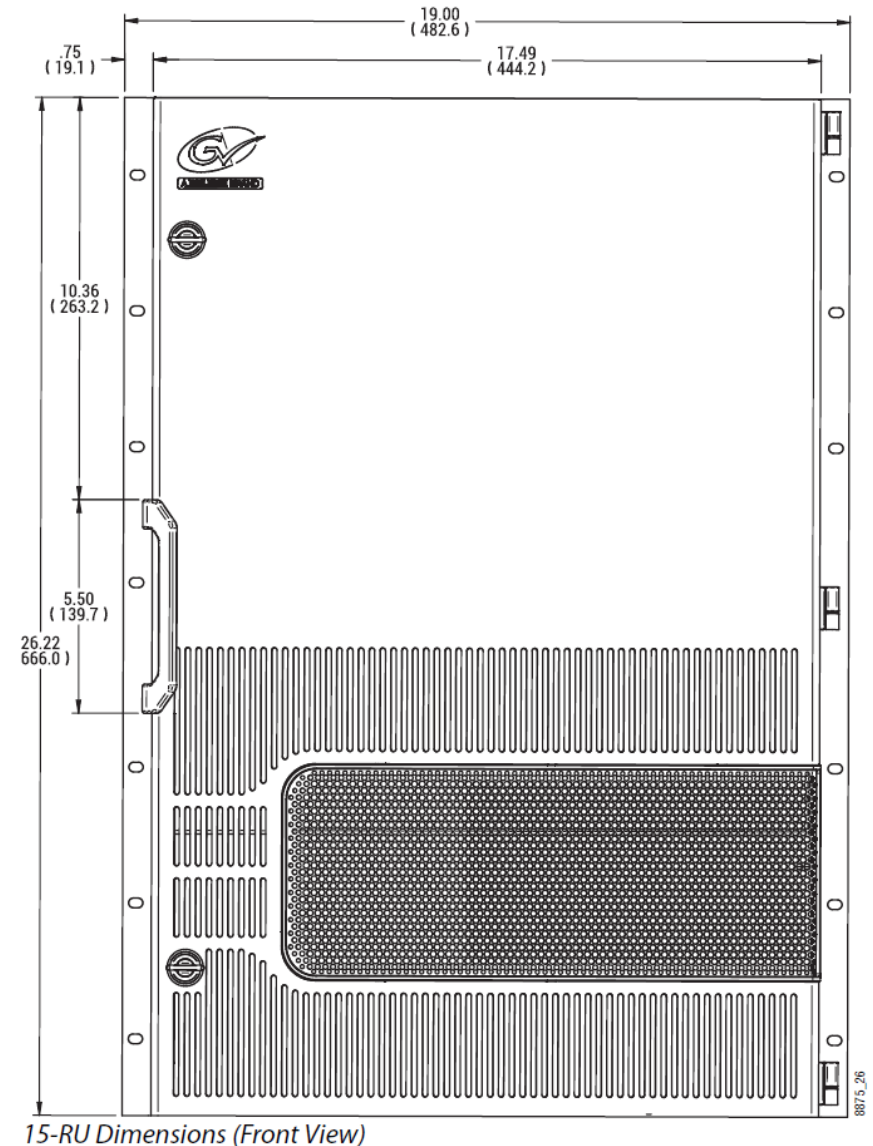
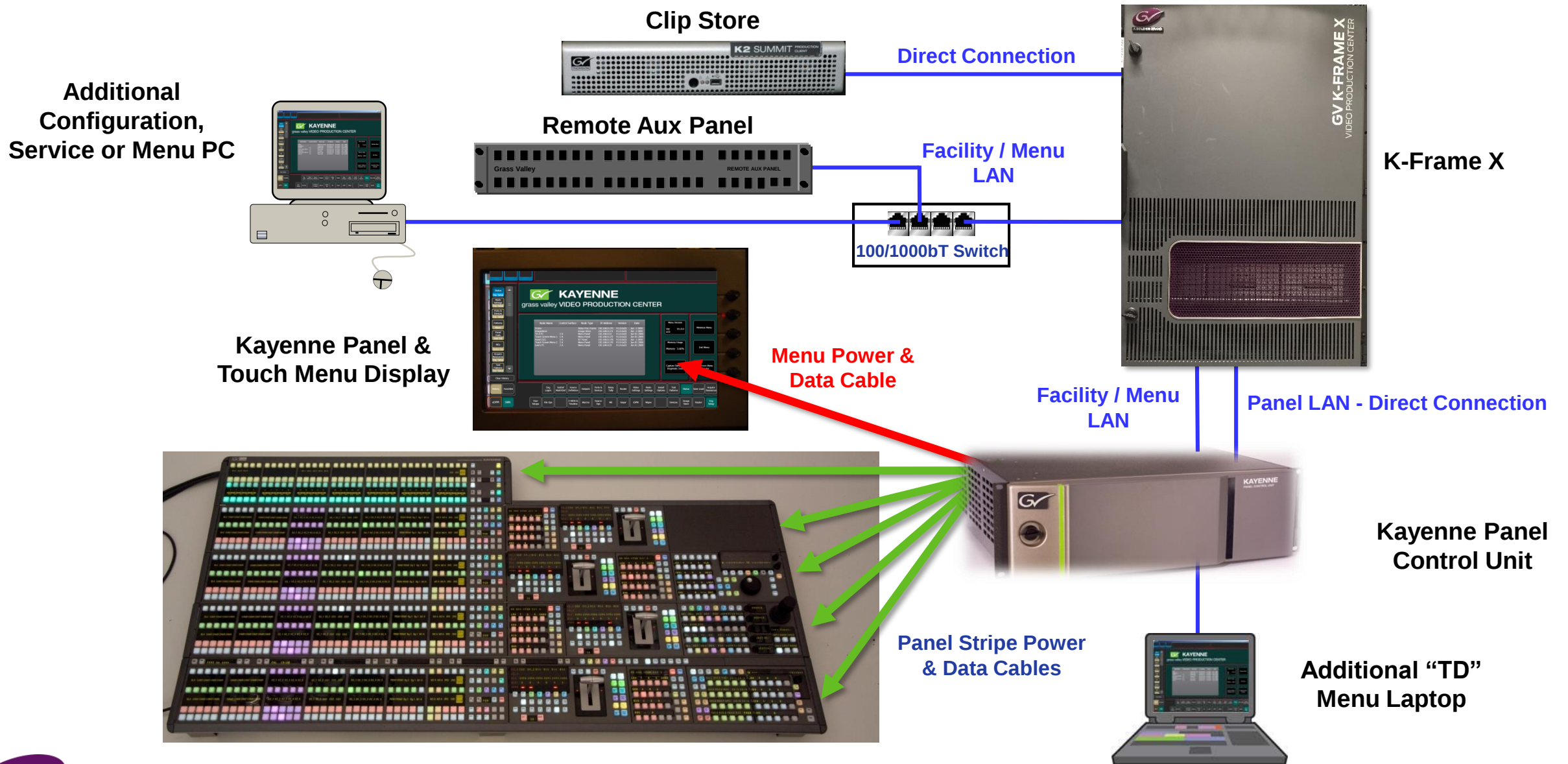


Section 6D - K-Frame X Hardware ST2110 and HDR

- Uses a new Large frame (15RU) for airflow and deeper rear modules
- Has the same basic ME functionality as the existing Large K-Frame
 - 160 Inputs x 80 Outputs (not including the Modular I/O)
 - Up to 10 - 16x8 input cards – SDI or IP modules
- Modular I/O
 - Up to 4 - 8x4 - Combination of SDI or IP Modules
 - Modular I/O cards will be available with conversion capability
- The X frame supports any mixture of SDI and
- IP I/O, up to 192 x 96

