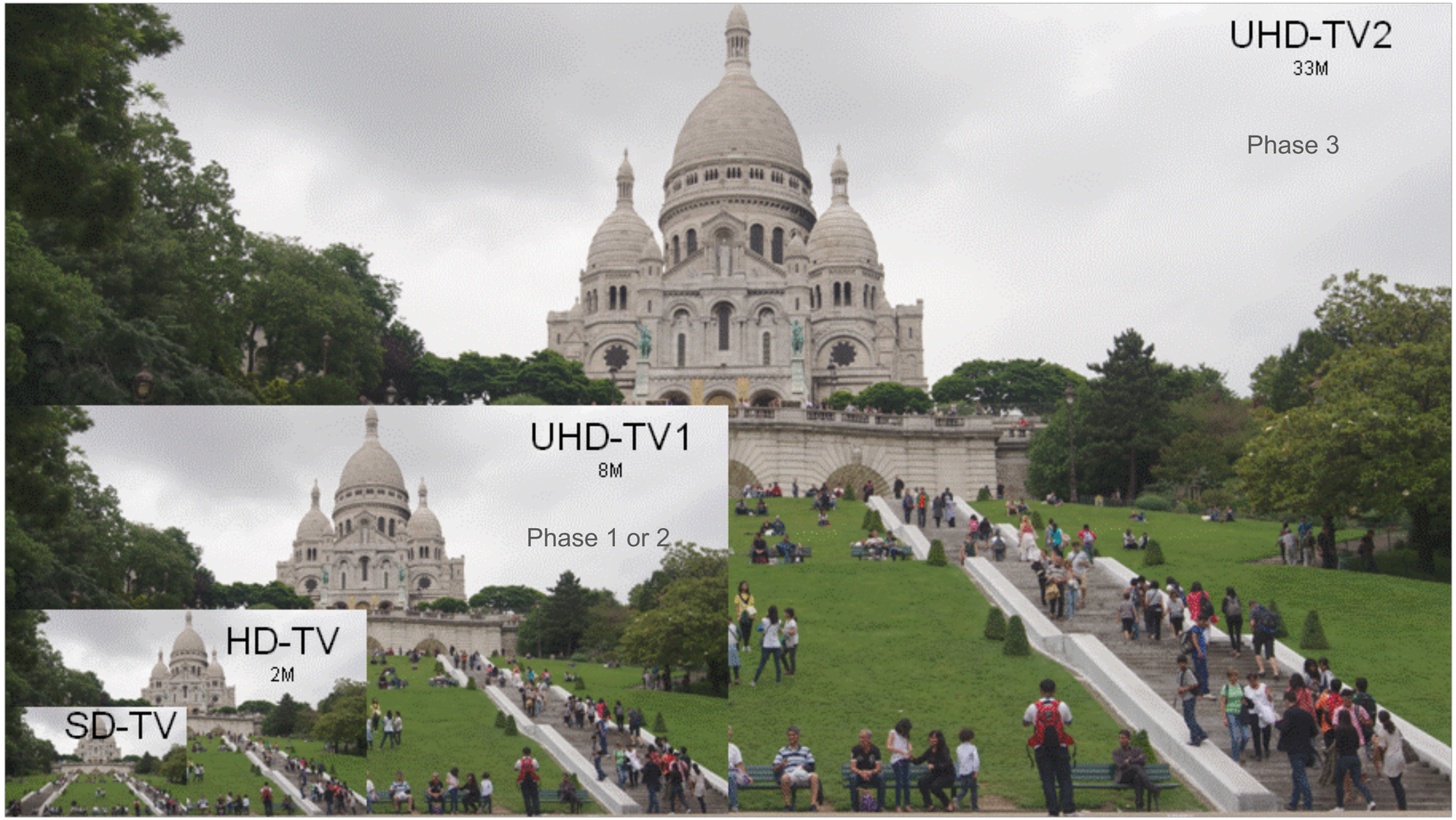
- **Introduction LDX XtremeSpeed**
- LDX 86 4K, XDR, Color Gamut explained
- **Technical inside LDX XtremeSpeed**
- *Basic Service and Diagnostics (session 7)*
- **Looking inside (Head,Adaptor,XCU)**
- *Basics Dyno and Summit (session 9)*

grass valley
A BELDEN BRAND

LDX86 HD/4K XS

- What is the 4K standard?
- What is UHD?
- 4096 x 2160 or 3840 x 2160?
  => 4K as used in a switcher is 3840 x 2160
- Transmission can be either:
  a. Quad Link - 4 quadrants – simultaneously
     i.e. 4 - IP streams or 4-HDSDI signals at 1080p
  b. Dual Pixel Interleave
     1,1,2,2,1,1,2,2 and 3,3,4,4,3,3,4,4 on 2 simultaneous streams
  c. Compression - TICO (Tiny Codec) 4k in a 3Gb signal (4:1 compression)

LDX86 HD/4K XS



4K

2015

What is UHD – Today and near term future

	DVB Digital Video Broadcasting	DVB Digital Video Broadcasting	ITU	SMPTE
Name	UHD - Phase 1	UHD - Phase 2	UHD (2160p)	UHDTV1
Pixel		3840 x 2160		
Scanning format	4 Q or 2 SI	Progressive		
Frame rate	24, 25, 30, 50, 60	24, 25, 30, 50, 60, 100, 120	24, 25, 30, 50, 60, 100, 119.88, 120	
Colour space	Rec. 709 BT 2020	BT. 2020		
Colour sampling	4:2:0, 4:2:2	4:2:0, 4:2:2, 4:4:4		
Bit depth [bit]	8-10	10-12		10-16
HDR	No / Yes	Yes, but definition unclear		

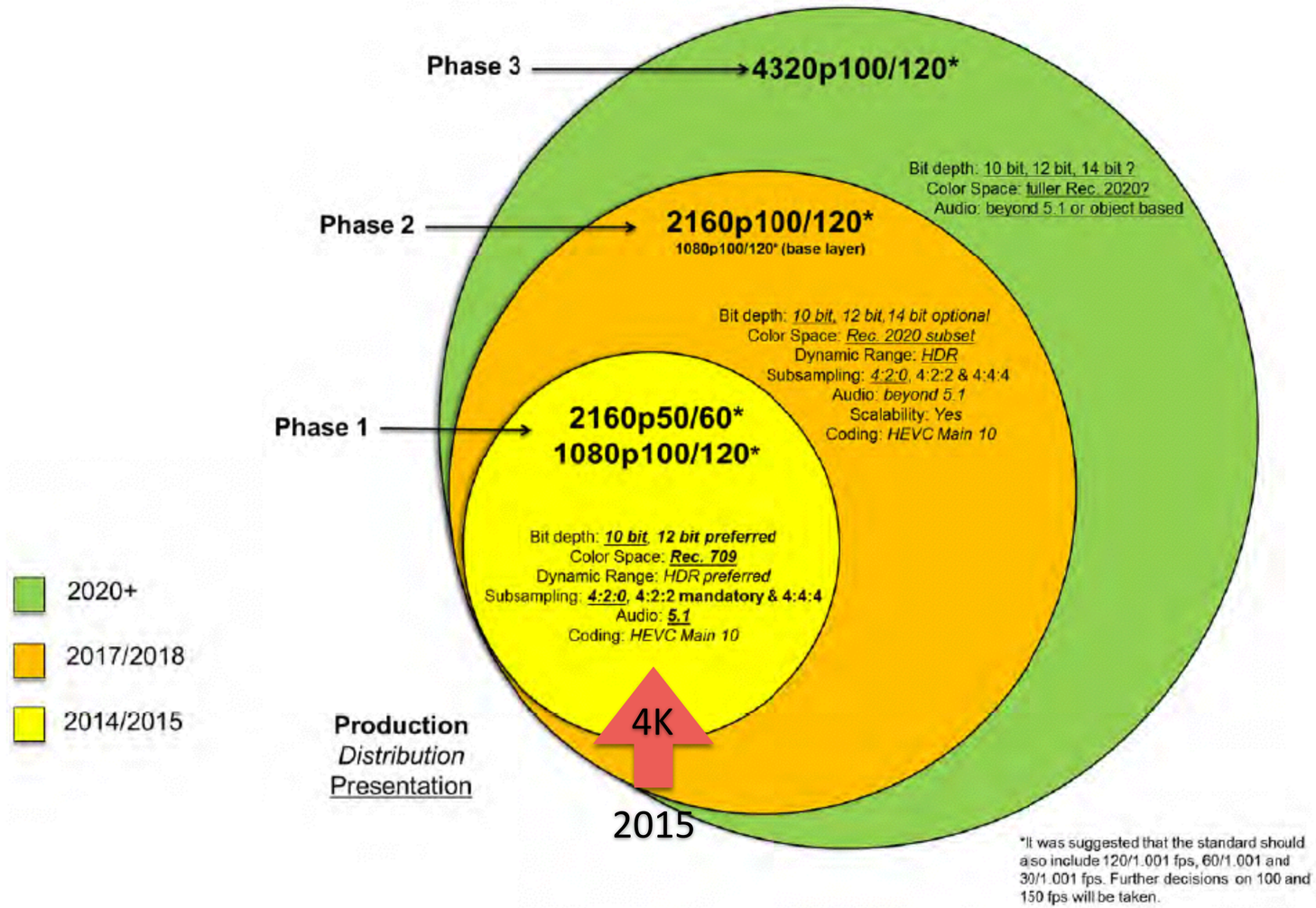
4K

2015

grass valley
A BELDEN BRAND

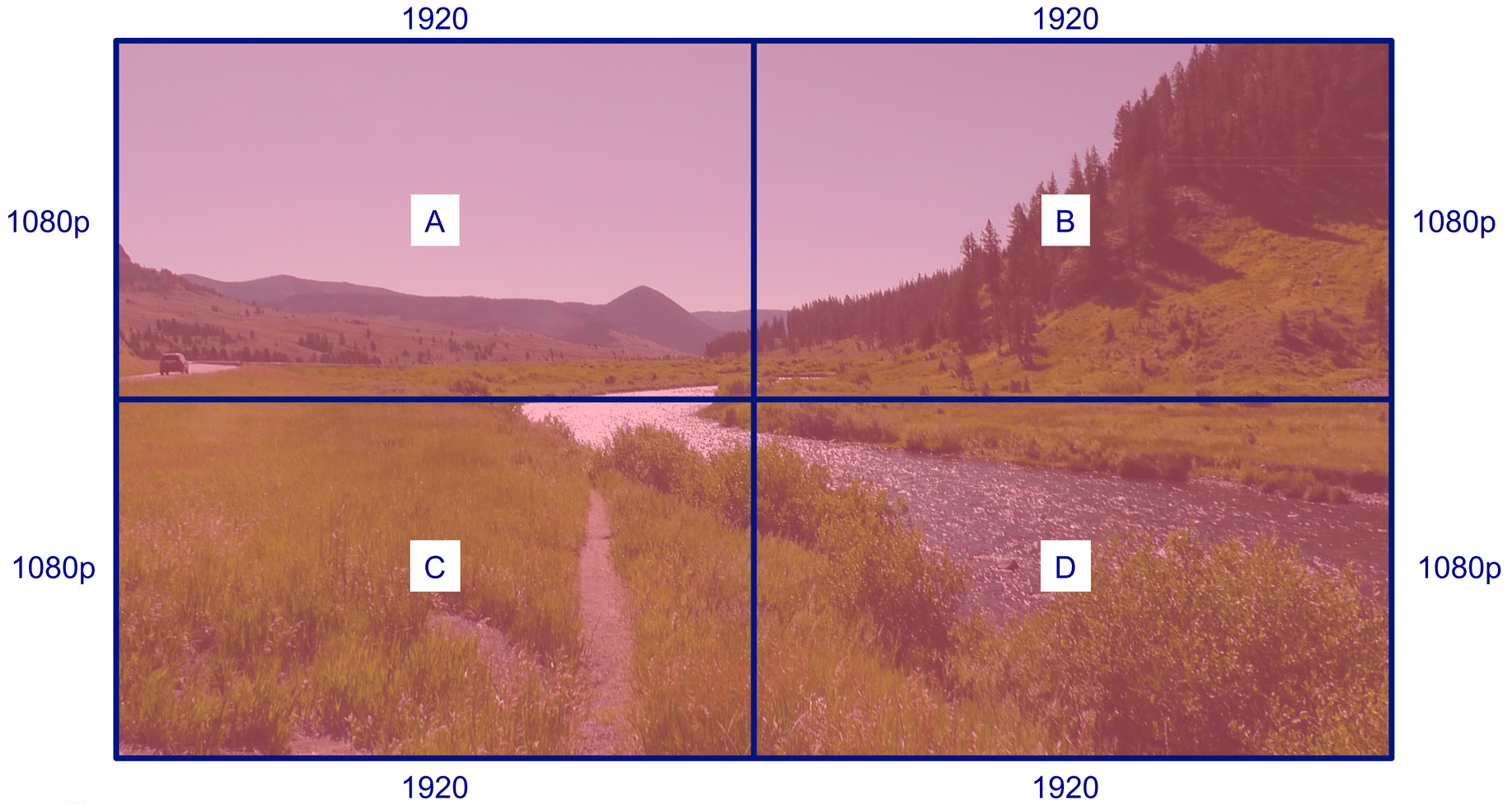
UHD/4K - The timing (referring to the EBU)

Exhibit 2 – UHD Implementation Phases



LDX86 HD/4K XS (modes)

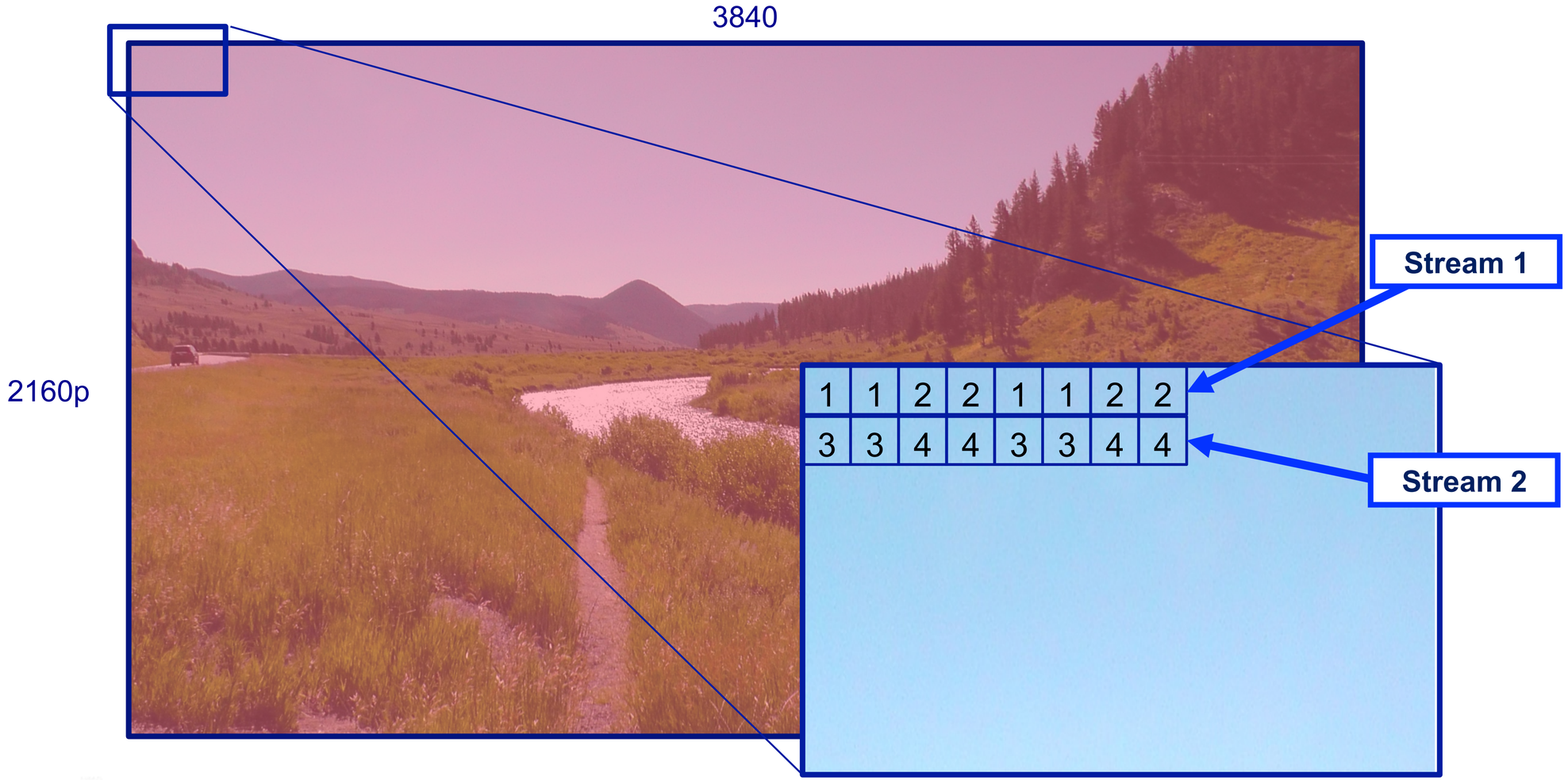
4K Quadrants = (3840 x 2160) **Quad link**



grass valley
A BELDEN BRAND

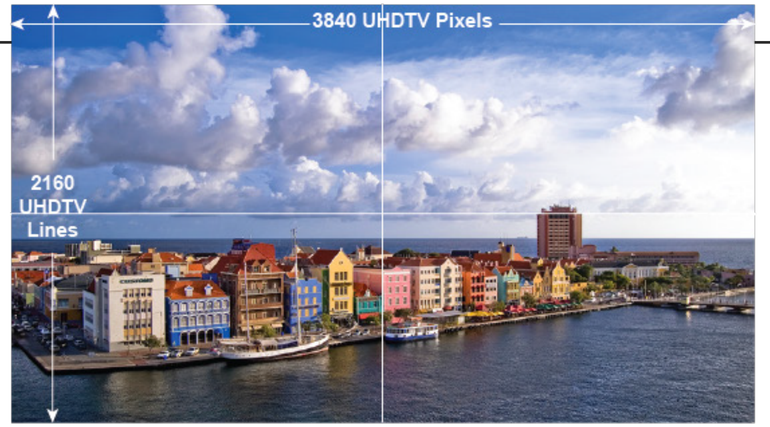
LDX86 HD/4K XS (modes)

4K Quadrants = (3840 x 2160) **Dual Pixel Interleave link**



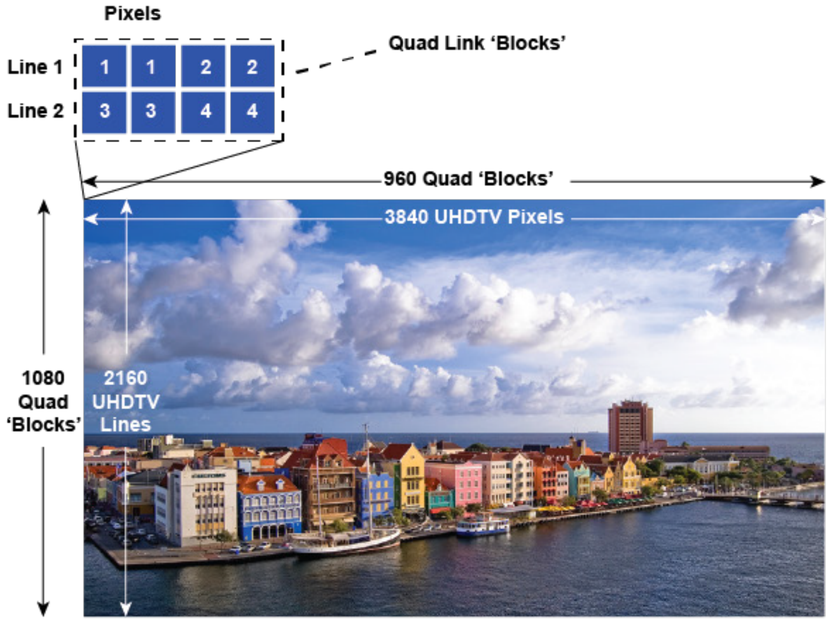
Square Division Quad Split

- Each link contains
  one quarter of the original image



Quad Link 2 Sample Interleave (2SI)

- Each link contains a full image
  at 1/4 resolution.



grass valley
A BELDEN BRAND

UHD/4K - How to watch 4K

- 4K images need a much shorter viewing distance
  - At today's screen sizes,
    the typical viewing distance does not allow viewers to see the full 4K resolution

or

- 4K needs much larger
  screen sizes

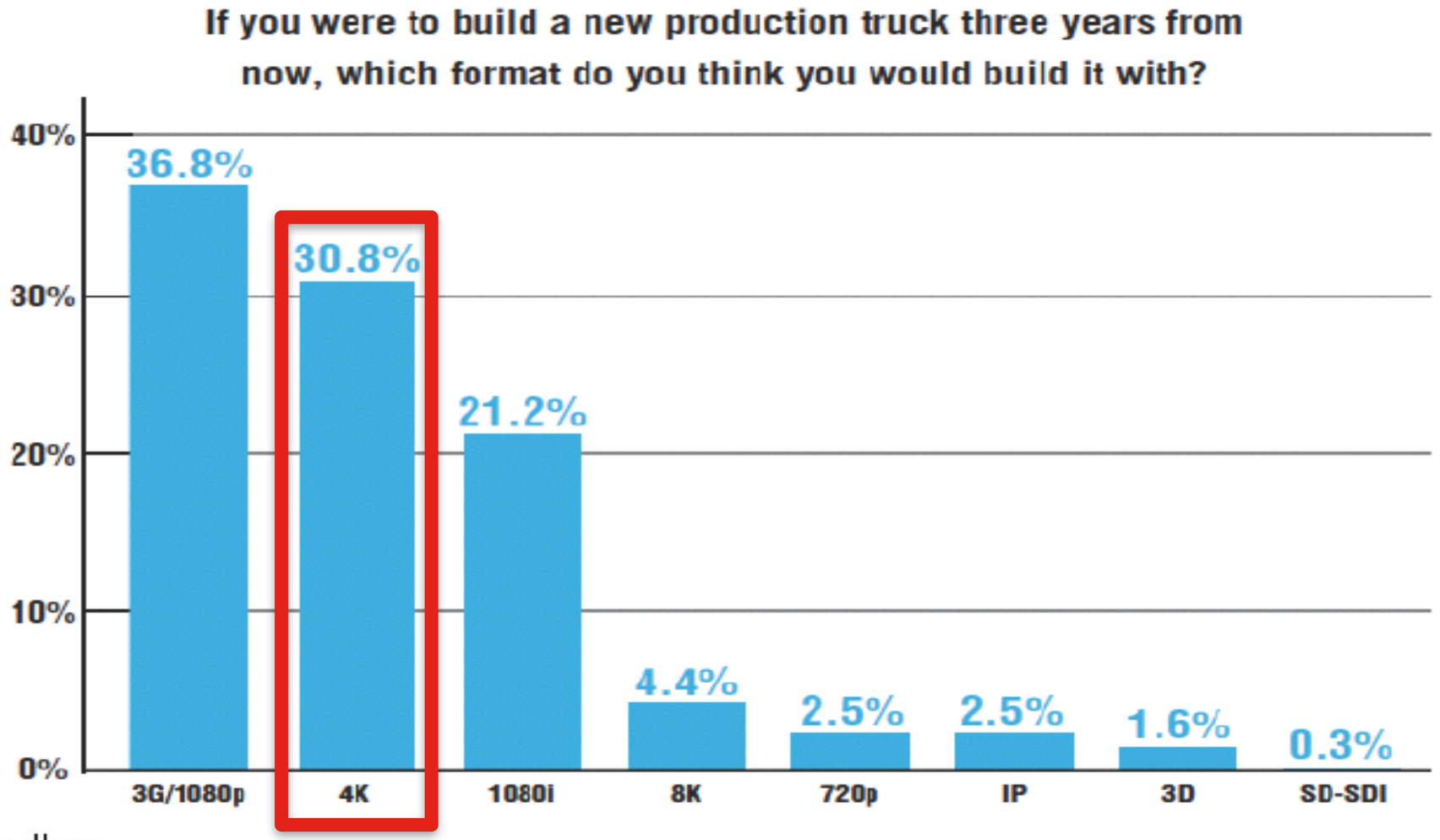
or

- 4K alone will miss
  the "WOW factor"

Image Diagonal	Minimum Viewing Distance for Full Resolution in cm				
Inch	SD	720p	1080p	4K	8K
32	232	186	124	62	31
37	268	215	143	72	36
40	290	232	155	77	39
42	305	244	163	81	41
47	341	273	182	91	45
50	363	290	193	97	48
55	399	319	213	106	53

UHD/4K - The (Production) market „Believe“ in 4K

Production company survey



grass valley
A BELDEN BRAND

Many broadcasters think a 4x higher

count won't deliver the "w

needed from a new broadca format

HDR opens up the potential for more engaging, more beautiful content, as well as future proofing

XDR is new feature in GV Cameras (Ready for 2K and 4K)

Why HDR - For most natural images

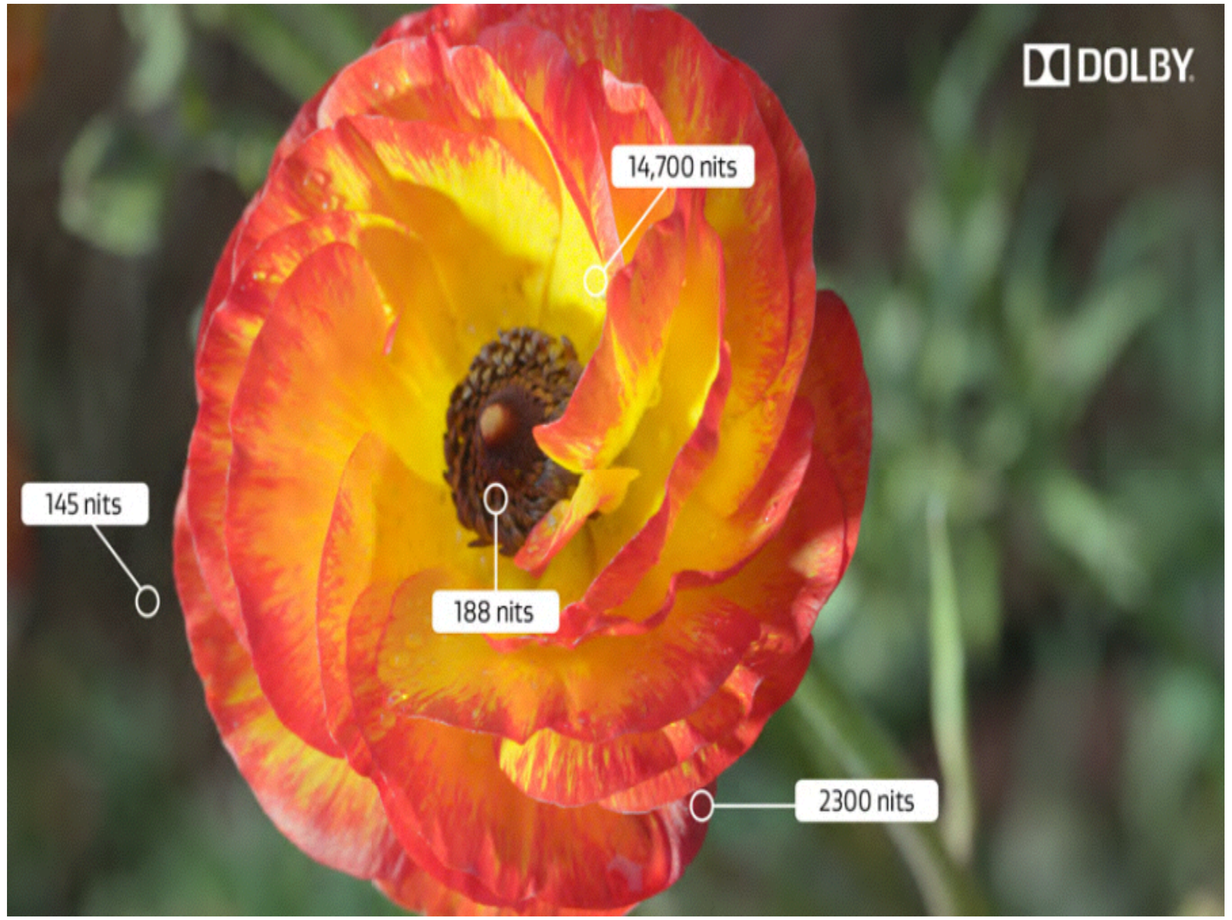
- **High scene contrasts can be found in many typical pictures**

A unit of measurement of luminance, or the intensity of visible light, where one nit is equal to one candela per square meter.
Nits are used to describe the brightness of displays, such as LCD and CRT monitors.