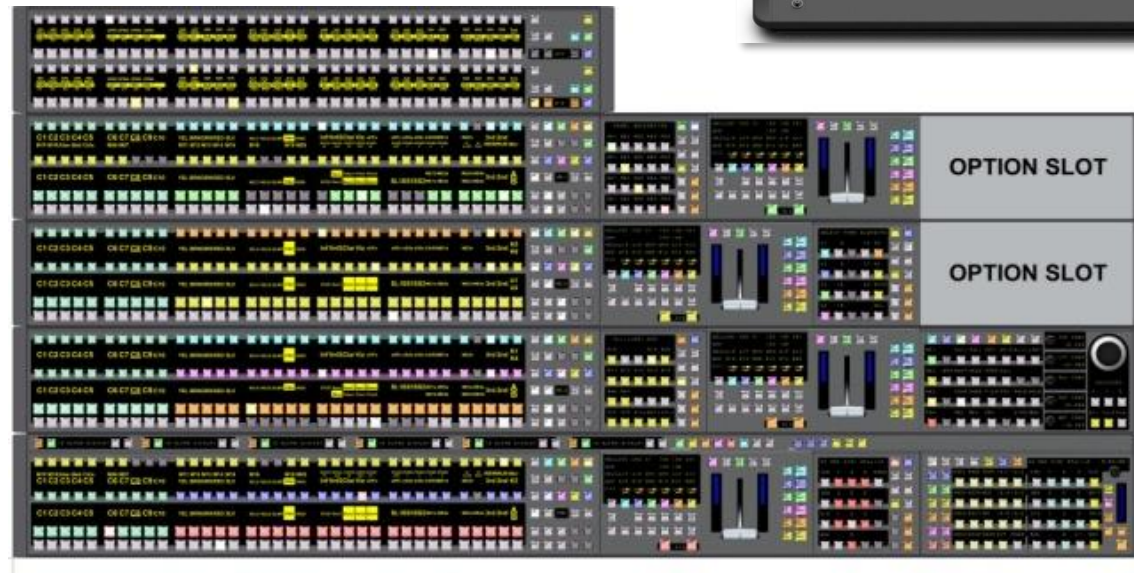


K-Frame X System Communications

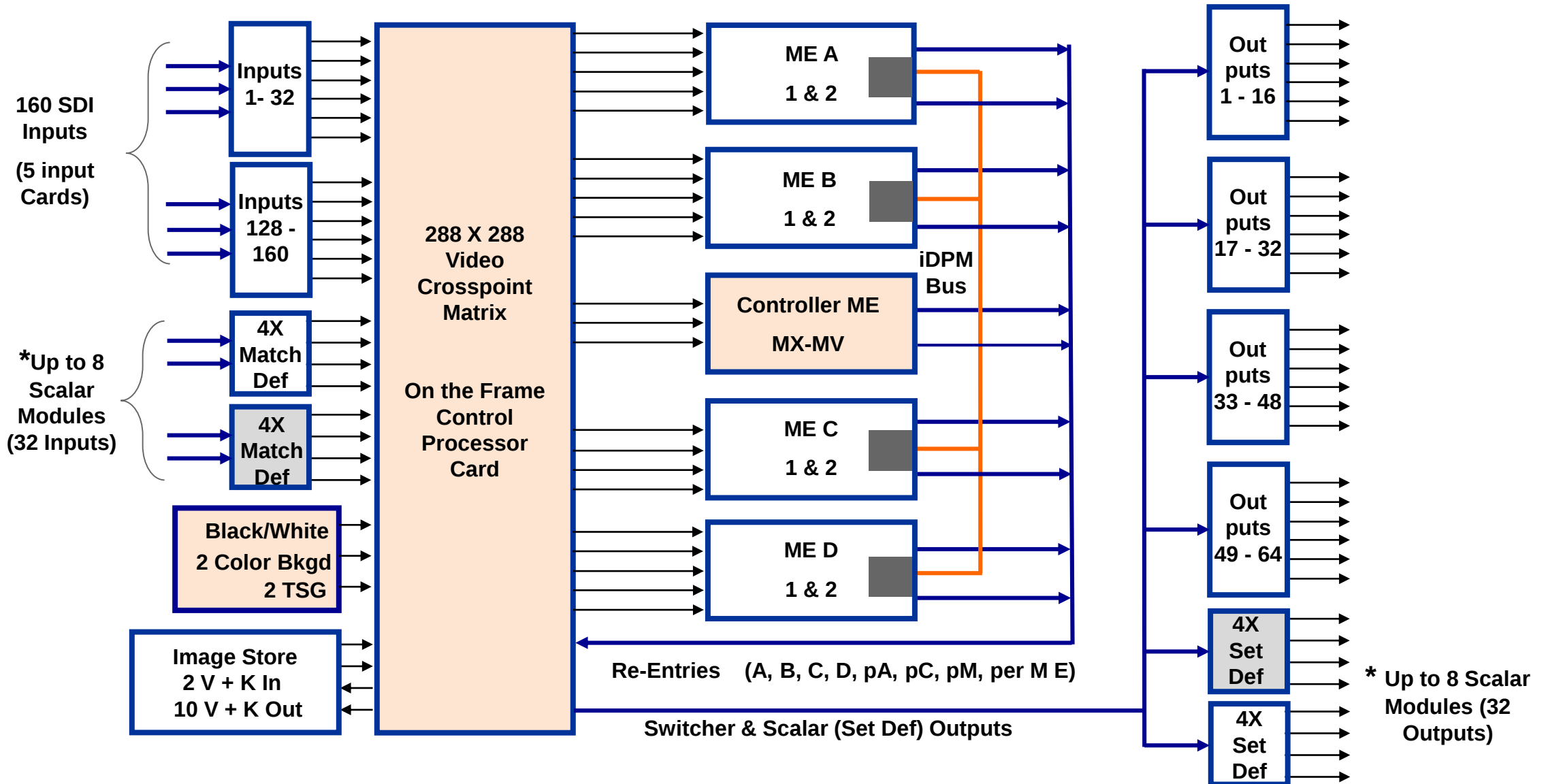


K-Frame X Control Surfaces

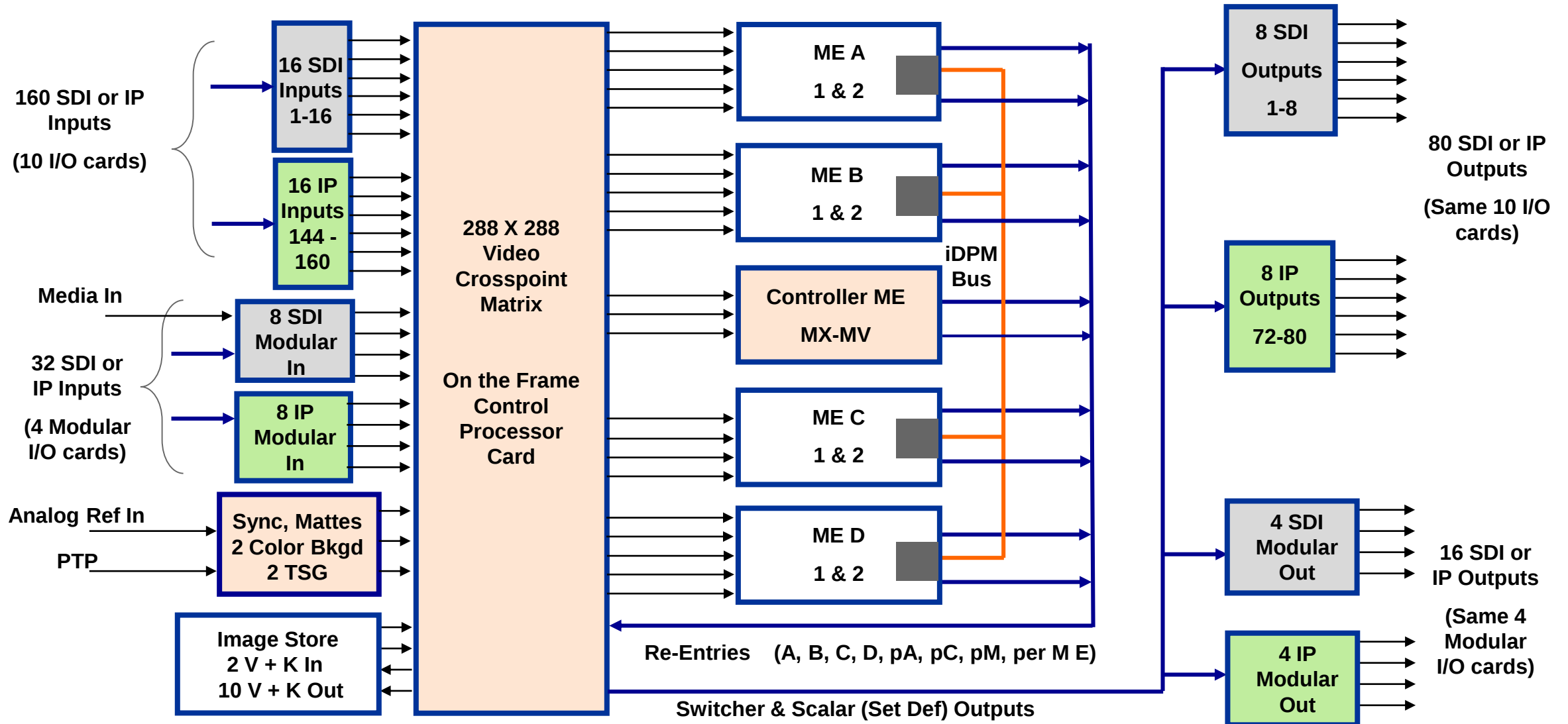
The X frame can be used with any K-Frame panel - Kayenne, Karrera, GV Korona or KSP combination



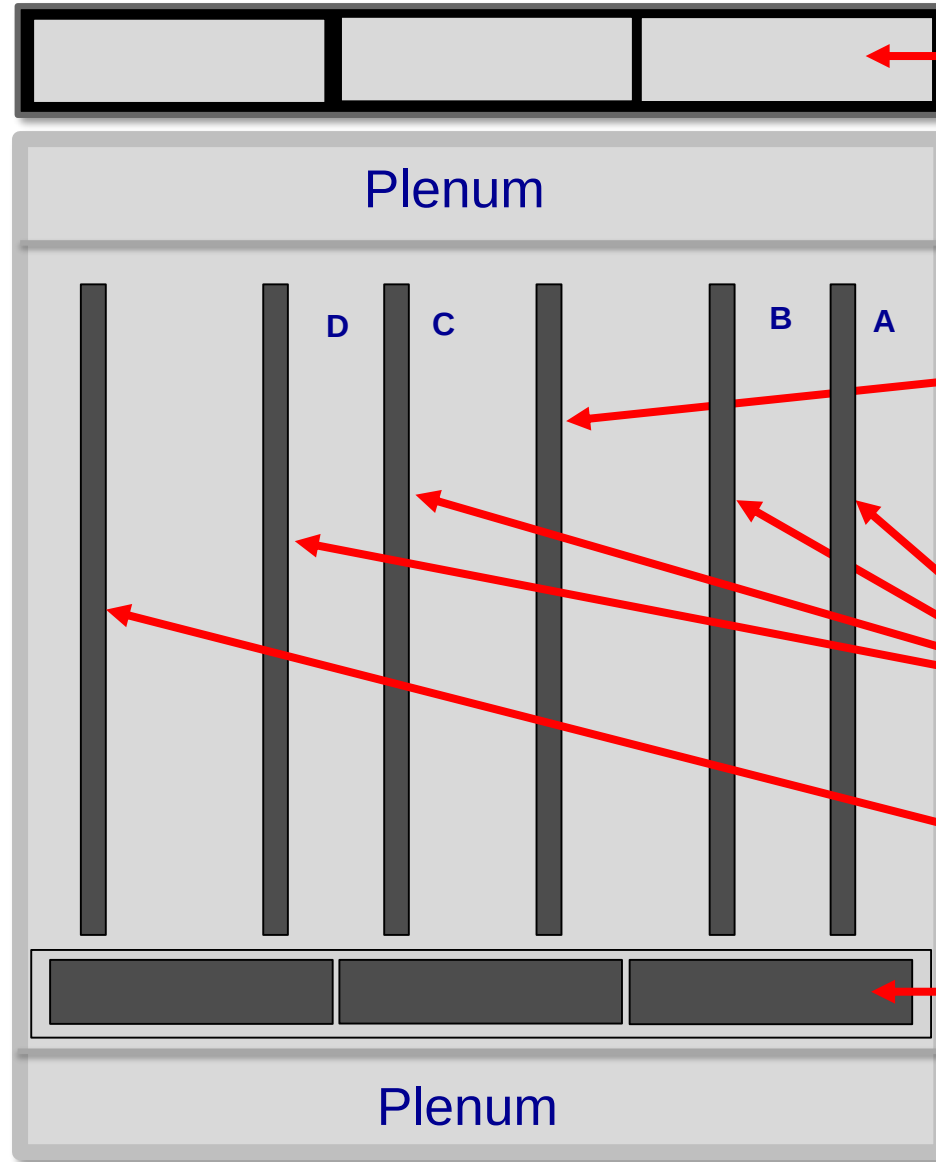
Large K-Frame Video Flow 9 ME (13 RU)



K-Frame X - Video Flow 9 ME (15 RU)