(1 nit = 1 cd/m2).

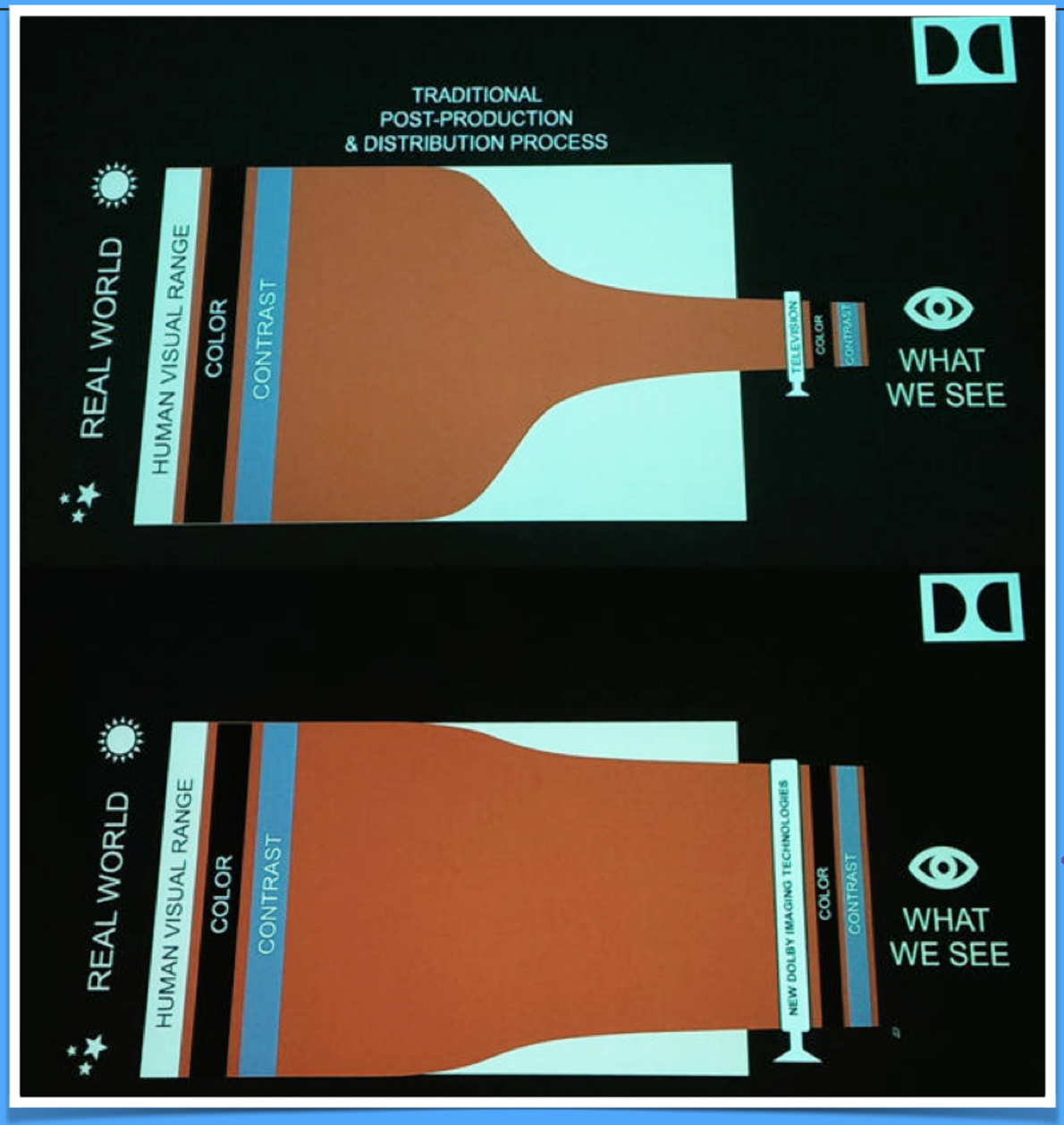
200 - 300 nits for Standard monitor
800 - 4000 nits for HDR monitor more in the future

100 Watts bulb emits 18000 nits
sunny day up to 50000 nits



grass valley
A BELDEN BRAND

Why HDR - For most natural images



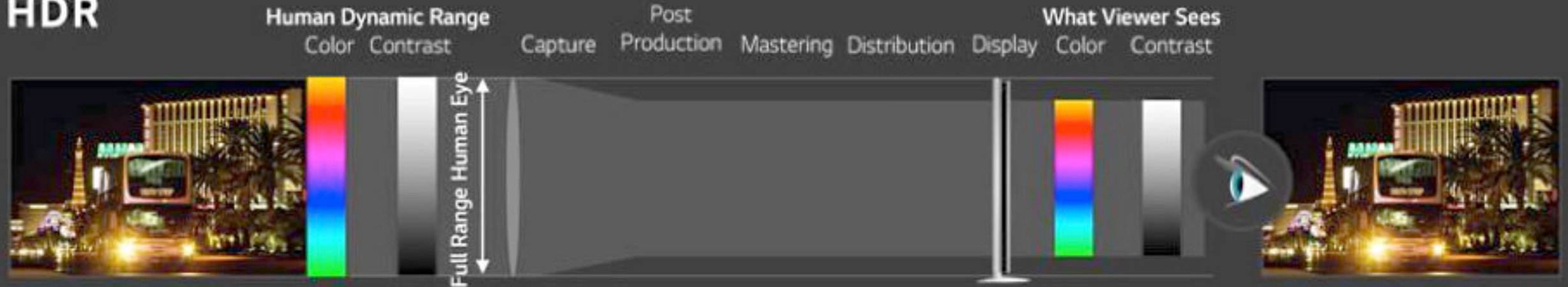
Looking to a standard monitor

Looking to a HDR monitor

Dynamic Range in Television

SDR

HDR



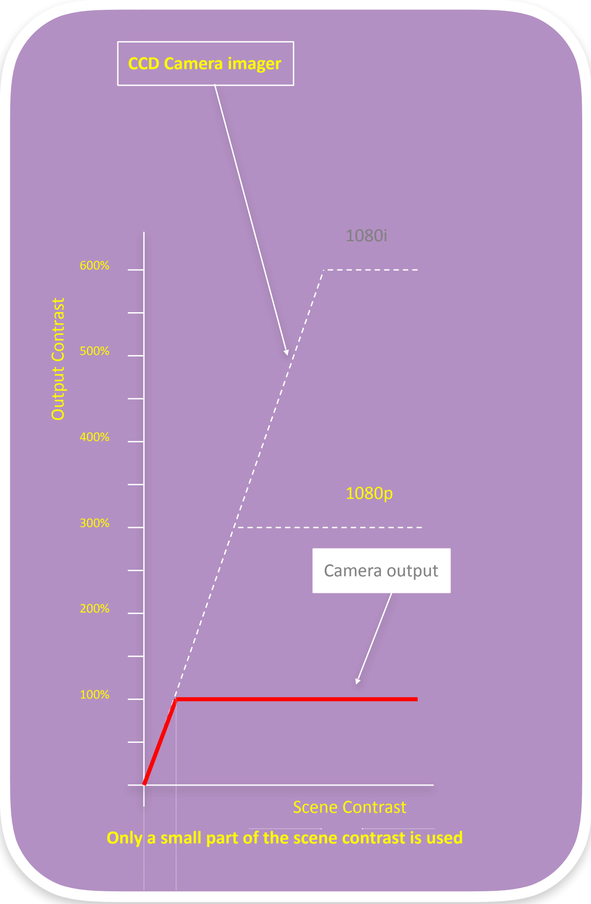
Why HDR - For challenging lighting conditions

- **High scene contrasts are most challenging in live broadcast applications**

  - Lighting conditions are typically not under control
  - Pictures must be perfect at any time, and can't be fixed in post

Why HDR - For challenging lighting conditions

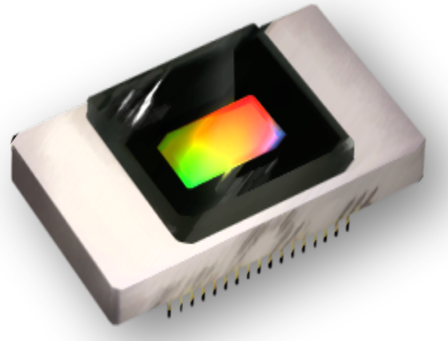
- HDR can be used to avoid washed out highlights



Note: For the sake of clarity, the gamma correction is not included in the graphs

How HDR is generated – What is required?

- An imaging technology delivering highest dynamic range
  - ☑ CMOS delivers highest dynamic range in all formats, including progressive
- Highest performance pixels
  - ☑ “Large” pixel for 15 F-stops of live dynamic range without calculations
  - ☑ 5T pixel for global shutter operation
- A camera solution able to deliver HDR signals
  - ☑ Supporting the requested “HDR mappings”
  - ☑ True parallel processing of HDR and SDR signals
  - ☑ Easy control of both signals at the same time
  - ☑ Supporting 1080i/p, 720p, 4K (both 50 or 59Hz)



How HDR is generated – What is required?

- Display with a higher contrast range (higher peak white)

SDR Display

300 nits

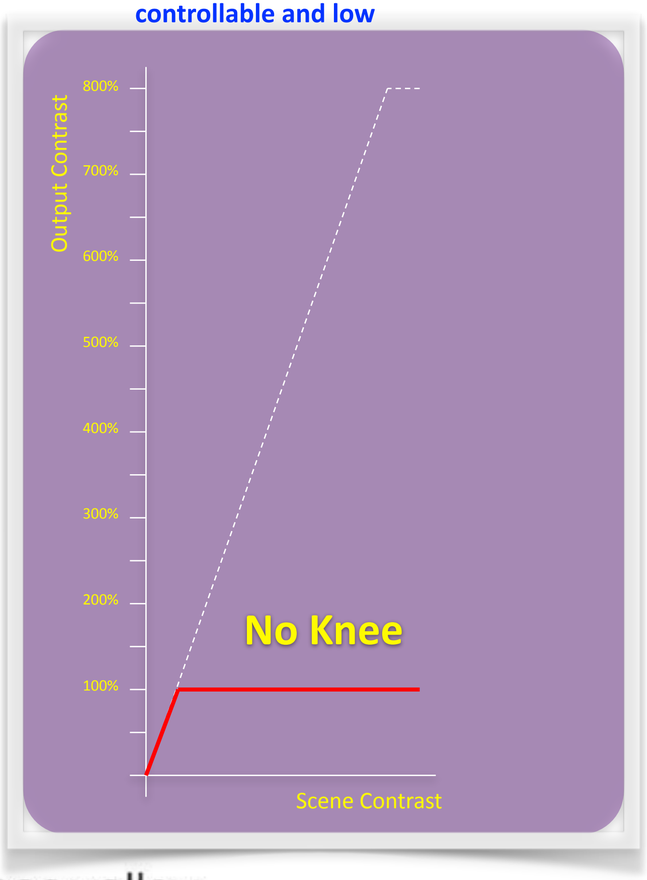
HDR Display

1.000 – 10.000 nits

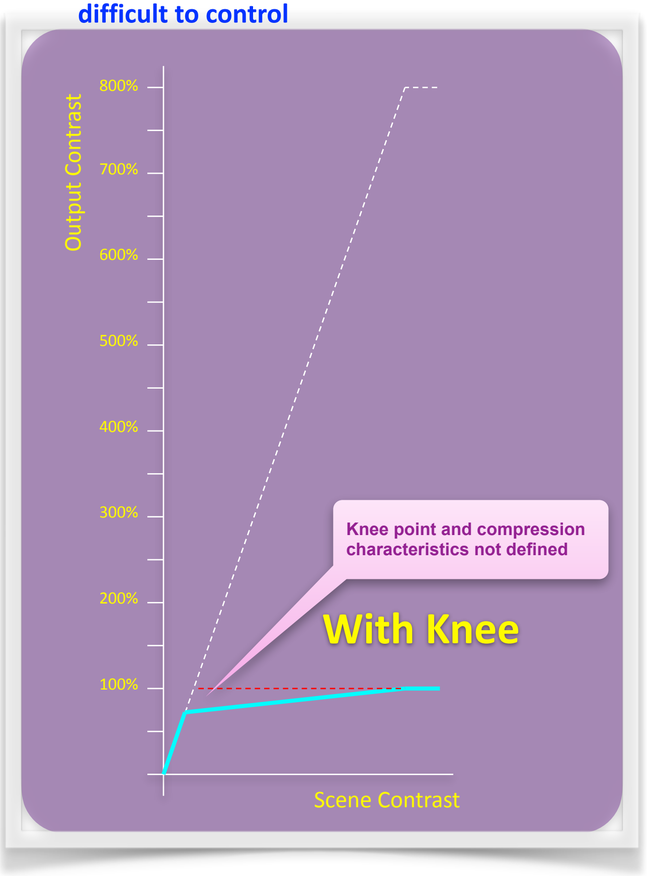
How HDR is generated – Signal mapping

- HDR needs a different signal mapping compared to SDR

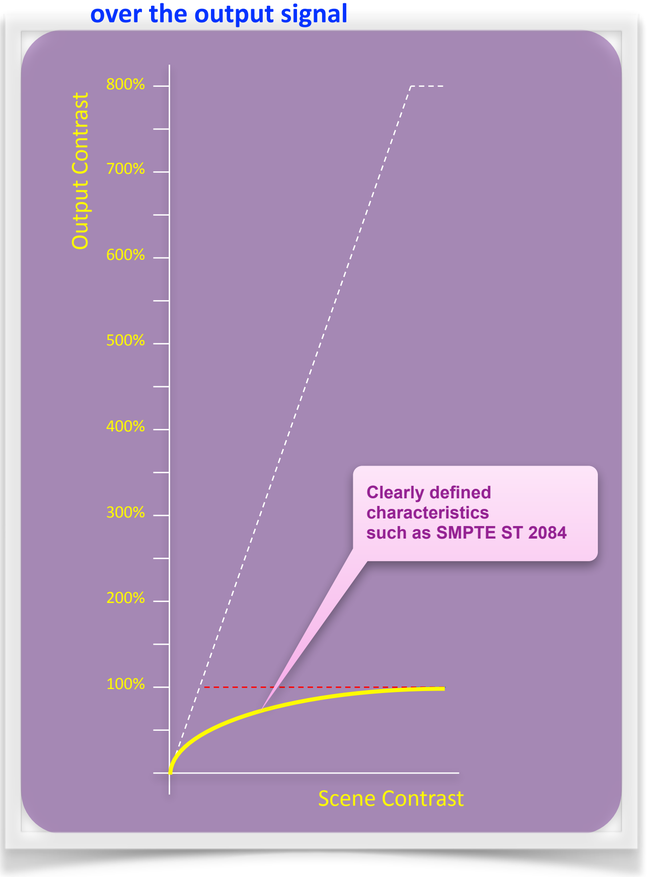
Signal processing with linear output
Only useable if scene contrast is controllable and low