K-Frame X Board Layout



External Power Supply Frame

9 ME's with Dual ME boards

Controller Board with XPT,
1 dedicated MultiViewer and
the Controller ME

Dual ME boards (A1-2, B 1-2, C 1-2, D 1-2)
each with hardware for 4 iDPMs

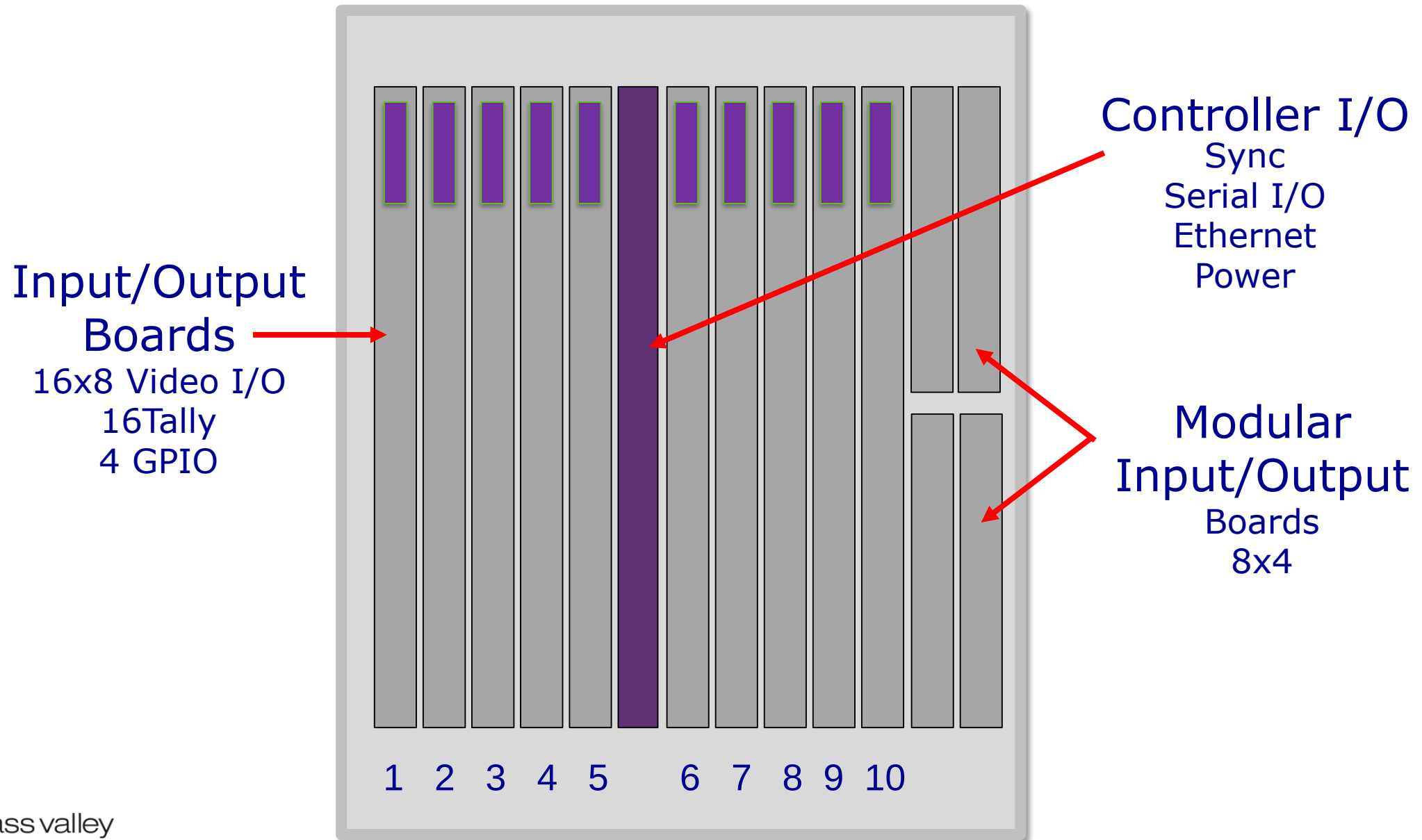
Image Store

Fans

Air flow

In from the front and out the sides and rear

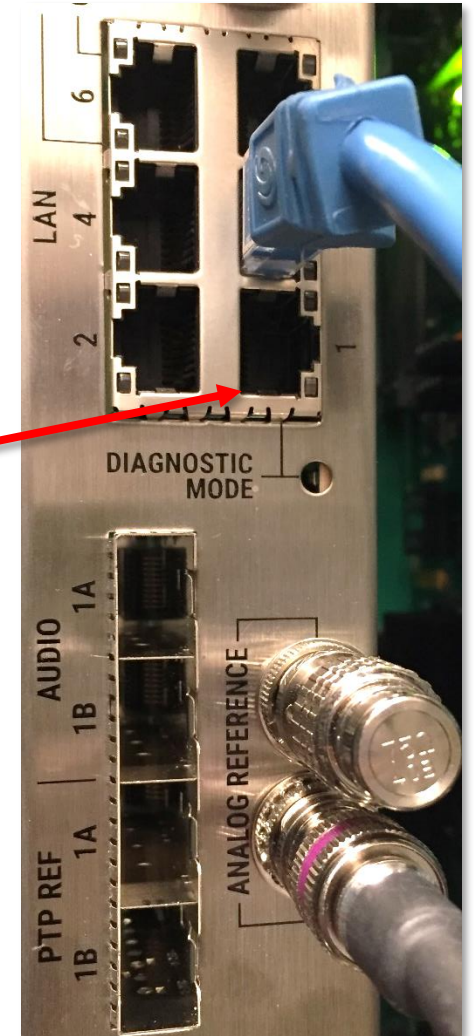
K-Frame X - Rear Layout



X - Controller

- The Controller module has the same basic functionality as the Large K-Frame Controller
 - Main CPU with SSD
 - 288 x 288 Video Crosspoint chip
 - Controller ME
 - 1 Multiviewer (dedicated)
 - 2 Test, B, W and 2 Matte signal generators
 - 8 Serial ports
 - 6 port Ethernet switch
 - Sync – New inputs to support PTP and audio references

Ethernet
Port 1 is the
diagnostic
port

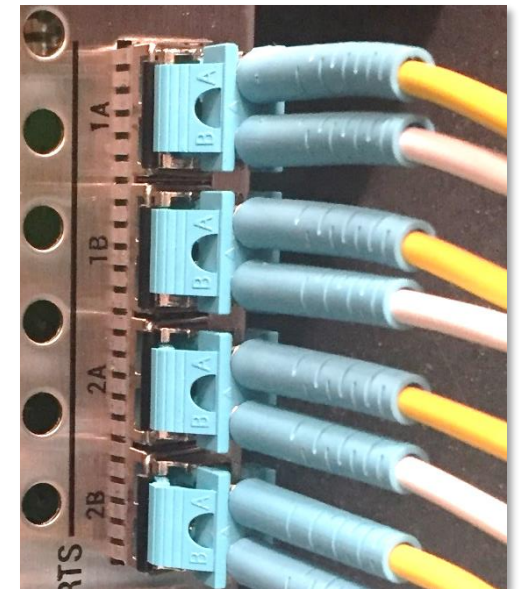
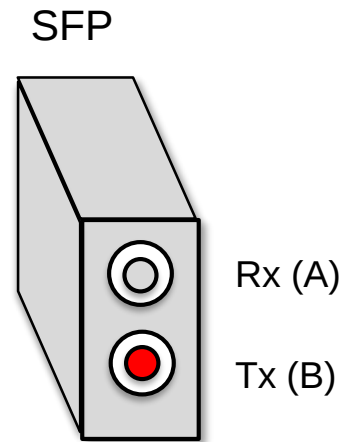
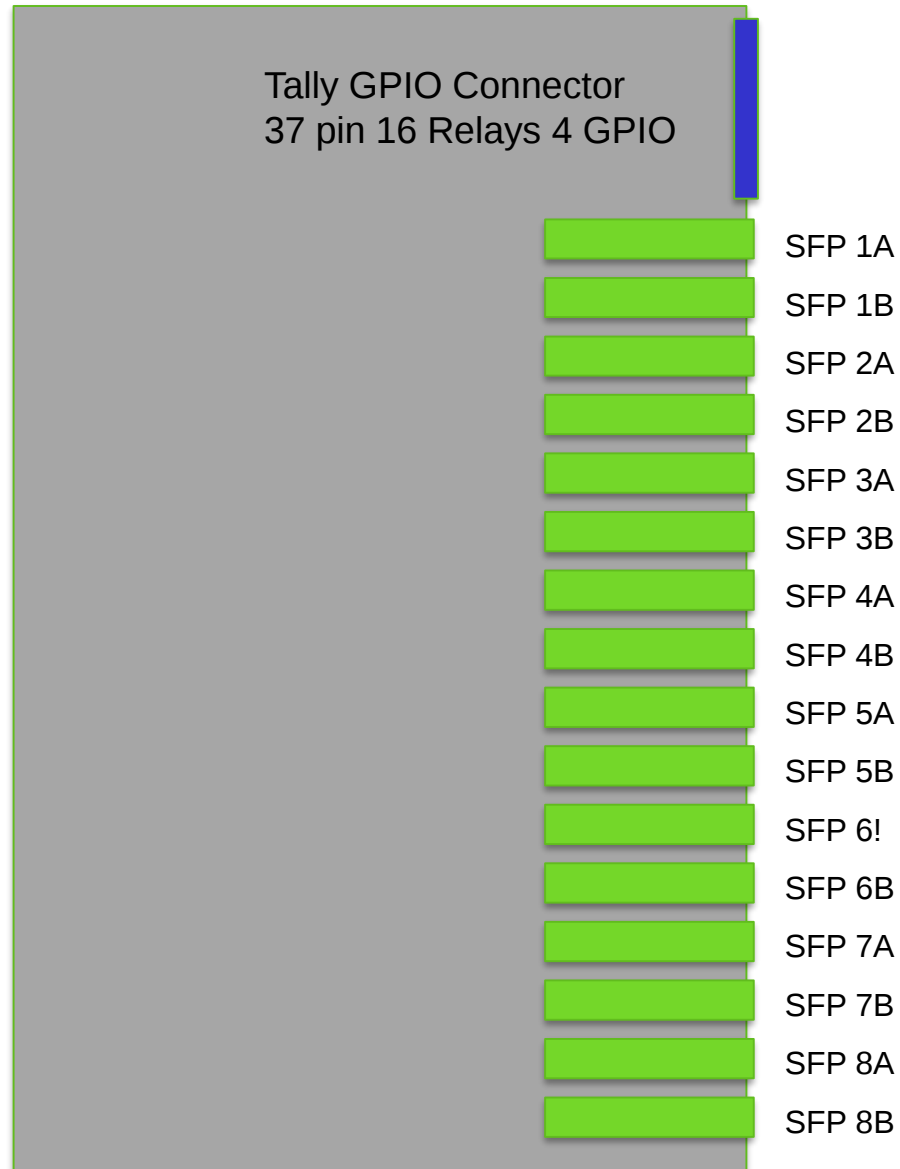
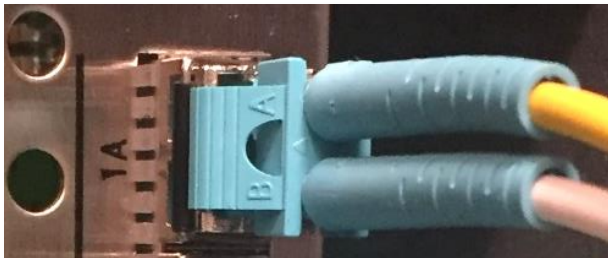


X - In/Out Module

- There are 2 versions of the I/O board, SDI and IP
 - Both are 16 in, by 8 out
- 10 modules can be installed for a 160 x 80 basic matrix size
- The SDI module has 16 terminating Inputs and 8 Dual Output connectors
- The IP module has 16 SFP+ slots for fiber I/O connections
 - These are set up as 8 redundant pairs (A and B)
 - The SFPs are SFP+ 10G
- Each SFP+ provides both Input and Output port connections

X - Input /Output IP Module

- The IP board has sockets for 8 pairs of SFP+ A and B
- Each SFP+ has an Rx and Tx optical fiber connection
- The optical ports are also labeled A and B