Signal processing with knee compression
Highlights are heavily compressed , difficult to control



Signal processing for HDR operation
Scene contrast more even distributed over the output signal

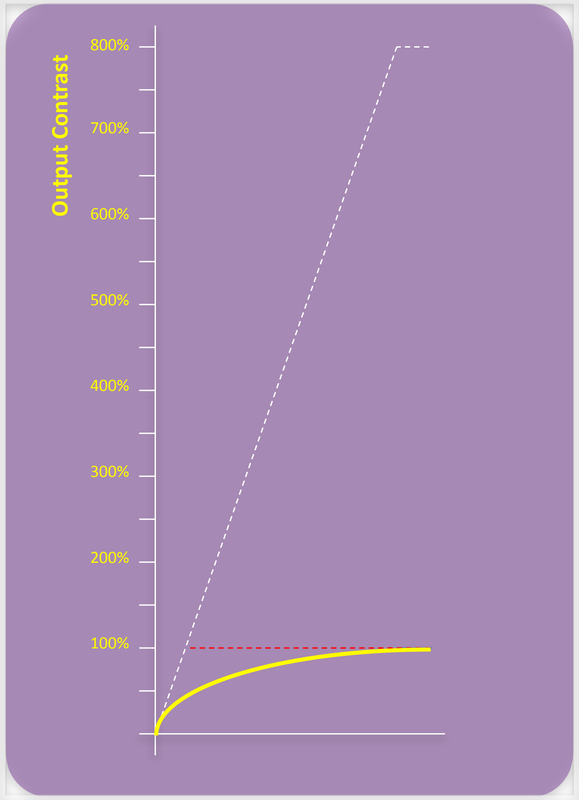


Note: For the sake of clarity, the gamma correction is not included in the graphs

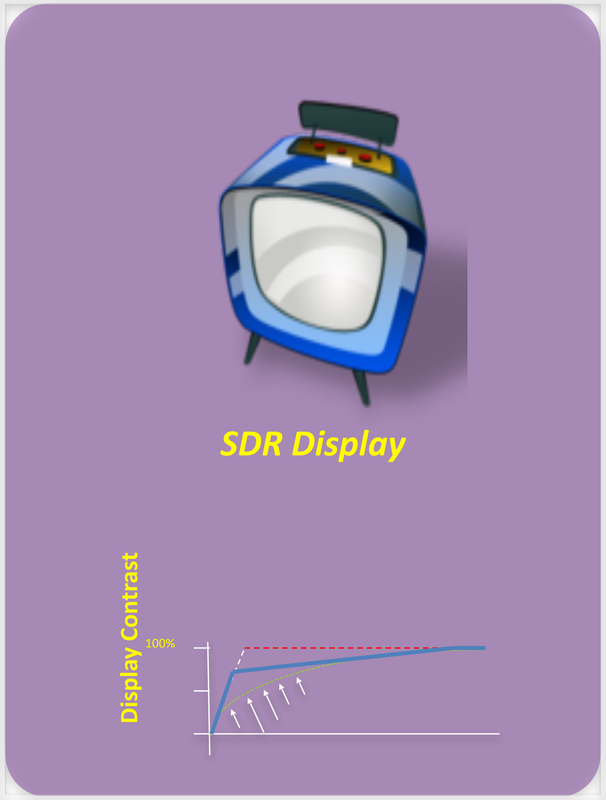
How HDR is generated – Signal mapping

- HDR signals can be re-mapped for simultaneous SDR operation

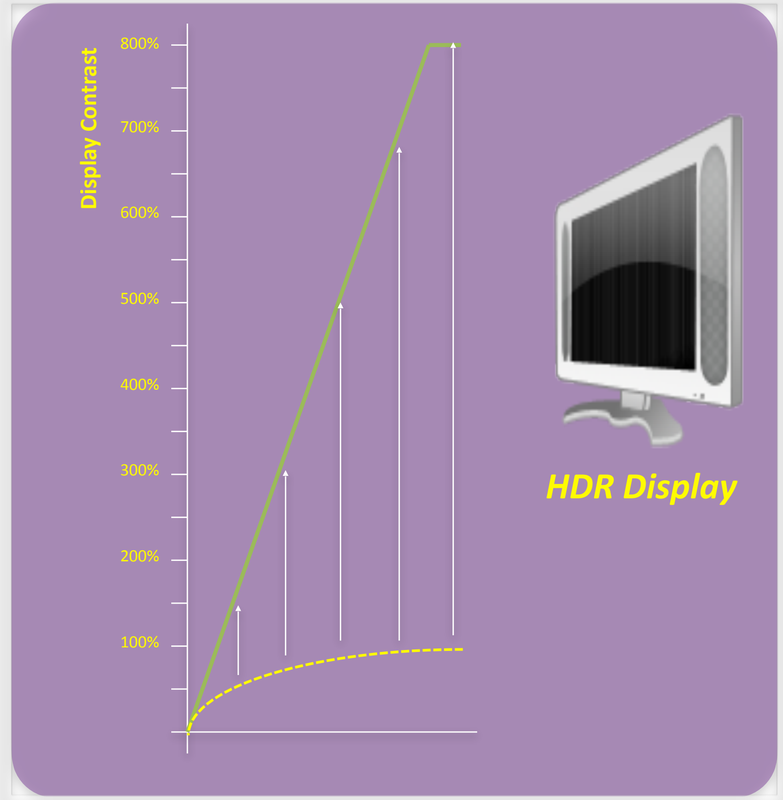
Signal processing for HDR operation
Scene contrast is more even distributed over the output signal



Re-mapping of the HDR signal for SDR use



Re-mapping of the HDR signal for HDR use



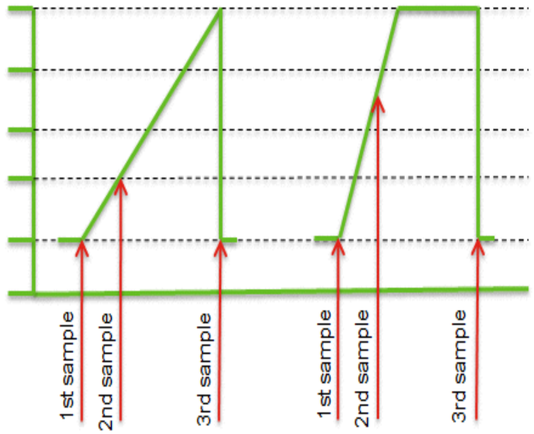
Note: For the sake of clarity, the gamma correction is not included in the graphs

HDR Explained

- HDR offer a very clear improvement of the viewing experience
  - ☑ Not resolution dependent
  - ☑ Visible from all distances and on all screen sizes
- There several competing system proposals
  - ☑ From Dolby, BBC, Technicolor, Philips, NHK
- They are not compatible to each other
  - ? ☐ Will there be one system for all markets, countries, etc.?
  - ? ☐ If not will one system be convertible into another?

HDR Explained

- High dynamic range operation is easy to realize with CMOS imagers
  - The latest FT-CMOS cameras offer a dynamic range of up to 15 F-stops
  - In regular operation with a linear exposure and readout of the imager
- CMOS imagers can offer a further extended dynamic range
  - By using a multiple readout of the pixels during one exposure cycle
  - Because of the non- destructive readout



XDR Solutions

- Delivering the full dynamic range of 15 F-stops
- ☑ Enough for all HDR displays in the foreseeable future
- Parallel HDR and SDR outputs for highest flexibility
- ☑ Dual control mode of the camera control panels for best results in both outputs

LDX 86 Series Camera Head with XF Fiber Transmission

XCU Universe XF with the Cradle

HD/4K out
HDR

HD/4K out
SDR

grass valley
A BELDEN BRAND

Why called XDR - Extended Dynamic Range?

Many products claim HDR performance with limited 13-14 F-stops*[1] of dynamic range

[1] Equal to 200 - 400% of a regular camera

Grass Valley goes beyond this *full 15 F-stops*[*2]

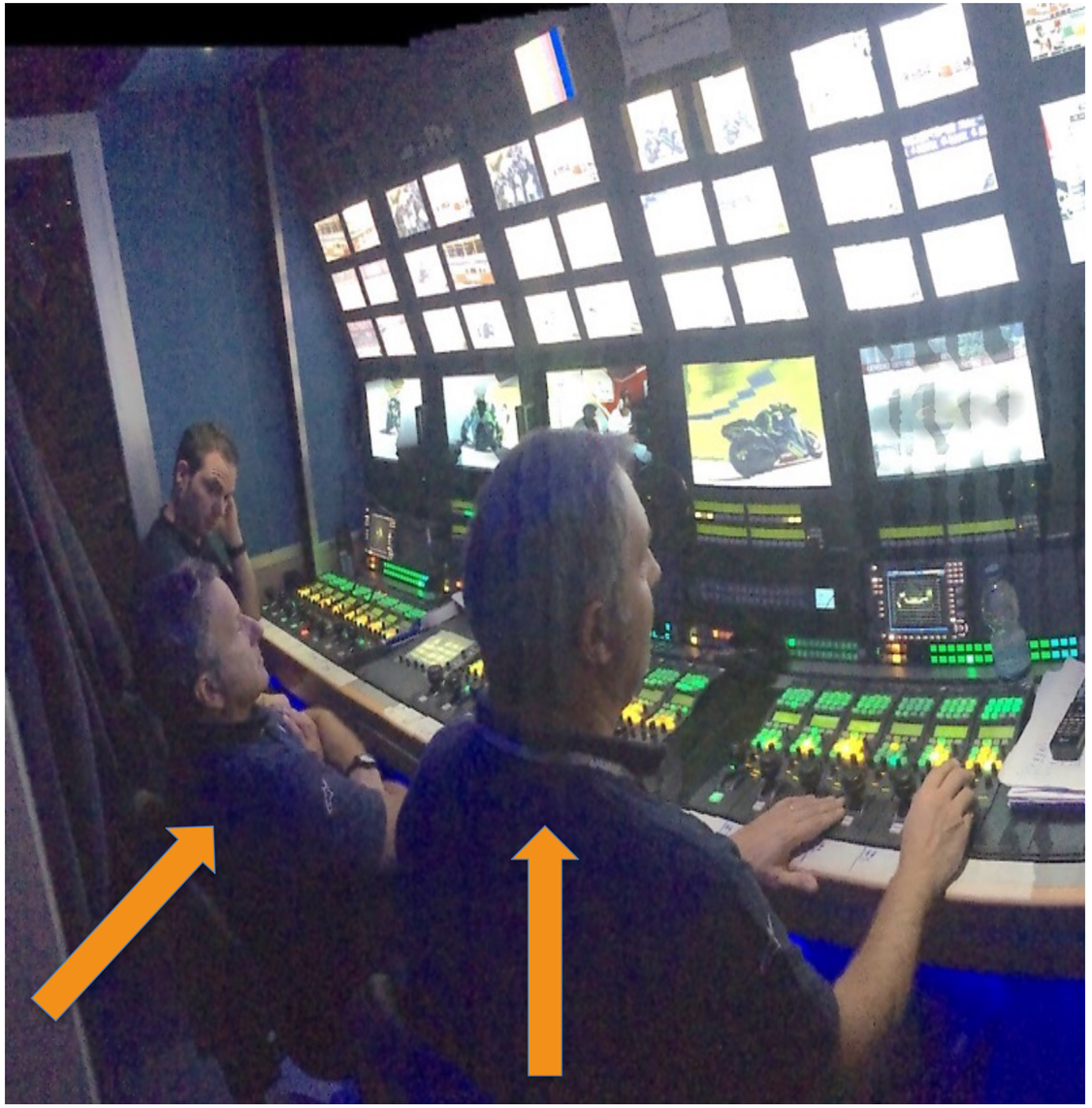
*[*2] Equal to >800% of a regular camera*

- **XensiumFT** imagers with
  15 F-stops of dynamic range
  - In regular operation with a linear exposure and readout of the imager

- **CMOS** imaging offers solutions for an even greater dynamic range
  - By using a multiple readout of the pixels during one exposure cycle
    - Because of the non-destructive readout

15 F-stops of dynamic range from Xensium FT imagers

XDR Solutions from LDX Series



LDX86 HD Extended Color Gamut

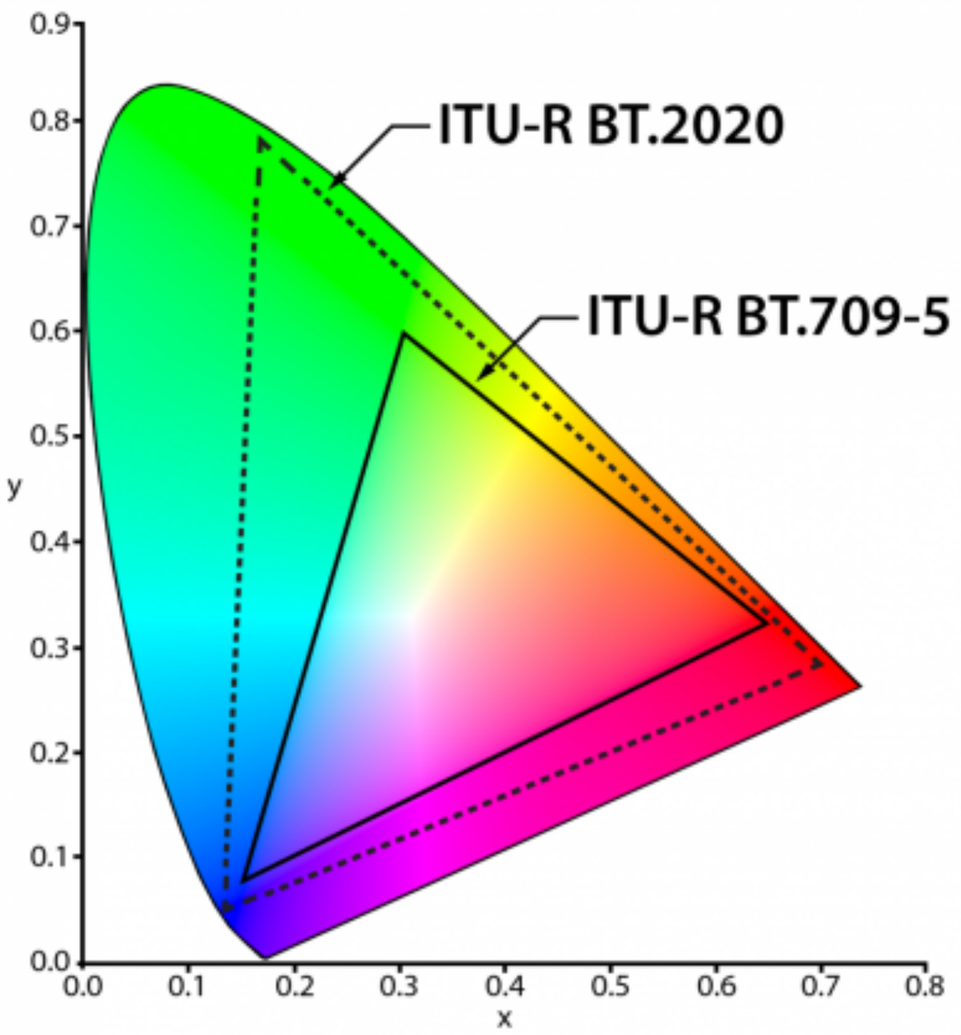
Many 4K cameras still use the color gamut from HD as specified in the