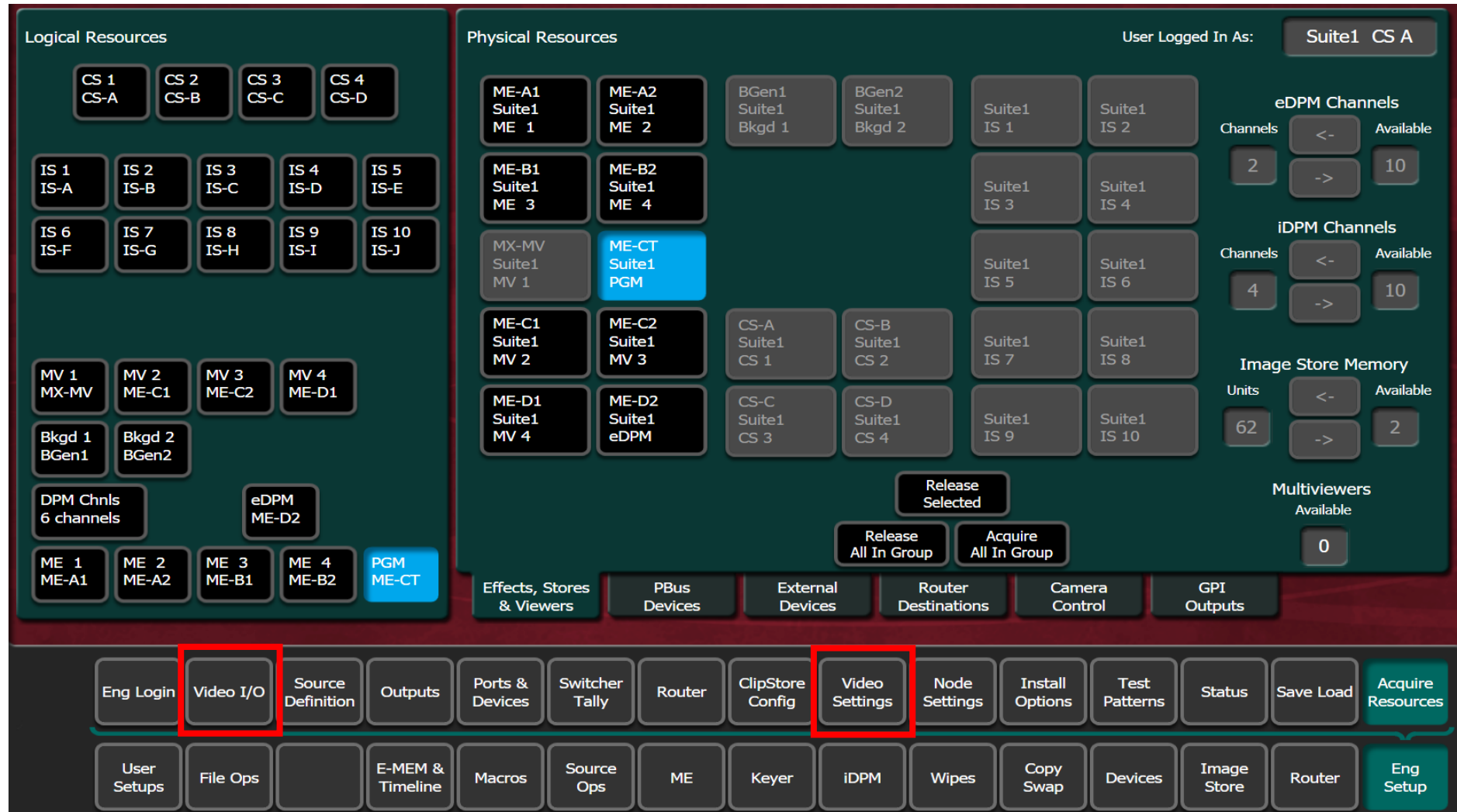


X - Modular I/O

- There are 2 versions of the Modular I/O board, SDI and IP
 - Both are 8 in by 4 out
- 4 modules can be installed for additional 32 Inputs and 16 Outputs
- The SDI board has terminating Inputs and single Outputs
 - The SDI board also has a HDMI 'style' media input port
- The IP board has 8 SFP+ slots for fiber I/O connections
 - These are set up as redundant pairs
 - The SFPs are currently SFP+ for 10G Fibre connections
- Each SFP+ provides both Input and Output

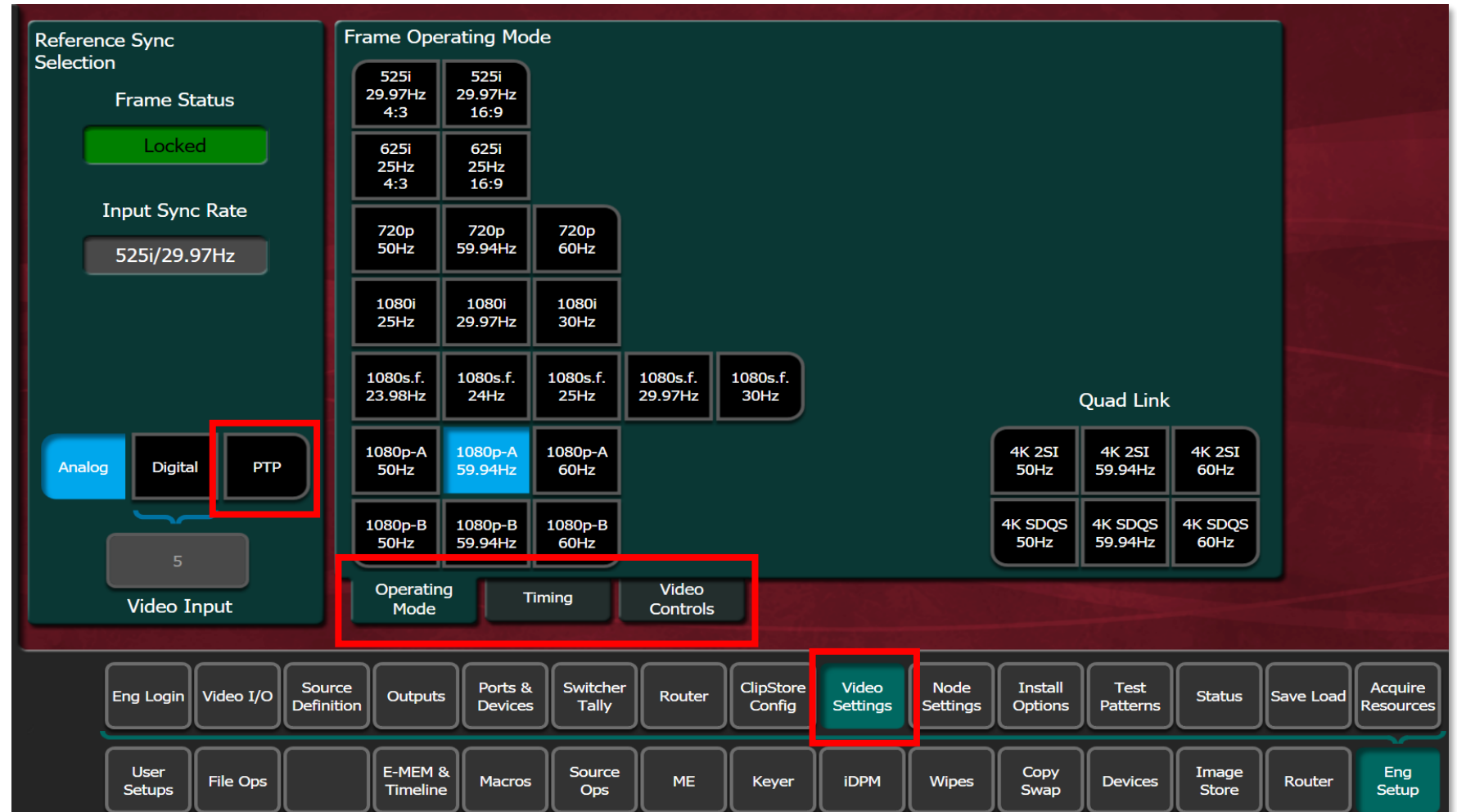
X - Acquire Resources Menus – v12.0

- This is identical to the Large K-Frame Menu



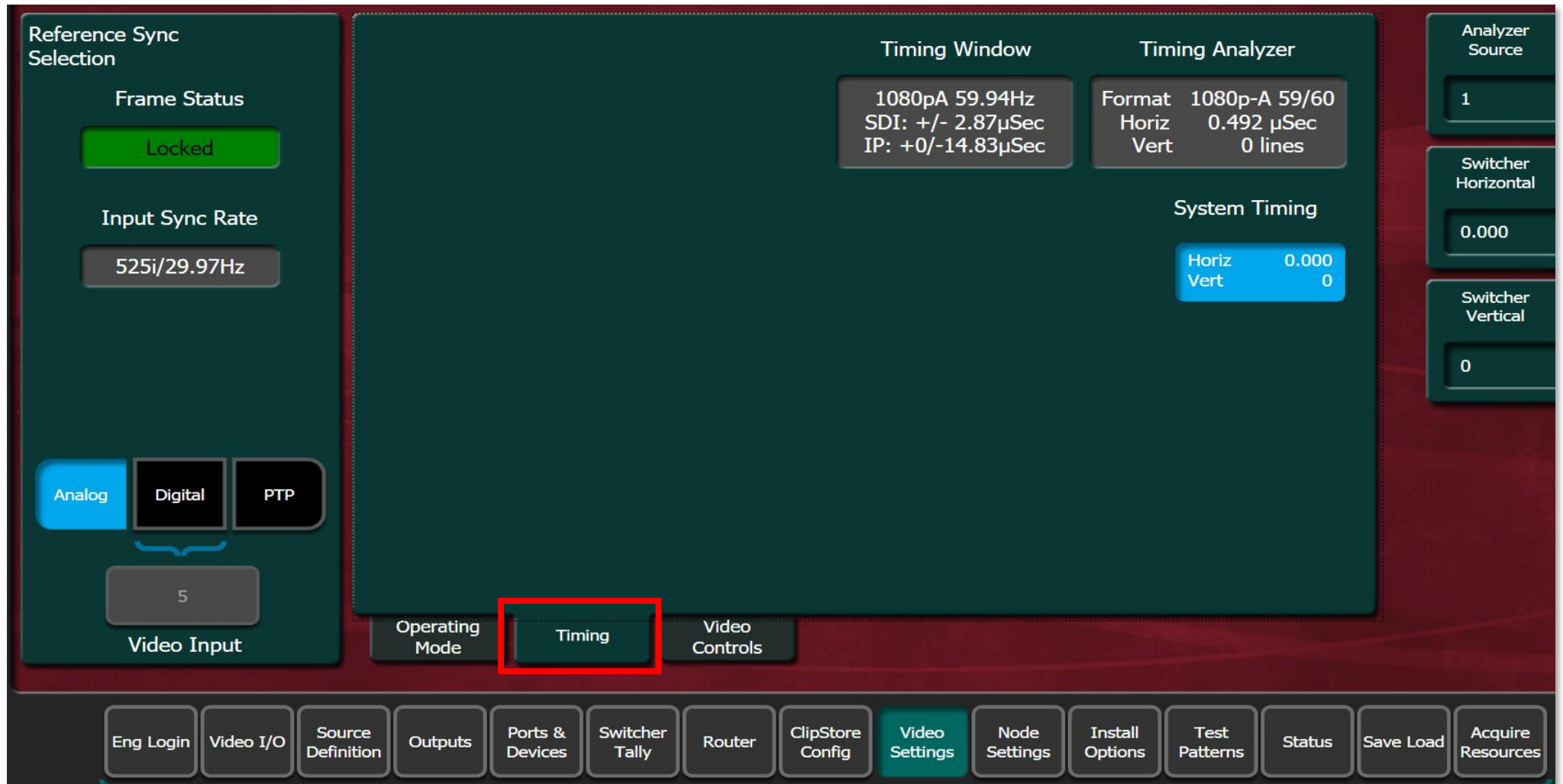
X - Video Settings (1)

- The Video Settings menu now has 3 tabs
- Besides the new layout there is a new Reference Sync selection button for PTP sync
- The 4K modes are either 2SI or SDQS