ITU-R BT.709

At the LDX 86 Series a wide color gamut can be selected as specified in the

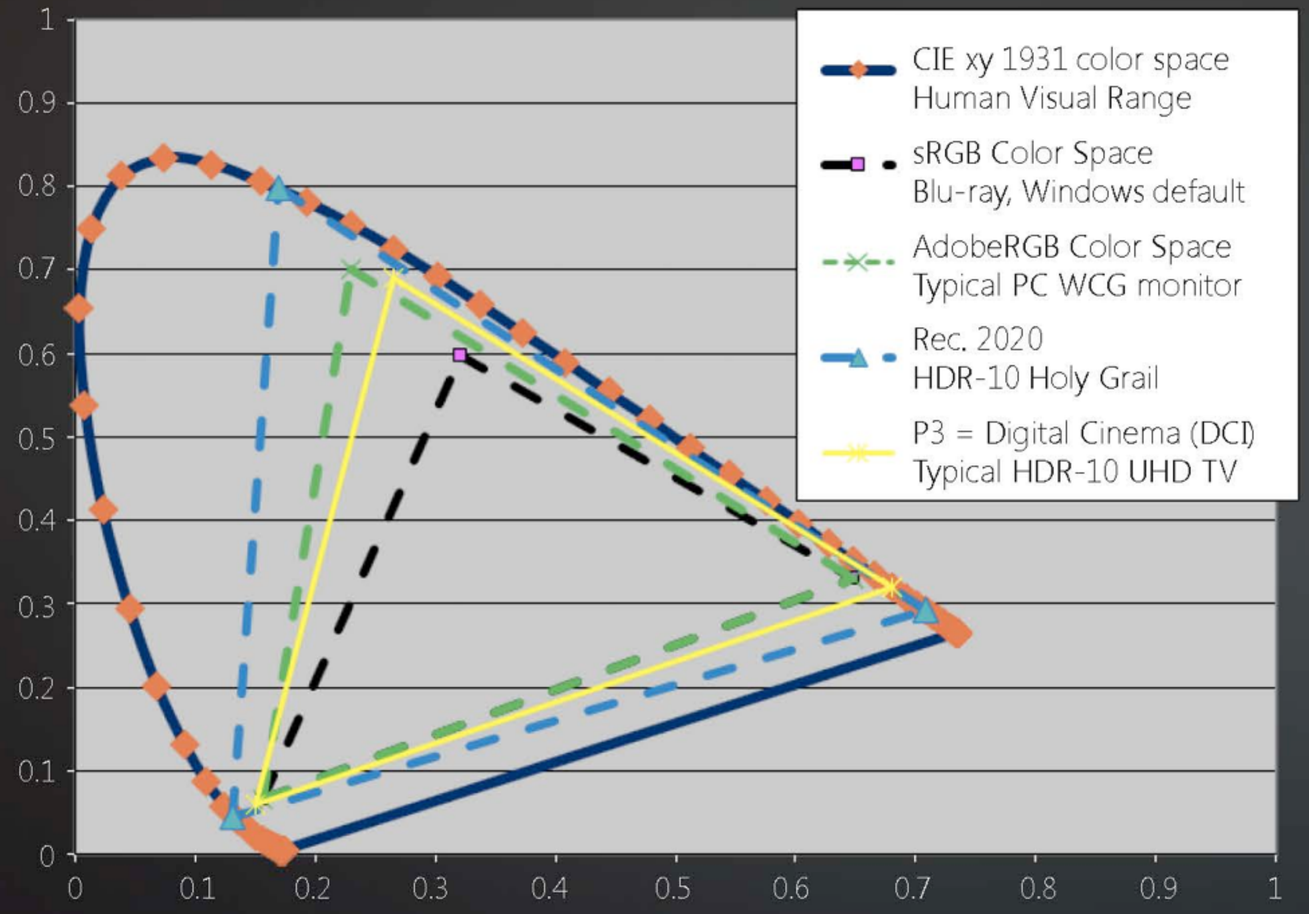
ITU-R BT.2020

Available in the next free of charge software package update

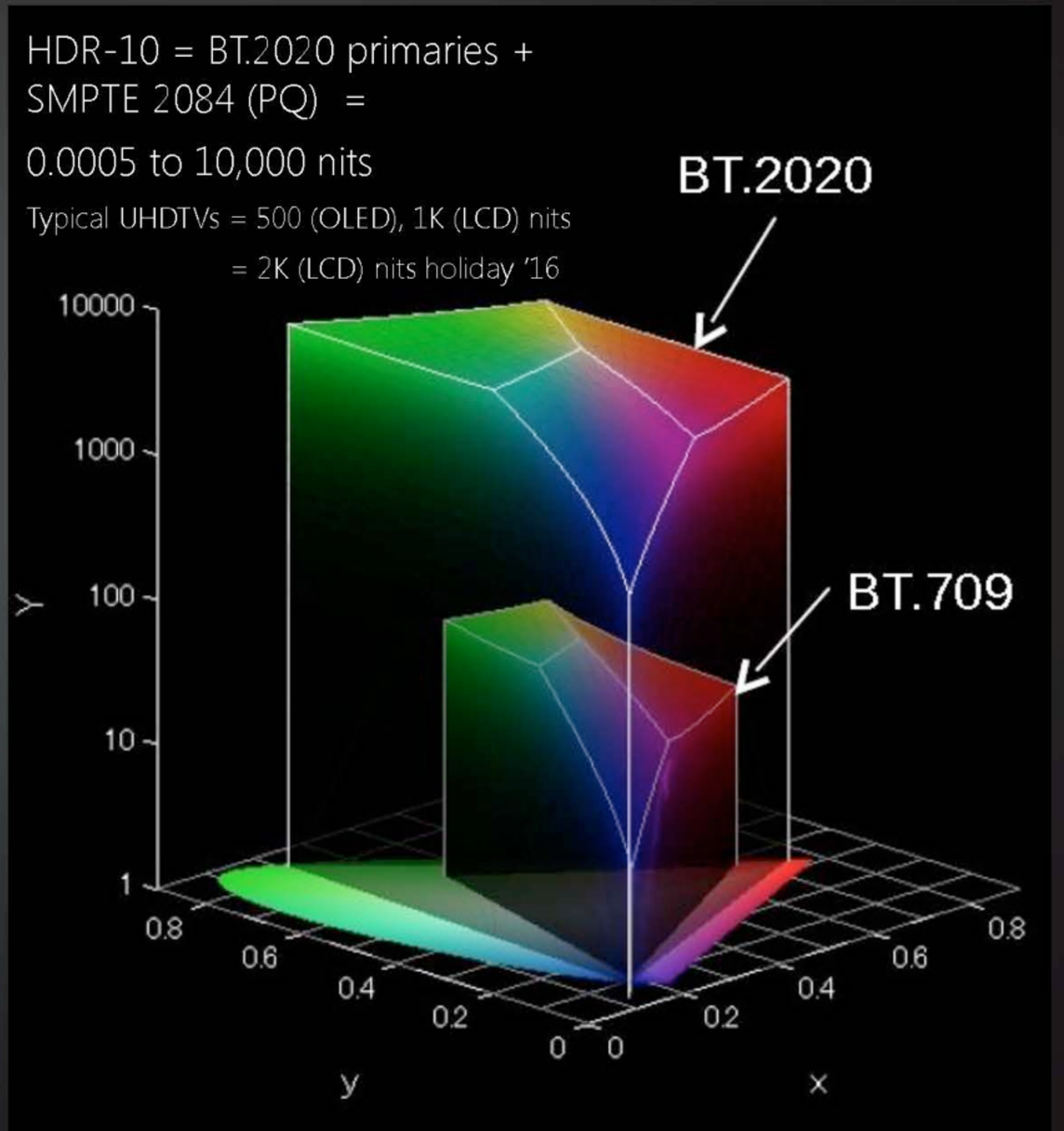


grass valley
A BELDEN BRAND

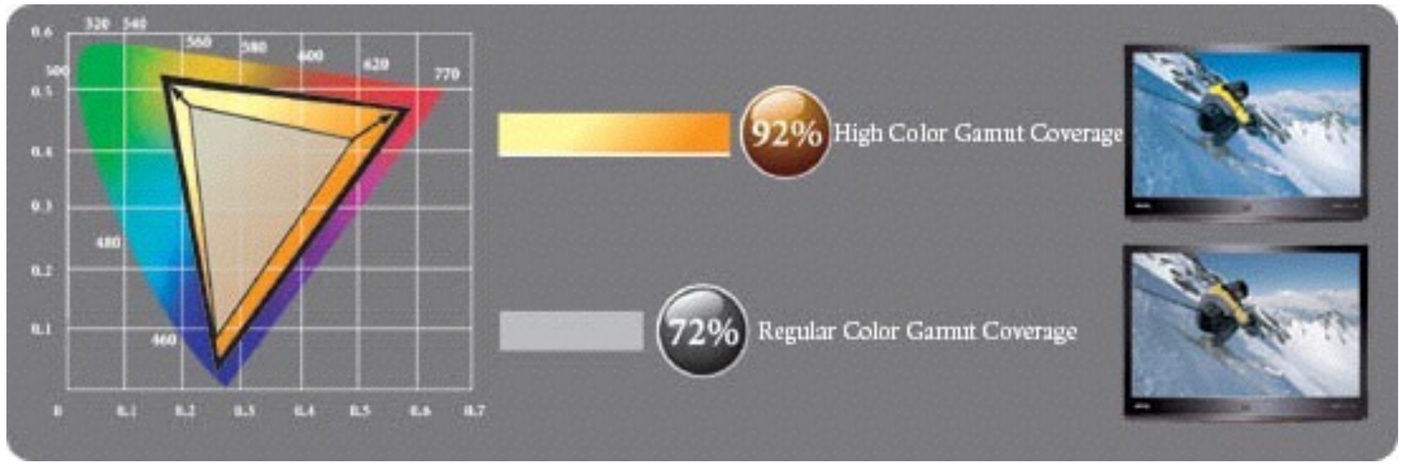
We Need More Color



- BT.709, sRGB, SMPTE 1886 (Gamma 2.4) = today's digital content
- BT.2020, SMPTE 2084 (PQ) = HDR Content's color container



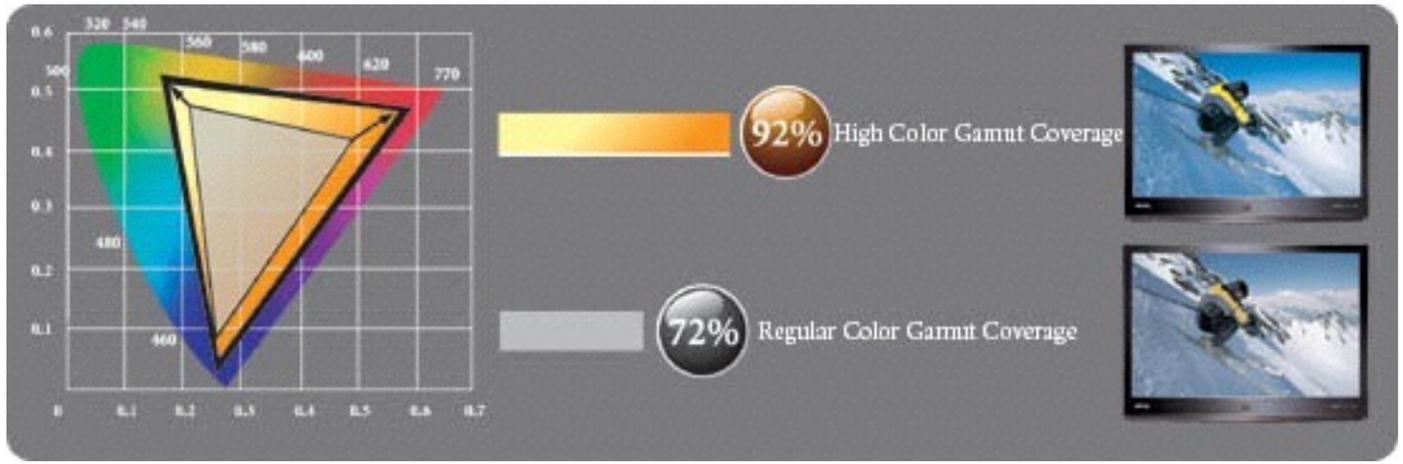
LDX86 HD Extended color Gamut



Wide Colour Gamut for true-to-life colours

grass valley
A BELDEN BRAND

LDX86 HD Extended color Gamut



When using Extended color Gamut
It is important also to set the display in this mode

Set both devices in
Extended color gamut

grass valley
A BELDEN BRAND

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 XtremeSpeed**
- **LDX 86 4K , XDR, CG explained**
- Technical inside LDX XtremeSpeed
- *Basic Service and Diagnostics (session 7)*
- **Looking inside (Head,Adaptor,XCU)**
- *Basics Dyno and Summit (session 9)*

grass valley
A BELDEN BRAND

LDX XtremeSpeed series

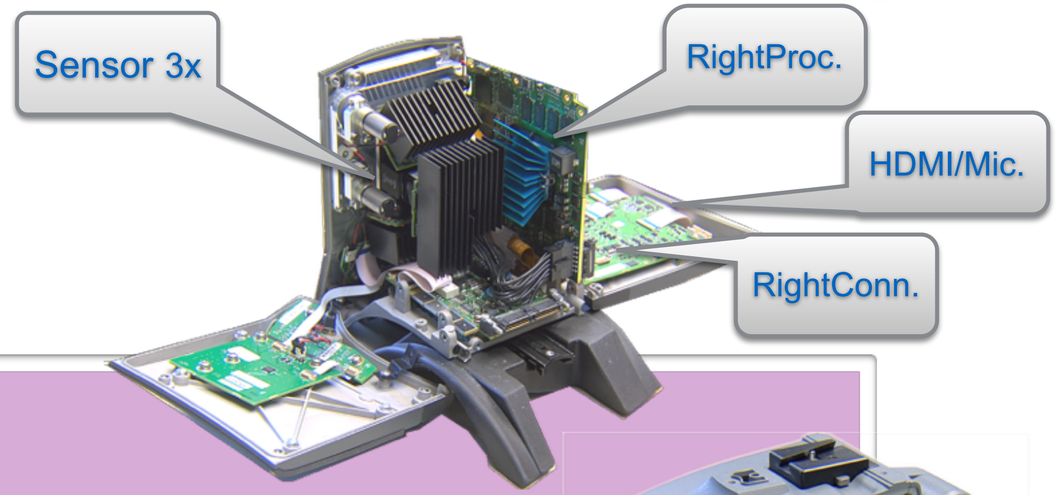
Introduction LDX XtremeSpeed

Within the HighSpeed project a new high speed camera system is being developed based on the LDX camera head, the New Fiber adapter and the XCU base station.

The goal is to develop a camera platform that is basically identical to the Worldcam LDX camera system, and can be upgraded to a high-speed camera system by licensing.

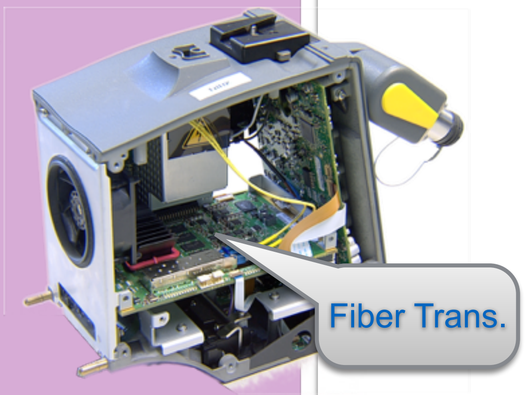
LDX XtremeSpeed series

- Introduction LDX XtremeSpeed



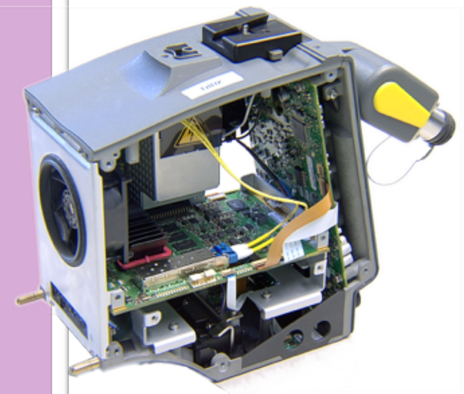
The most important issues are:

- For the LDX-camera:
  - The new FT HS sensor (which will replace the current FT-Xensium sensor).
  - The video processing (RP-board).
  - The RC-board (improvements w.r.t audio and HDMI 1080P)
  - The HDMI and Mic. board
- For the Adapter:
  - The new transmission system (based on the newly developed fiber transmission board).
- For the XCU:
  - Implementing the new transmission system
  - Anylight algorithm (for 1080p 3-speed and 1080I / 720 P 6-speed)
  - Fiber Interconnection to the server.



LDX XtremeSpeed series

Introduction LDX XtremeSpeed



As these high-speed video frame rates (uncompressed) are rather new for the broadcast market, the interface to the storage/play-out equipment has to be communicated and agreed upon with the suppliers of the servers: both GrassValley (internally) and EVS.

3 Coaxes with 3 Gbit signals (1.5 Gbit for 1080i and 720P 3-speed) shall be used for the interface with the server in the first phase of the project.

The Anylight algorithm has to be modified due to the fact that the 3-consequent frames will be available at the same time.

The next step will be to have one high-speed interconnection direct to the Network based environment.

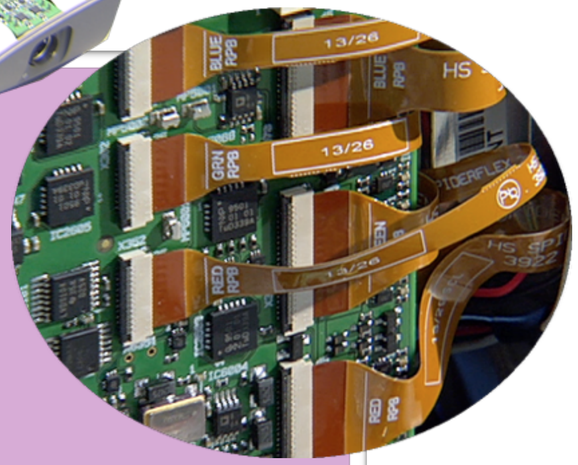
LDX XtremeSpeed series

- Introduction LDX XtremeSpeed

The Sensor (front)

A replacement for the current FT-Xensium is needed

to meet the speed which is necessary for the higher frame rates asked for in this project.



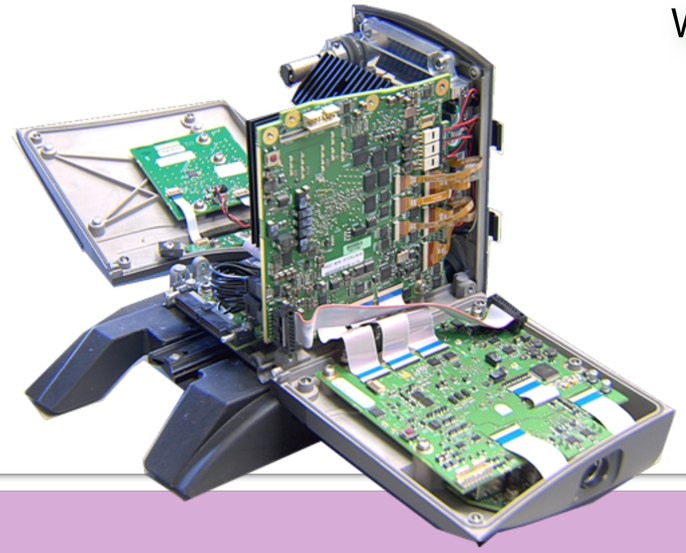
An extra connector at the sensor boards and the processing board will be added to

transfer all the data from the sensor to the processing board.

This means that also the so-called spider flex has to be updated

LDX XtremeSpeed series

- Introduction LDX XtremeSpeed



The Sensor (front)

As the new AD-converters from the sensor are designed to run at a maximum frequency of 225 MHz, the maximum speed with full resolution will be limited to 3 x 1080P or 6 times 1080i (processing speed is 450 Mhz).

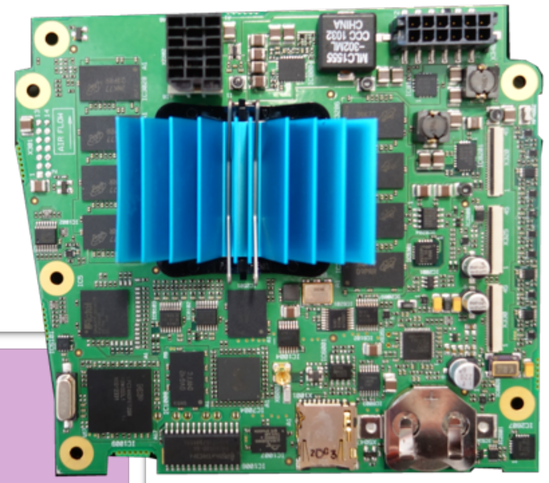
(The sensor has four AD-converters and is read-out twice for each image, so the total frequency of the sensor output is 900 MHz).

The interlaced image (1080I) in 3-speed will be converted from the 1080p signal in the processing.

For 6-speed 1080I the image will be generated inside the sensor by adding two lines to keep the output sample rate limited to 900 Mhz.

LDX XtremeSpeed series

- Introduction LDX XtremeSpeed



The Video processing (RP board)

3-Speed processing for the 1080P format or 6-speed processing for the 1080I or 720P format asks for a processing speed of 450 MHz.

As this will lead to a lot of timing errors in the FPGA-modules used for the processing, it is decided to do the processing in 3 parallel streams.

This will also lead to a more efficient use of bandwidth for the memories used for the input processing.

For 1080P three frames will be processed in parallel. The memories of the input processing will be used to create this parallel stream of three frames.

For all these new processing a new Right Processor board was developed.

LDX XtremeSpeed series

- Introduction LDX XtremeSpeed

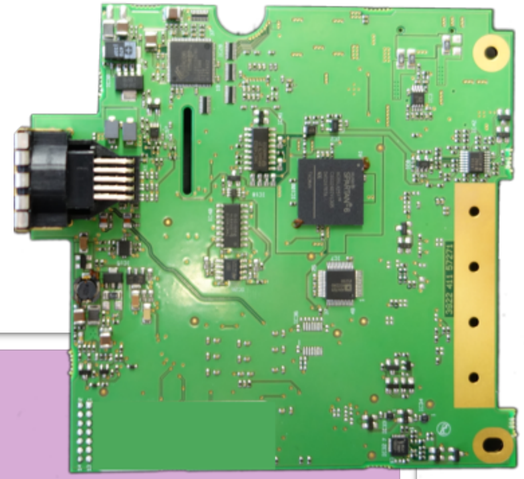
The Video processing (RP board)

Part of the processing of the signals in the single and triple speed modes for 1080I and 720P will be done in 1080P format.

This will cost some extra power, but it gives the possibility to combine and scale the VF-signal in a different way than the output signal.

operational video mode	VF-output
	- Adaptor HD BNC - VF connector
1080I50/59	1080I50/59
1080P50/59	1080I50/59
720P50/59	720P50/59
1080I150/179	1080I50/59 (combined)
1080P150/179	1080I50/59 (combined)
720P150/179	720P50/59 (combined)
1080I300/359	1080I50/59 (combined)
720P300/359	720P50/59 (combined)

- Introduction LDX XtremeSpeed



Right Cover and HDMI Mic board

With the current LDX it is not possible to have 1080P signals at the HDMI or VF connector.

These interfaces at the RC & HDMI Board have to be upgraded for these functions.

The VF and HDMI output are prepared for 3G HDSDI.

Also the audio input for the front microphone needs an update this to optimize the performance of the audio signal.

This means a gain controlled amplifier at the input, where now a fixed gain is implemented.

A new Right cover and HDMI Micr. board will be necessary to comply with the CRS

LDX XtremeSpeed series

- Introduction LDX XtremeSpeed

Synchronisation

As the camera head has to be combined with the current LDX-adapters and the new 3G Triax/Fiber adapter (for single speed only), it is necessary to use the same synchronization system as it is used in the current LDX camera.

This means that the synchronization is based on the (analogue) H-lock signal and a frame reset puls.

This is also the most cost-effective way of synchronizing for the 3G triax adapter.

Additionally it will be possible to synchronize the camera head with a 3-level sync-signal (future developments such as a compact adapter or wireless system) and through the HD-SDI-signal at the EXT-1 input.

LDX XtremeSpeed series

- Introduction LDX XtremeSpeed

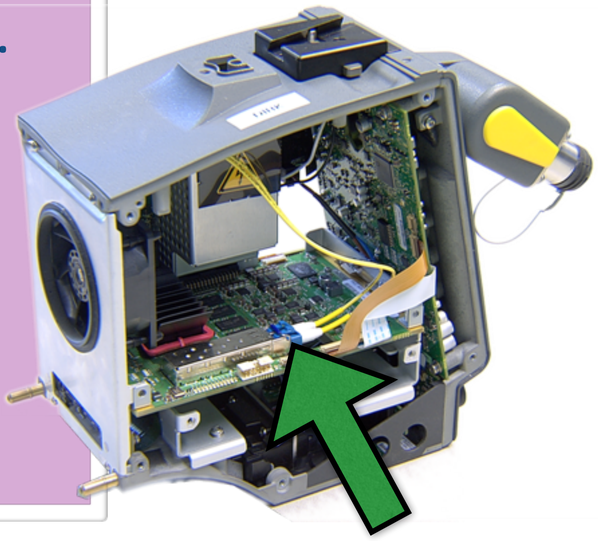
The Adaptor

The modifications from the LDX 5650(3G fiber) adaptor is limited to the transmission board.

The new fiber transmission board is now prepared for a 10 Gbit fiber transmission.

The rest of the adapter is generic and will not be influenced by this high speed mode.

The goal is to have an audible noise from the camera according the NR20 standard in single speed. For higher speed a higher noise level from the fan is acceptable. (max NR30)



LDX XtremeSpeed series

- Introduction LDX XtremeSpeed

The Transmission Camera to XCU

The following signals have to be transmitted from camera to XCU:

- 1, 3 or 6 speed video (1.5 to 9 Gbit/sec uncompressed video data)
- 4 audio channels (in total 6 Mbit/sec)
- 2 intercom channels (in total 3 Mbit/sec or less)
- control data (incl metadata) + private data (in total less than 1 Mbit/sec)
- 1 Gbit ethernet (for highspeed applications, this could be limited to 10 or 100 Mbit/sec)

LDX XtremeSpeed series

- Introduction LDX XtremeSpeed

The Transmission XCU to Camera

The return signals will be identical for all speeds, as the return video signals are always normal speed signals (processing in the generic board of the XCU).

These signals are:

- 2 return video signals (2 x 1.5 Gbit/sec: 1080I or 720P)
- Teleprompter video (270 Mbit/sec)
- 3 intercom signals (Engineering and Production intercom and program audio)
- control data + private data
- 1 Gbit ethernet (for highspeed 10 or 100 Mbit/sec)

LDX XtremeSpeed series

- Introduction LDX XtremeSpeed

The Basestation (XCU)

The new transmission system will be implemented on a new pc-board in the XCU at the position of the 3G triax transmission board.

The current interconnection from this Transmission board to the Generic board is 2 x 3 Gbit/sec.