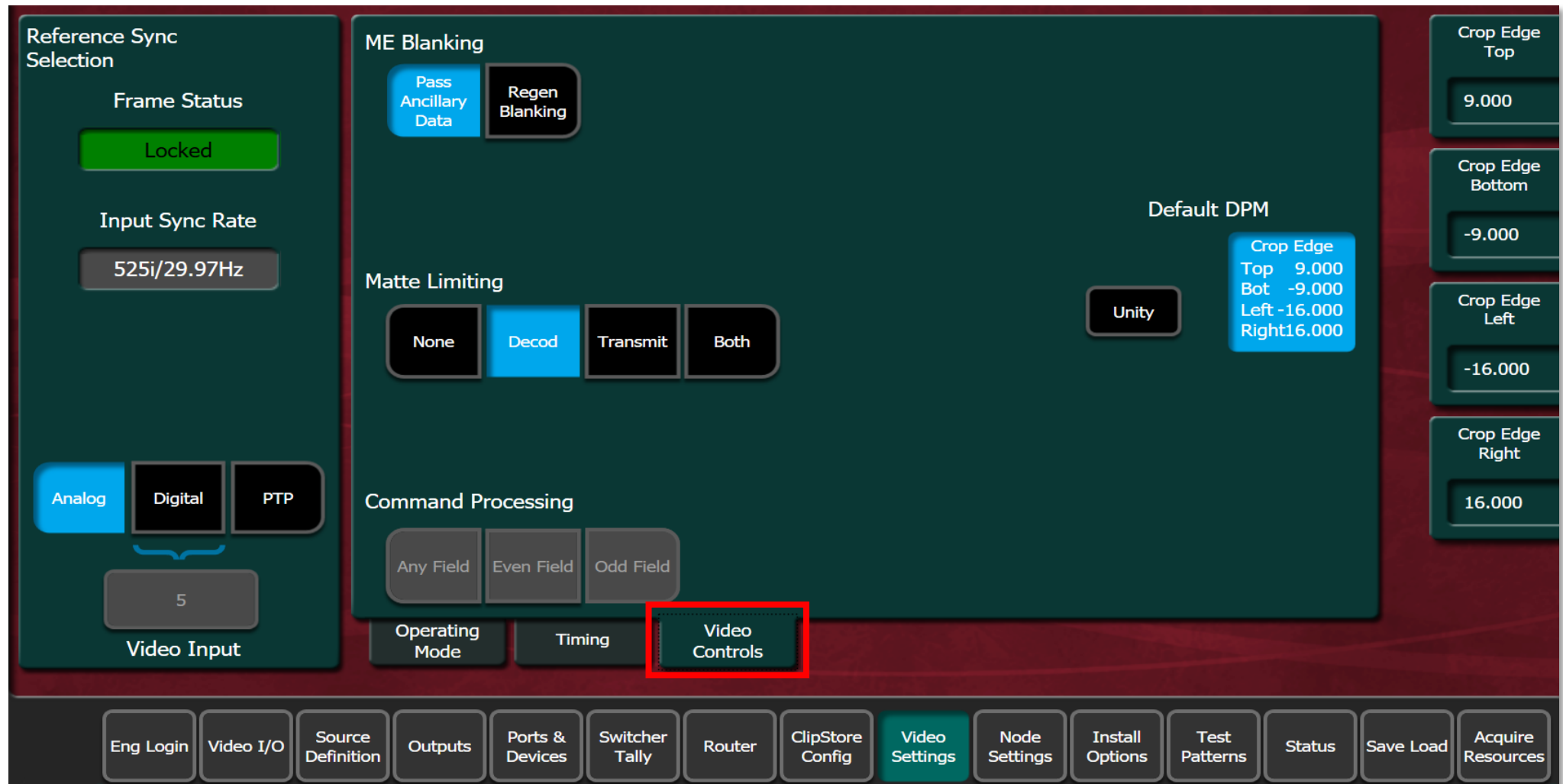
X - Video Settings (2)

- The Timing tab has no additional controls



X - Video Settings (3)

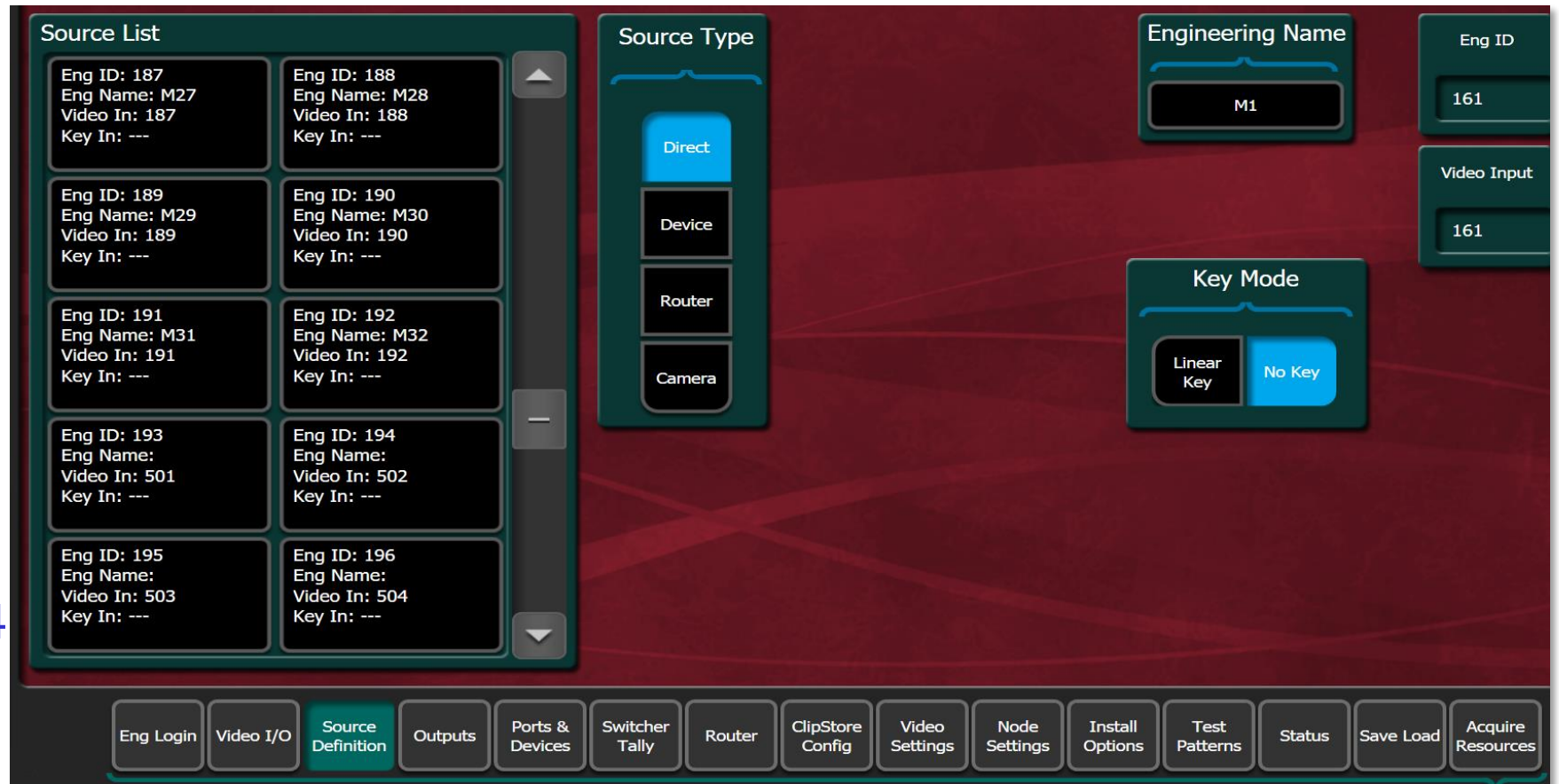
- The Video Controls tab has the remaining video settings buttons



X – Source Definition

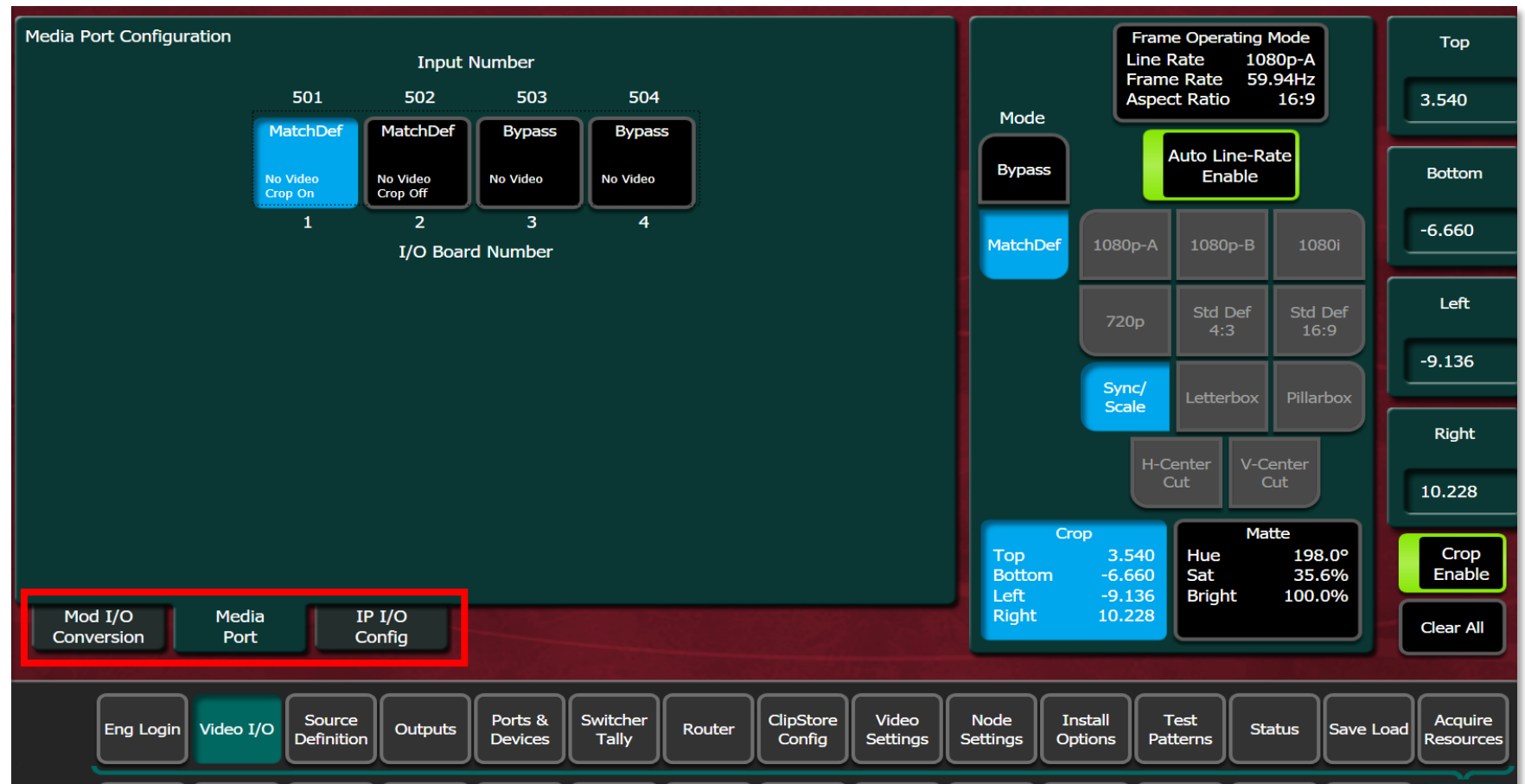
- The Source Definition Menu has not changed

- Note the Modular inputs are still 161 to 192 (M1-32) and the Media inputs on the SDI modular boards are Inputs 501-504



X - Video I/O

- The Video IP Button shows 3 tabs
- Modular I/O conversion cards are currently not available
- Media ports on the SDI modular cards (501-504) do have conversion as shown
- The IP config is set up on the third tab



X – IP I/O Config

- The IP I/O Config can be set up in a variety of ways
- It has buttons for:
 - Inputs
 - Outputs
 - Port Config of the SFP+s
- There are also buttons to 'Import or Export Config File' and to perform 'Bulk Configuration'

The screenshot displays the IP I/O Config interface. On the left, a sidebar contains buttons for 'Bulk Configuration', 'Import/Export Config File', 'Inputs', 'Outputs', and 'Port Config SFPs'. The main area features a table with columns for System SFP, Board SFP, SFP, Local IP, Subnet Mask, and Gateway. Below the table are sections for 'Video I/O Board' and 'Mod I/O Board'. At the bottom, a navigation bar includes buttons for 'Eng Login', 'Video I/O', 'Source Definition', 'Outputs', 'Ports & Devices', 'Switcher Tally', 'Router', 'ClipStore Config', 'Video Settings', 'Node Settings', 'Install Options', 'Test Patterns', 'Status', 'Save Load', and 'Acquire Resources'.

System SFP	Board SFP	SFP	Local IP	Subnet Mask	Gateway
25	1	1A	10.10.2.98	0.0.0.0	0.0.0.0
		1B	0.0.0.0	0.0.0.0	0.0.0.0
26	2	2A	10.10.2.102	0.0.0.0	0.0.0.0
		2B	0.0.0.0	0.0.0.0	0.0.0.0
27	3	3A	10.10.2.106	0.0.0.0	0.0.0.0
		3B	0.0.0.0	0.0.0.0	0.0.0.0
28	4	4A	10.10.2.110	0.0.0.0	0.0.0.0
		4B	0.0.0.0	0.0.0.0	0.0.0.0

Video I/O Board: 1 2 3 4 5 6 7 8 9 10

Mod I/O Board: 1 2 3 4

Mod I/O Conversion Media Port IP I/O Config

Eng Login Video I/O Source Definition Outputs Ports & Devices Switcher Tally Router ClipStore Config Video Settings Node Settings Install Options Test Patterns Status Save Load Acquire Resources

X – SFP+ Config

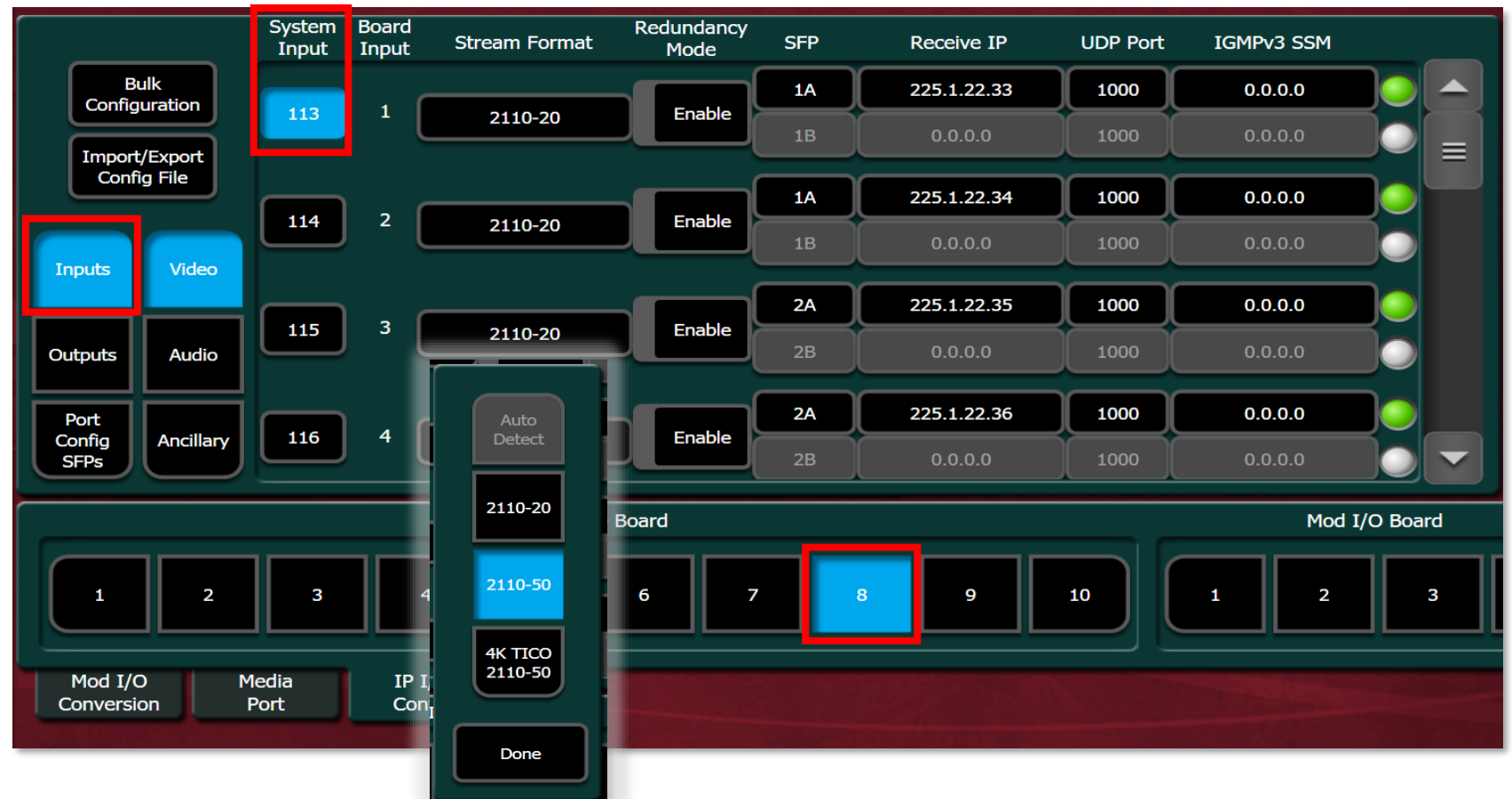
- The SFP Config sets the local IP addresses of the physical SFP
 - SFPs are selected by Board and SFP number
- Each SFP has a Primary 'A' SFP and Secondary 'B' SFP for redundancy
- Changes are shown highlighted until they are applied

The screenshot displays the SFP Configuration interface. On the left, there are navigation buttons: 'Bulk Configuration', 'Import/Export Config File', 'Inputs', 'Video', 'Outputs', 'Audio', 'Port Config SFPs' (highlighted with a red box), and 'Ancillary'. The main area contains a table with columns: System SFP, Board SFP, SFP, Local IP, Subnet Mask, and Gateway. The table lists configurations for System SFPs 25 through 28. System SFP 28 is highlighted with a red box, and its 'Local IP' field (1.1.1.2) is also highlighted. On the right, there are buttons for 'SFP' (showing 25), 'Restore Defaults', 'Restore Settings', and 'Apply Settings' (all three are highlighted with a red box). At the bottom, there are two sections: 'Video I/O Board' with ports 1-10 (port 4 is highlighted) and 'Mod I/O Board' with ports 1-4. Below these are buttons for 'Mod I/O Conversion', 'Media Port', and 'IP I/O Config'.

System SFP	Board SFP	SFP	Local IP	Subnet Mask	Gateway
25	1	1A	10.10.2.98	0.0.0.0	0.0.0.0
		1B	0.0.0.0	0.0.0.0	0.0.0.0
26	2	2A	10.10.2.102	0.0.0.0	0.0.0.0
		2B	0.0.0.0	0.0.0.0	0.0.0.0
27	3	3A	10.10.2.106	0.0.0.0	0.0.0.0
		3B	0.0.0.0	0.0.0.0	0.0.0.0
28	4	4A	1.1.1.2	0.0.0.0	0.0.0.0
		4B	0.0.0.0	0.0.0.0	0.0.0.0

X – IP Config - Inputs

- The Input IP Config sets up the IP receive 'from' information
- Each Input can be selected for Format, Redundancy mode and SFP number
- The Input format is also selected
- The receive (from) IP#, UDP port and Multicast values can be set



X – SFP Config - Outputs

- The Output Config sets up the IP addresses for the send to destination

- Output Format, SFP and UDP port, are also set for each System Output

The screenshot displays the 'SFP Config - Outputs' interface. On the left, a sidebar contains buttons for 'Bulk Configuration', 'Import/Export Config File', 'Inputs', 'Video' (highlighted), 'Outputs' (highlighted with a red box), 'Port Config SFPs', 'Audio', and 'Ancillary'. The main area shows a table of outputs with columns: System Output, Board Output, Stream Format, Redundancy Mode, SFP, Transmit IP, and UDP Port. The table lists four outputs (1-4) for the Video I/O Board, each with a Stream Format of '2110-50' and Redundancy Mode of 'Enable'. The 'System Output' column shows values 57, 58, 59, and 60. The 'SFP' column lists pairs (1A, 1B), (2A, 2B), (3A, 3B), and (4A, 4B). The 'Transmit IP' column shows '225.1.20.25' for output 1 and '0.0.0.0' for others. The 'UDP Port' column shows '1000' for all. Below the table, the 'Video I/O Board' section shows a row of buttons numbered 1 to 10, with button 8 highlighted. To the right, the 'Mod I/O Board' section shows buttons numbered 1 to 3. At the bottom, there are buttons for 'Mod I/O Conversion', 'Media Port', and 'IP I/O Config'.

System Output	Board Output	Stream Format	Redundancy Mode	SFP	Transmit IP	UDP Port
57	1	2110-50	Enable	1A 1B	225.1.20.25 0.0.0.0	1000 1000
58	2	2110-50	Enable	2A 2B	0.0.0.0 0.0.0.0	1000 1000
59	3	2110-50	Enable	3A 3B	0.0.0.0 0.0.0.0	1000 1000
60	4	2110-50	Enable	4A 4B	0.0.0.0 0.0.0.0	1000 1000

Video I/O Board: 1 2 3 4 5 6 7 8 9 10

Mod I/O Board: 1 2 3

Mod I/O Conversion Media Port IP I/O Config

IP Config Overview

- The Input and output signals are set in the 'Source Definition' and 'Output' menus

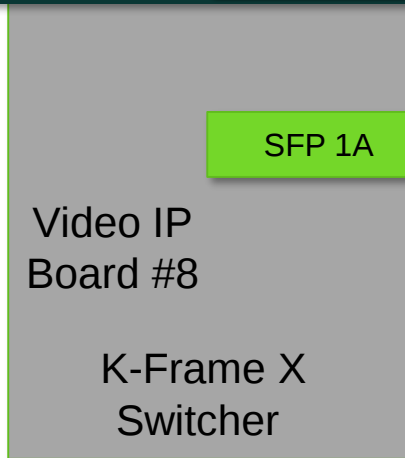
Input signal set in Source Definition menu

Input Config

System Input	Board Input	Stream Format	Redundancy Mode	SFP	Receive IP	UDP Port	IGMPv3 SSM
113	1	2110-20	Enable	1A	225.1.22.33	1000	0.0.0.0
				1B	0.0.0.0	1000	0.0.0.0

SFP Config

System SFP	Board SFP	SFP	Local IP	Subnet Mask	Gateway
57	1	1A	225.1.20.89	255.0.0.0	225.0.0.1
		1B	0.0.0.0	0.0.0.0	0.0.0.0



225.1.20.89

Fibre Optic IP Router

225.1.22.33

Video Source

Video Destination

225.1.20.25

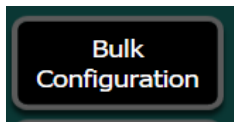
Output Config

System Output	Board Output	Stream Format	Redundancy Mode	SFP	Transmit IP	UDP Port
57	1	2110-50	Enable	1A	225.1.20.25	1000
				1B	0.0.0.0	1000