As the Live signal is also generated at the transmission board there is a need for four 3 Gbit video connections from transmission board to generic board.

The output of the video outputs on the CCU in the high-speed mode will be according the table on slide 41

LDX XtremeSpeed series

Introduction LDX XtremeSpeed

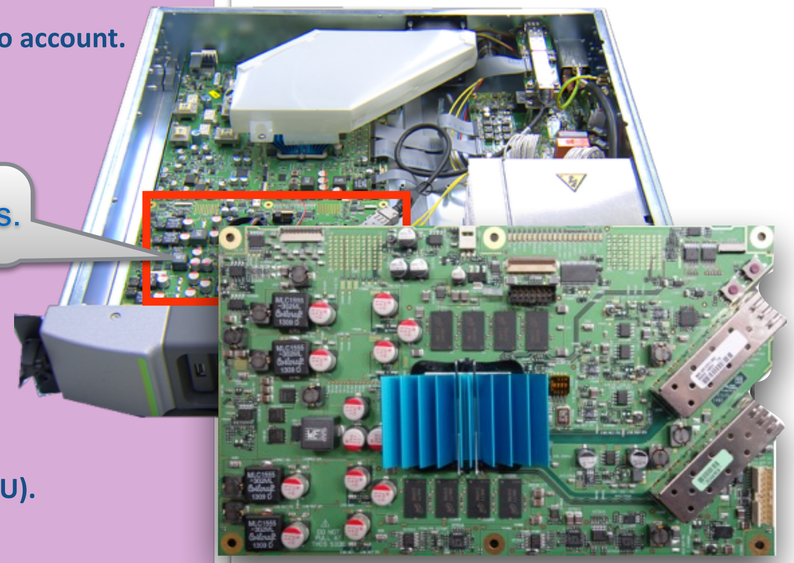
The Transmission board (XCU)

The Transmission board will be equipped with an SFP+ module for the interface to the camera.
For the location of the SFP-module at the board it is necessary to take the length of the fibers of the connector assembly into account.

A big FPGA (Xilinx) and enough memory will be necessary to handle the 10Gbit protocol with
the Forward Error Correction. Also the Any Light algorithm is implemented on this board.
The FEC error correction for the return channels can be limited to save bandwidth in the memories.

As the combined signal has to be generated before the Anylight algorithm, also the combined signal has to be generated
at the transmission board and send to the generic board.

This board must also be prepared for the (fiber) interface to IP based environment.
If this is a 10 Gbit interface, a second SFP+ module must be prepared (going to the interconnection at the backside of the XCU).



LDX XtremeSpeed series

Introduction LDX XtremeSpeed

The Generic board (XCU)

A new version of The Generic board is created for the extra input signals.

The redesign is mainly limited to the lay-out of the board, as the FPGA used on the current board can handle these extra input signals (number of receivers).

The resources of the FPGA and the memory on the board are expected to be able to handle the signal routing and eventually down-converting the Live signal (in 1080P switchable between 1080i and 1080P).

This new Generic board can be the default board for all XCU's.

Some extra features have to be implemented with respect to the current XCU (also for the sheep adapter):

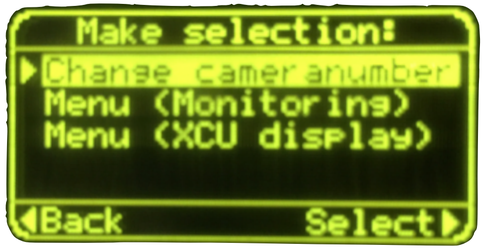
- The 1 Gbit (10, 100 Mb) ethernet trunk which is prepared, but not operational yet.
- Handling the EXT input signal from the camera (to Live/effect output) in single speed.
- The loop-through of the monitoring signal (selectable: input at EXT3)
- Extra ancillary data (meta data) embedding.
- Sending Metadata over the C2IP-link to the LDK connect Gateway.

The latency of the Live signal will be as short as possible as this signal will be used in the Live production.

Together with the monitoring and SDI output signals, this signal will be synchronized with the EXT reference input.

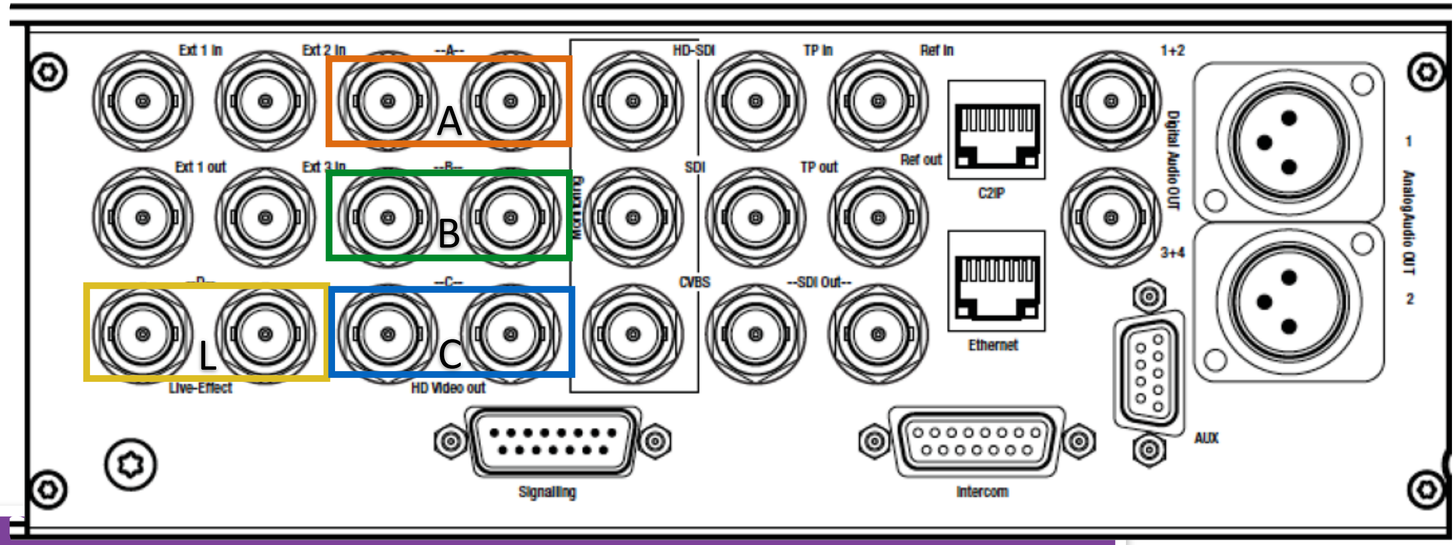
LDX86 HD/4K XS

New menu control with XCU display



LDX86 HD/4K XS

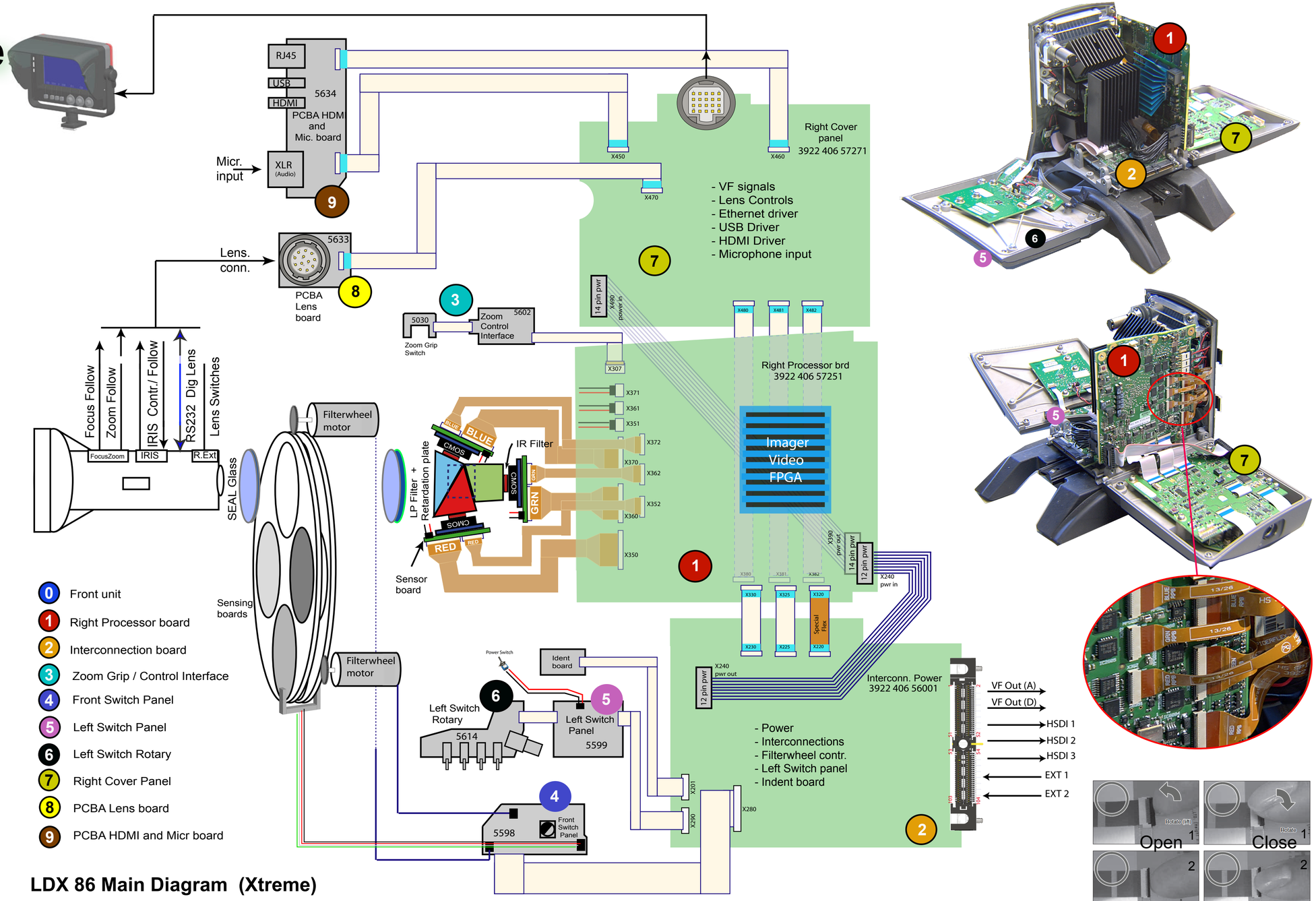
XCU Outputs

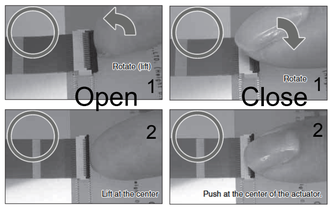


Video Format	Output A	Output B	Output C	Live-out	Monitoring
1080P150/179	Phase 1 (3Gb/s)	Phase 2 (3Gb/s)	Phase 3 (3Gb/s)	Live (3Gbit/s)	Live (1.5Gbit/
1080I150/179	Phase 1 (1.5Gb/s)	Phase 2 (1.5Gb/s)	Phase 3 (1.5Gb/s)	Live (1.5Gbit/	Live (1.5Gbit/
1080I300/359	Phase 1+2 (3Gb/s)	phase 3+4 (3Gb/s)	Phase 5+6 (3Gb/s)	Live (1.5 Gbit/	Live (1.5Gbit/
720P150/179	Phase 1 (1.5Gb/s)	Phase 2 (1.5Gb/s)	Phase 3 (1.5Gb/s)	Live (1.5Gbit/	Live (1.5Gbit/
720P300/359	Phase 1+2 (3Gb/s)	phase 3+4 (3Gb/s)	Phase 5+6 (3Gb/s)	Live (1.5 Gbit/	Live (1.5Gbit/
4K 50/59	Q1 (3Gb/s)	Q2 (3Gb/s)	Q3 (3Gb/s)	Q4 (3Gb/s)	Live (1.5Gbit/
XDR	XDR	XDR	XDR	XDR or SDR	SDR