Output signal set in Outputs menu

X – IP Bulk Config

- Bulk Config allows Multiple, sequential port parameters to set together



- This is done for separately SFPs, Inputs and Outputs

SFP Port Config Bulk Configuration

SFP A

		Local IP			Subnet Mask			Gateway		
System Start	System End	Starting Address	Octet	Inc	Starting Address	Octet	Inc	Starting Address	Octet	Inc
1	1	0.0.0.0	4th	1	0.0.0.0	4th	0	0.0.0.0	4th	0
		Ending Address	0.0.0.0		Ending Address	0.0.0.0		Ending Address	0.0.0.0	

SFP B

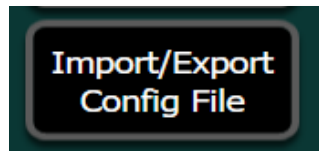
		Local IP			Subnet Mask			Gateway		
Starting Address	Octet	Inc	Starting Address	Octet	Inc	Starting Address	Octet	Inc		
0.0.0.0	4th	1	0.0.0.0	4th	0	0.0.0.0	4th	0		
Ending Address		0.0.0.0		Ending Address		0.0.0.0		Ending Address		

Enter Cancel

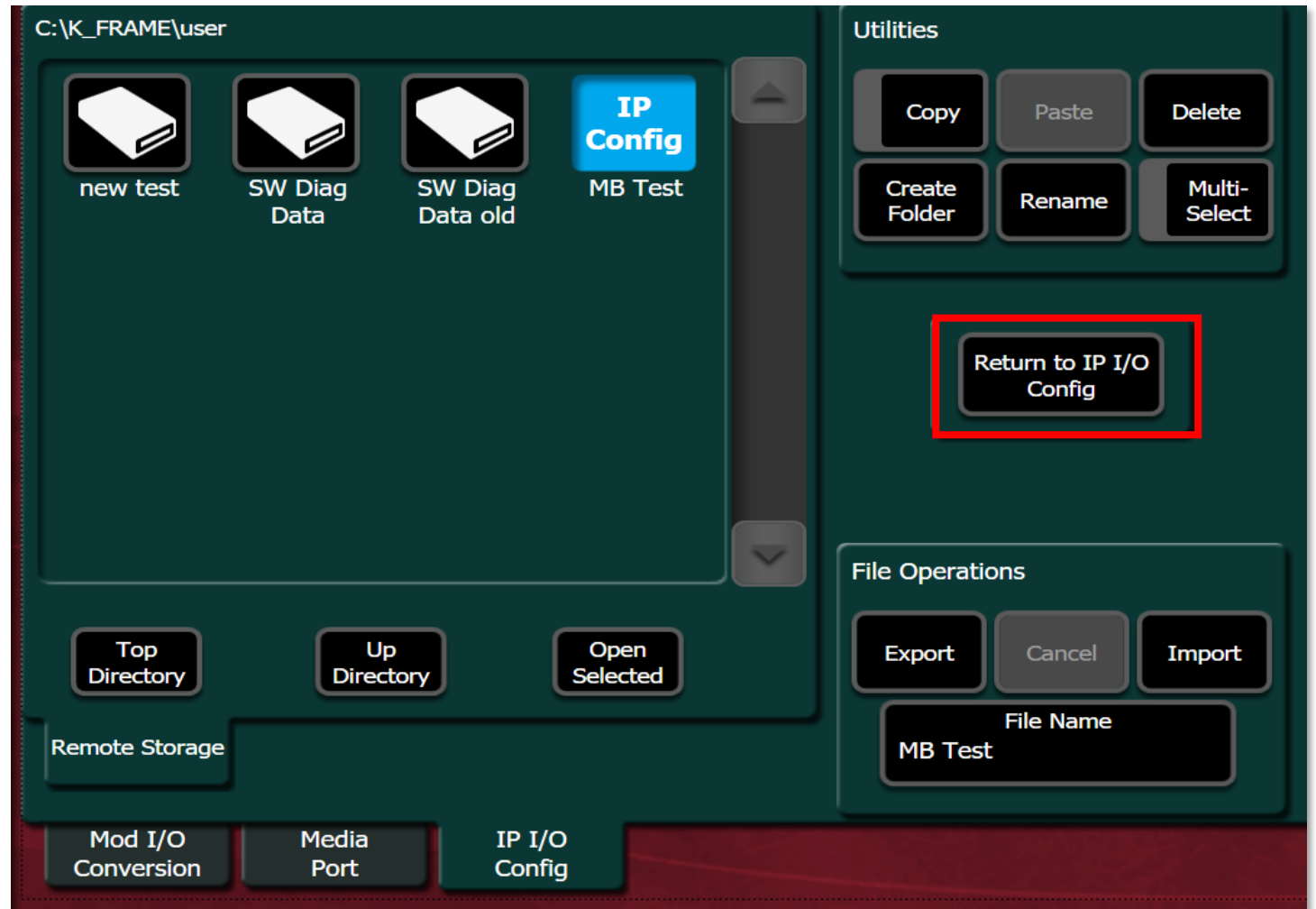
Mod I/O Conversion Media Port IP I/O Config

X – Import/Export Config File

- Import/Export allows a Config file to be compiled on a spreadsheet



- Simply choose a location using the normal Save/Load menu
- IP Config files can be opened using Excel or similar spreadsheet program



X – IP Config Spreadsheet - Inputs

	A	B	C	D	E	F	G	H	I	J	K	L
1	System Input	Board Number	Board Input	Stream Format	Redundancy Mode	SFP Number	Video A Receive IP	Video A UDP Port	Video A IGMPv3 SSM	Video B Receive IP	Video B UDP Port	Video B IGMPv3 SSM
2	1	1	1	2110-50	Off	1	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
3	2	1	2	2110-50	Off	1	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
4	3	1	3	2110-50	Off	2	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
5	4	1	4	2110-50	Off	2	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
6	5	1	5	2110-50	Off	3	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
7	6	1	6	2110-50	Off	3	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
8	7	1	7	2110-50	Off	4	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
9	8	1	8	2110-50	Off	4	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
10	9	1	9	2110-50	Off	5	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
11	10	1	10	2110-50	Off	5	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
12	11	1	11	2110-50	Off	6	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
13	12	1	12	2110-50	Off	6	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
14	13	1	13	2110-50	Off	7	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
15	14	1	14	2110-50	Off	7	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
16	15	1	15	2110-50	Off	8	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
17	16	1	16	2110-50	Off	8	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
18	17	2	1	2110-50	Off	1	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
19	18	2	2	2110-50	Off	1	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
20	19	2	3	2110-50	Off	2	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
21	20	2	4	2110-50	Off	2	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
22	21	2	5	2110-50	Off	3	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
23	22	2	6	2110-50	Off	3	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
24	23	2	7	2110-50	Off	4	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
25	24	2	8	2110-50	Off	4	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
26	25	2	9	2110-50	Off	5	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
27	26	2	10	2110-50	Off	5	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
28	27	2	11	2110-50	Off	6	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
29	28	2	12	2110-50	Off	6	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
30	29	2	13	2110-50	Off	7	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
31	30	2	14	2110-50	Off	7	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0
32	31	2	15	2110-50	Off	8	0.0.0.0	1000	0.0.0.0	0.0.0.0	1000	0.0.0.0

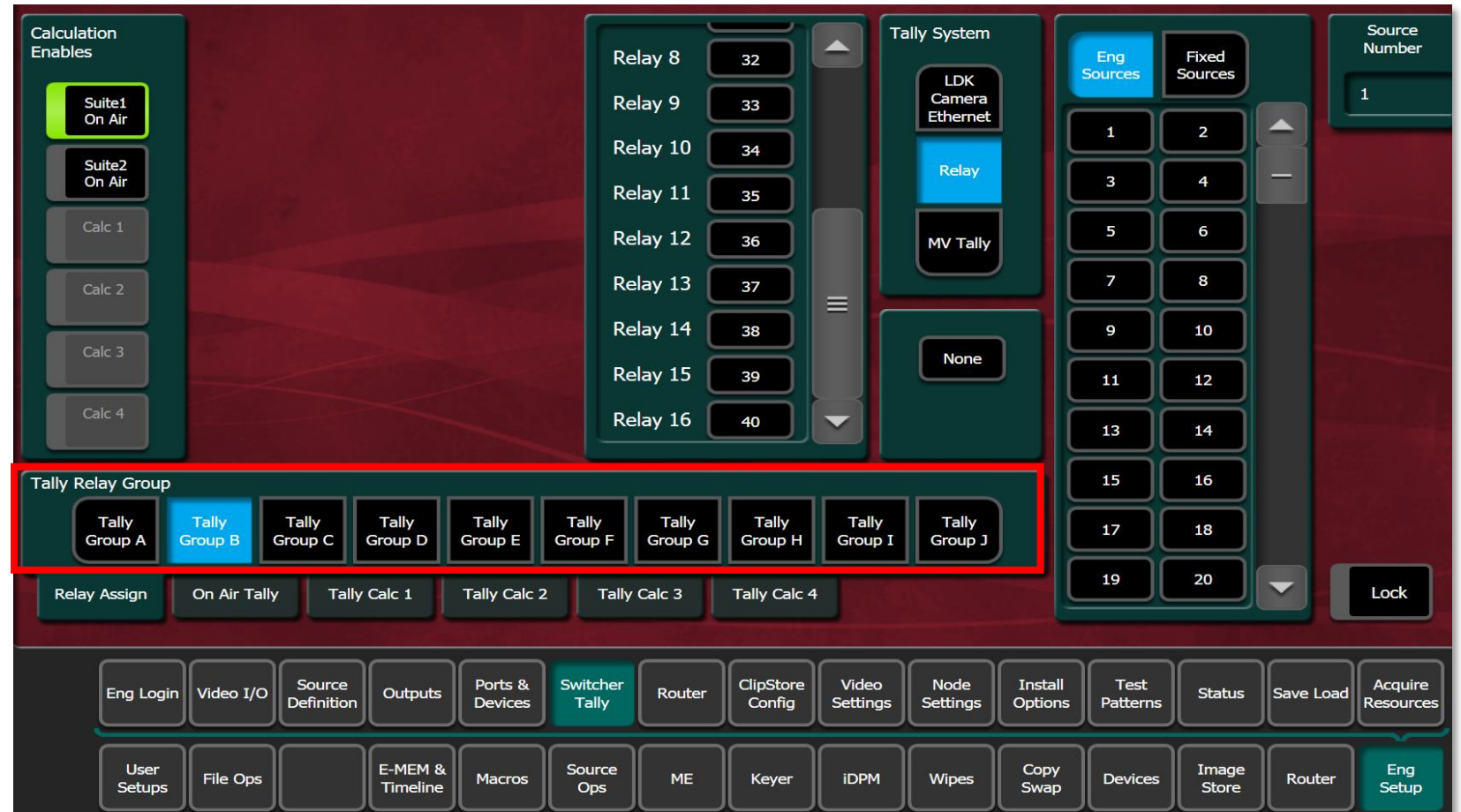
Inputs

Outputs

SFPs

X – Tally

- Switcher Tally operates the same way except that the relays are now in 10 Groups
- Each Group has 16 relays related by default to the inputs on that module



X – HTML Pages (1)

- The X frame IP information is similar to that in the other K-Frames
- The status page shows the 3 fan trays and the status of the 4 fans in each tray



GV K-Frame X Web Access

[Software Versions](#)
Frame Status
[Frame Message Log](#)
[Frame Network Address](#)
[Frame Date & Time](#)
[Frame Description](#)
[SNMP Configuration](#)
[IP Video Input](#)
[IP Video Output](#)
[IP Audio Input](#)
[IP Audio Output](#)
[IP Ancillary Input](#)
[IP Ancillary Output](#)
[IP SFP](#)