grass valley
A BELDEN BRAND

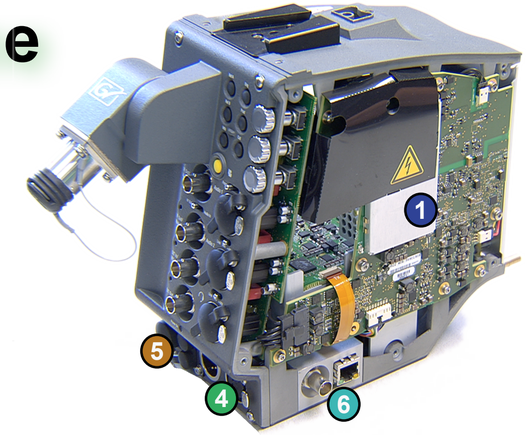
LDX Extreme Head

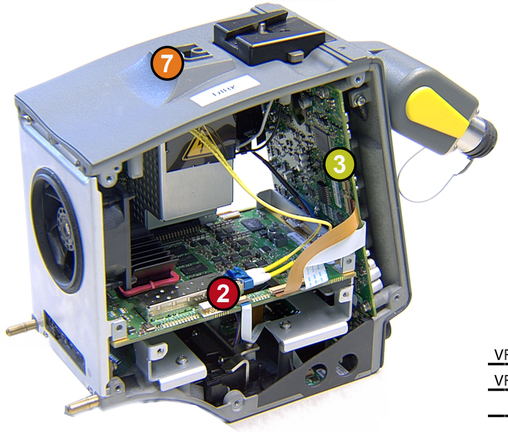




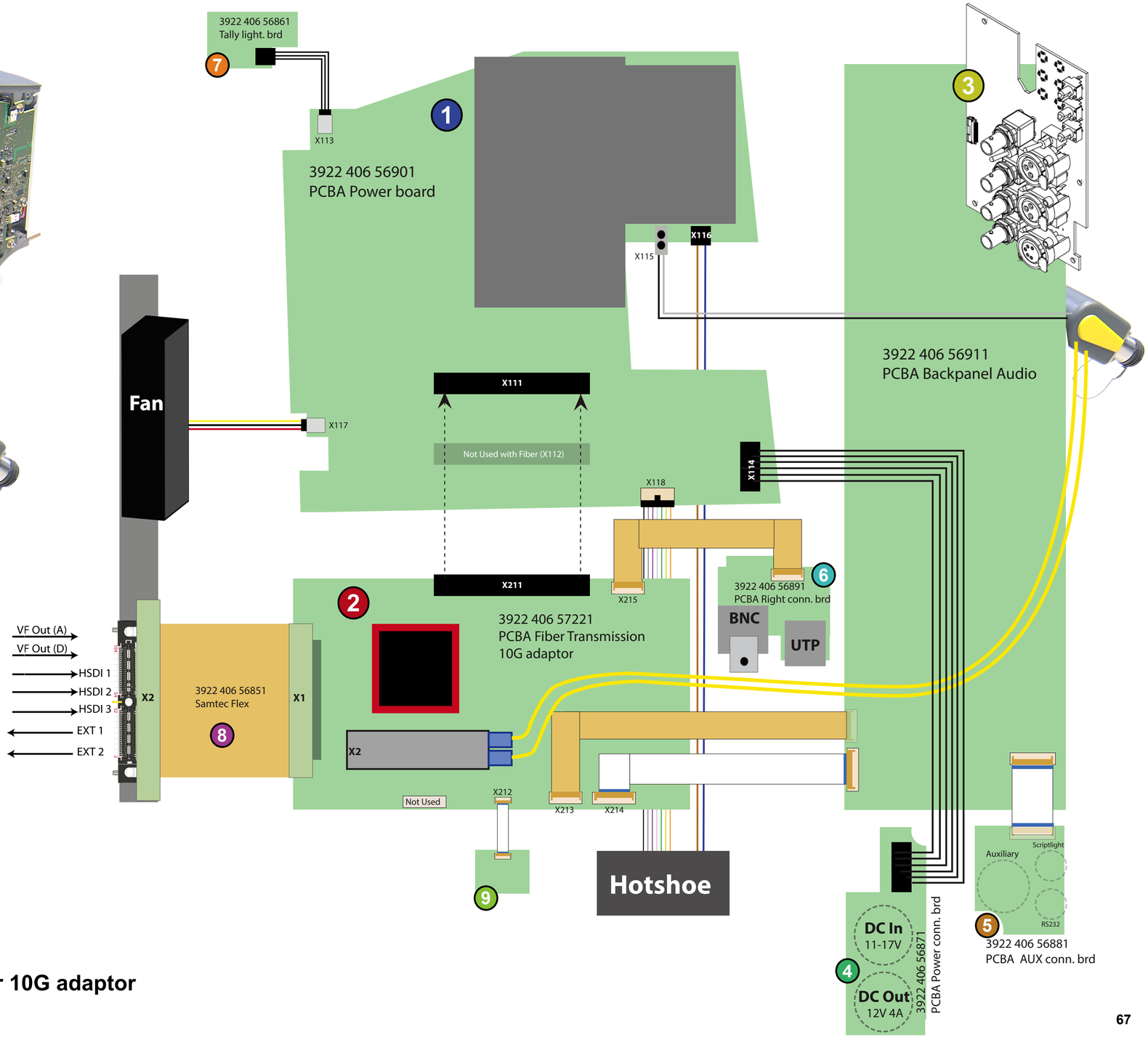
LDX 86 Main Diagram (Xtreme)

LDX Extreme Adaptor



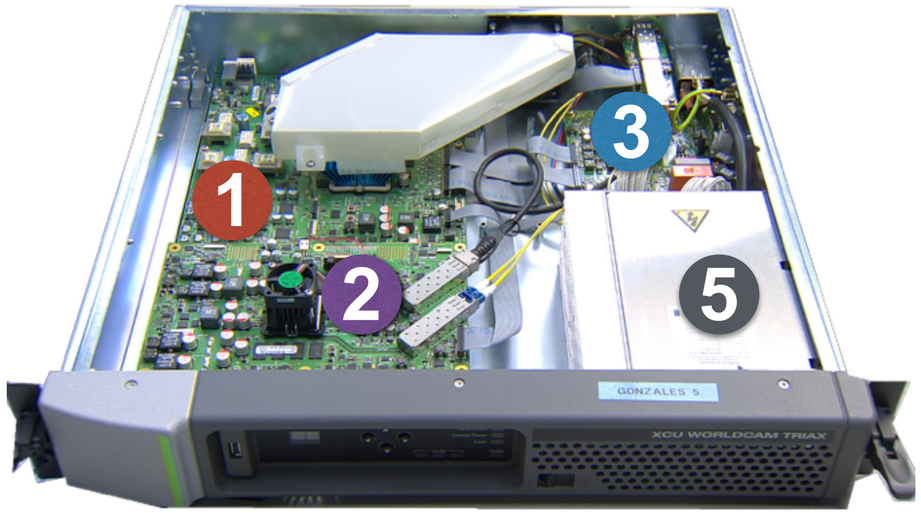


1. PCBA Power board
2. PCBA Fiber Trans. 10G adaptor
3. PCBA Backpanel Audio
4. PCBA Power conn.board
5. PCBA AUX conn. brd
6. PCBA Right conn. brd
7. Tally light board
8. SamTec Flex
9. Indentification board

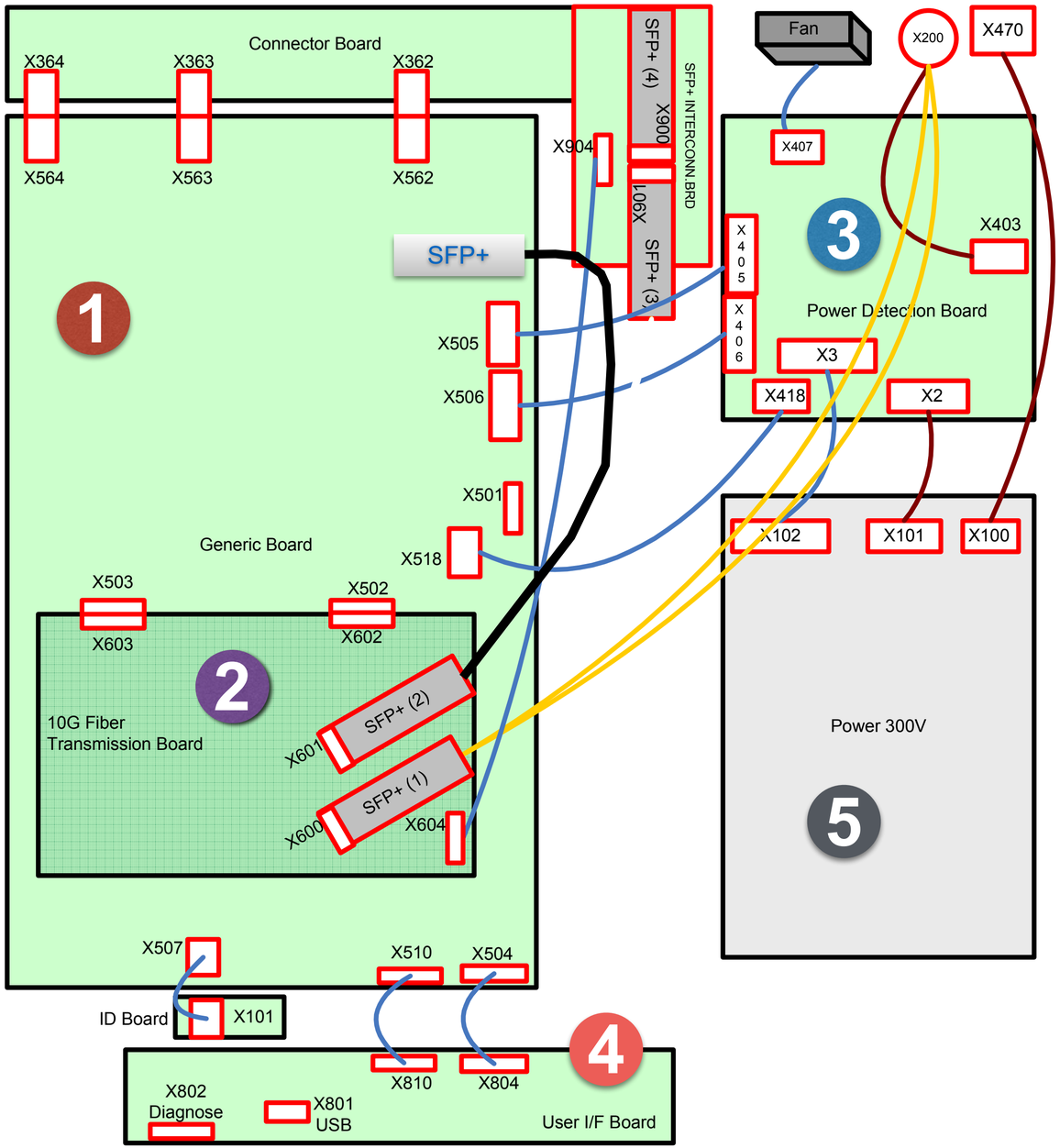


LDX Fiber 10G adaptor

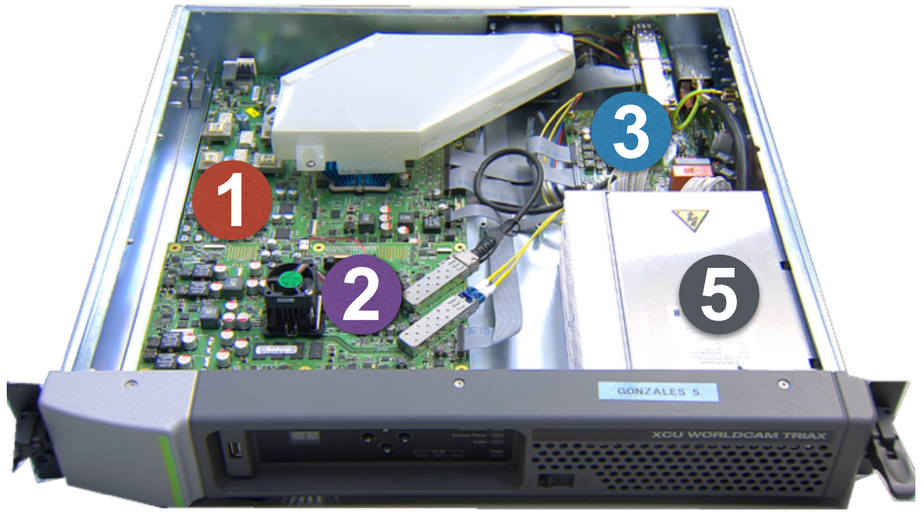
LDX Extreme XCU / 4K (BNC)



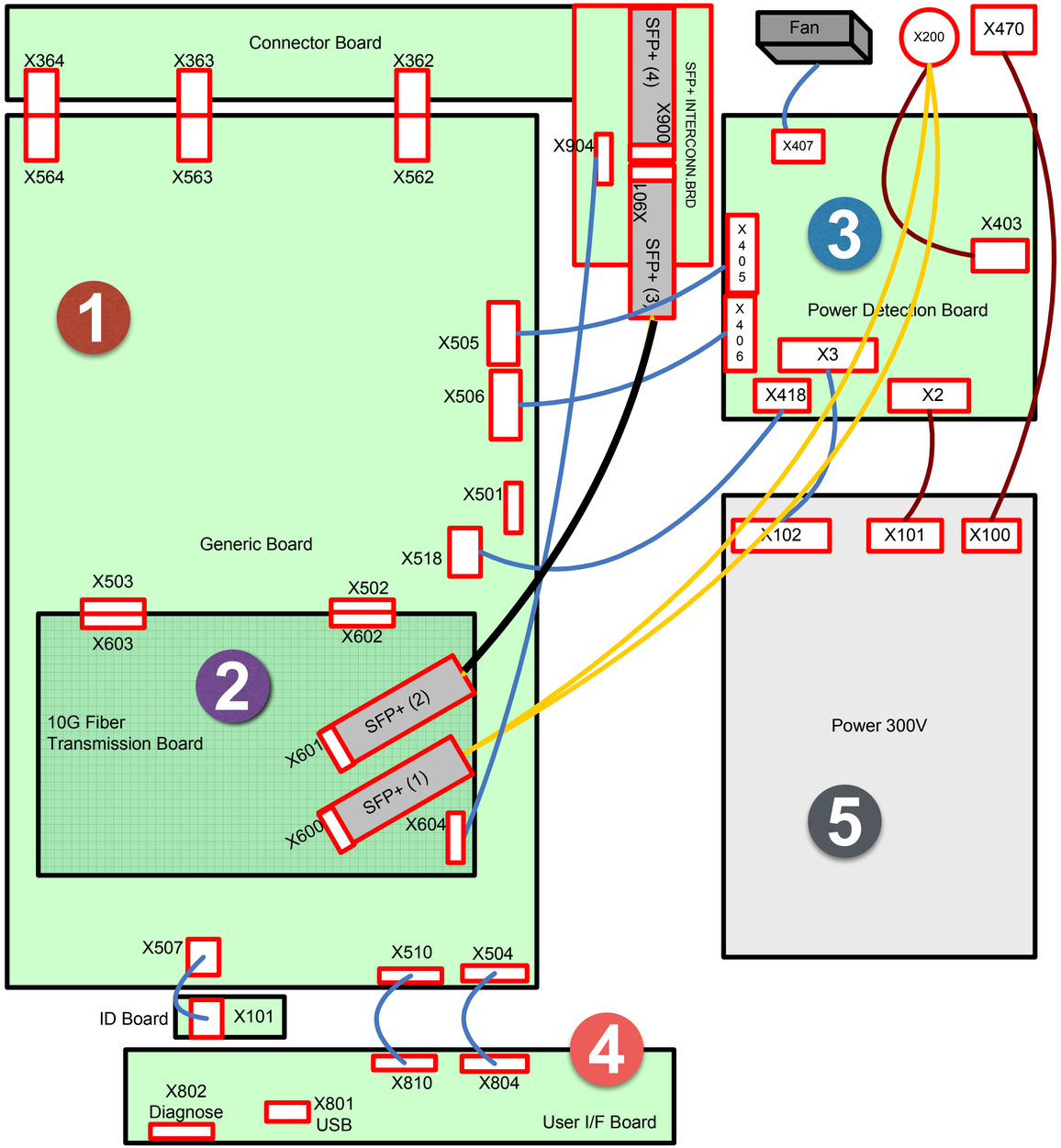
1: Generic board
2: Transmission board
3: Power detection board
4: User I/F board
5: Power 300V



LDX IP XCU 4K over TICO



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



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 XtremeSpeed**
- **LDX 86 4K , XDR, CG explained**
- **Technical inside LDX XtremeSpeed**
- *Basic Service and Diagnostics (session 7)*
- Looking inside (Head,Adaptor,XCU)
- *Basics Dyno and Summit (session 9)*

LDX 86/Adaptor/XCU

-> Disassemble