Power Supply 1 Status : Present OK
Power Supply 2 Status : Present OK
Power Supply 3 Status : Present OK
Chassis Temperature : Warm

Fan Status

Left Fan Tray Present			Center Fan Tray Present			Right Fan Tray Present		
Fan	State	Speed	Fan	State	Speed	Fan	State	Speed
1	OK	5702 RPM	1	OK	5750 RPM	1	OK	5427 RPM
2	OK	5750 RPM	2	OK	5850 RPM	2	OK	5678 RPM
3	OK	5825 RPM	3	OK	5953 RPM	3	OK	5927 RPM
4	OK	5775 RPM	4	OK	5953 RPM	4	OK	6033 RPM

Video Sync Status

Reference Signal : Present
Reference Lock : Locked
Video Frame Rate : 59.94Hz
Vertical Resolution : 1080
Scan Type : Progressive

Disk Space Status

Available : 21,359,656,960 Bytes
Capacity : 21,863,955,456 Bytes

X – HTML Pages (2)

- The X frame IP pages show the status of the IP ports and packet information

 **grass valley**
A BELDEN BRAND

GV K-Frame X Web Access

[Software Versions](#)
[Frame Status](#)
[Frame Message Log](#)
[Frame Network Address](#)
[Frame Date & Time](#)
[Frame Description](#)
[SNMP Configuration](#)
[IP Video Input](#)
[IP Video Output](#)
[IP Audio Input](#)
[IP Audio Output](#)
[IP Ancillary Input](#)
[IP Ancillary Output](#)
[IP SFP](#)

System Input	Board	Board Input	SFP	Link	Stream Format	Receive IP	UDP Port	Rx Throughput	Rx Packets	Rx Errors
1	16x8 IO IP 1	1	1A	Down	2110-50	225.1.21.1	1000	1	0	0
2	16x8 IO IP 1	2	1A	Down	2110-50	225.1.21.2	1000	0	0	0
3	16x8 IO IP 1	3	2A	Down	2110-50	225.1.21.3	1000	0	0	0
4	16x8 IO IP 1	4	2A	Down	2110-50	225.1.21.4	1000	0	0	0
5	16x8 IO IP 1	5	3A	Down	2110-50	225.1.21.5	1000	0	0	0
6	16x8 IO IP 1	6	3A	Down	2110-50	225.1.21.6	1000	0	0	0
7	16x8 IO IP 1	7	4A	Down	2110-50	225.1.21.7	1000	0	0	0
8	16x8 IO IP 1	8	4A	Down	2110-50	225.1.21.8	1000	0	0	0
9	16x8 IO IP 1	9	5A	Down	2110-50	225.1.21.9	1000	0	0	0
10	16x8 IO IP 1	10	5A	Down	2110-50	225.1.21.10	1000	0	0	0
11	16x8 IO IP 1	11	6A	Down	2110-50	225.1.21.11	1000	0	0	0
12	16x8 IO IP 1	12	6A	Down	2110-50	225.1.21.12	1000	0	0	0
13	16x8 IO IP 1	13	7A	Down	2110-50	225.1.21.13	1000	0	0	0
14	16x8 IO IP 1	14	7A	Down	2110-50	225.1.21.14	1000	0	0	0
15	16x8 IO IP 1	15	8A	Down	2110-50	225.1.21.15	1000	0	0	0
16	16x8 IO IP 1	16	8A	Down	2110-50	225.1.21.16	1000	0	0	0

 **grass valley**
A BELDEN BRAND

X – HTML Pages (3)

- The X frame SFP page shows the hardware configuration for each SFP



GV K-Frame X Web Access

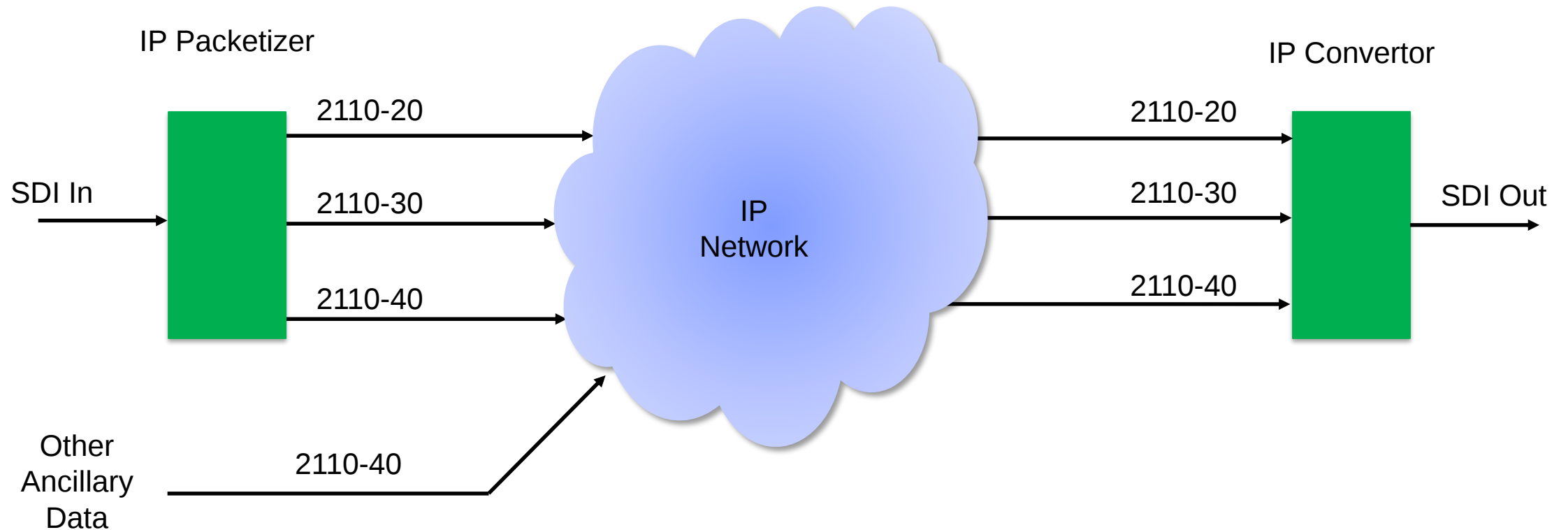
Software Versions	Board	SFP	Local IP	Subnet Mask	Gateway	MAC Address
Frame Status	16x8 IO IP 1	1A	10.10.14.2	255.255.0.0	0.0.0.0	00:00:00:00:00:00
Frame Message Log	16x8 IO IP 1	1B	10.10.12.2	255.255.0.0	0.0.0.0	00:00:00:00:00:00
Frame Network Address	16x8 IO IP 1	2A	10.10.14.6	255.255.0.0	0.0.0.0	00:00:00:00:00:00
Frame Date & Time	16x8 IO IP 1	2B	10.10.12.6	255.255.0.0	0.0.0.0	00:00:00:00:00:00
Frame Description	16x8 IO IP 1	3A	10.10.14.10	255.255.0.0	0.0.0.0	00:00:00:00:00:00
SNMP Configuration	16x8 IO IP 1	3B	10.10.12.10	255.255.0.0	0.0.0.0	00:00:00:00:00:00
IP Video Input	16x8 IO IP 1	4A	10.10.14.14	255.255.0.0	0.0.0.0	00:00:00:00:00:00
IP Video Output	16x8 IO IP 1	4B	10.10.12.14	255.255.0.0	0.0.0.0	00:00:00:00:00:00
IP Audio Input	16x8 IO IP 1	5A	10.10.14.18	255.255.0.0	0.0.0.0	00:00:00:00:00:00
IP Audio Output	16x8 IO IP 1	5B	10.10.12.18	255.255.0.0	0.0.0.0	00:00:00:00:00:00
IP Ancillary Input	16x8 IO IP 1	6A	10.10.14.22	255.255.0.0	0.0.0.0	00:00:00:00:00:00
IP Ancillary Output	16x8 IO IP 1	6B	10.10.12.22	255.255.0.0	0.0.0.0	00:00:00:00:00:00
IP SFP	16x8 IO IP 1	7A	10.10.14.26	255.255.0.0	0.0.0.0	00:00:00:00:00:00
	16x8 IO IP 1	7B	10.10.12.26	255.255.0.0	0.0.0.0	00:00:00:00:00:00
	16x8 IO IP 1	8A	10.10.14.30	255.255.0.0	0.0.0.0	00:00:00:00:00:00
	16x8 IO IP 1	8B	10.10.12.30	255.255.0.0	0.0.0.0	00:00:00:00:00:00
	16x8 IO IP 2	1A	10.10.14.34	255.255.0.0	0.0.0.0	00:00:00:00:00:00
	16x8 IO IP 2	1B	10.10.12.34	255.255.0.0	0.0.0.0	00:00:00:00:00:00

ST 2110 Media Transport Standard

- ST 2110 Allows separate transmission of each component
 - ST 2110-10 - Timing
 - ST 2110-20 - Video
 - ST 2110-30 - Audio
 - ST 2110-40 - ANC (Ancillary data)
 - ST 2110-50 - Combined Video, Audio and Ancillary data
- What Happened to ST 2022-6?
 - This is the current standard for sending SDI video, Embedded Audio and Ancillary together as one signal
 - It can be input to the switcher using the ST 2110-50 selection which supports ST 2022-6

ST 2110 Media Transport Standard

ST 2110 concept drawing

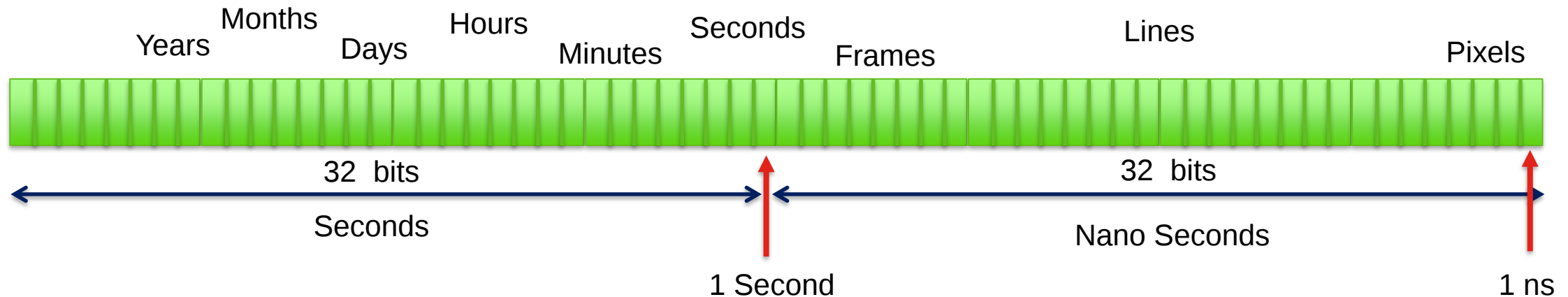


ST 2110-10 Timing

- ST 2110-10 – Timing
 - Specifies Requirements of the other streams
 - Uses ST 2059 PTP Timing standard (IP 'Sync')
 - 5 Sec lock time (Master/Slave clock environment)
 - 1uS Accuracy
 - This is sent to all IP devices in the system
 - Each IP stream produced will have timestamps in them
 - Specifies the SDP (Session Description Protocol) RFC 4566
 - Defines the requirements of the session i.e.
 - Group (ie Pri/Sec)
 - Video format (ie 1280 x720)
 - Sampling (ie 4:2:2)
 - Colorimetry
 - Metadata
 - Timestamp

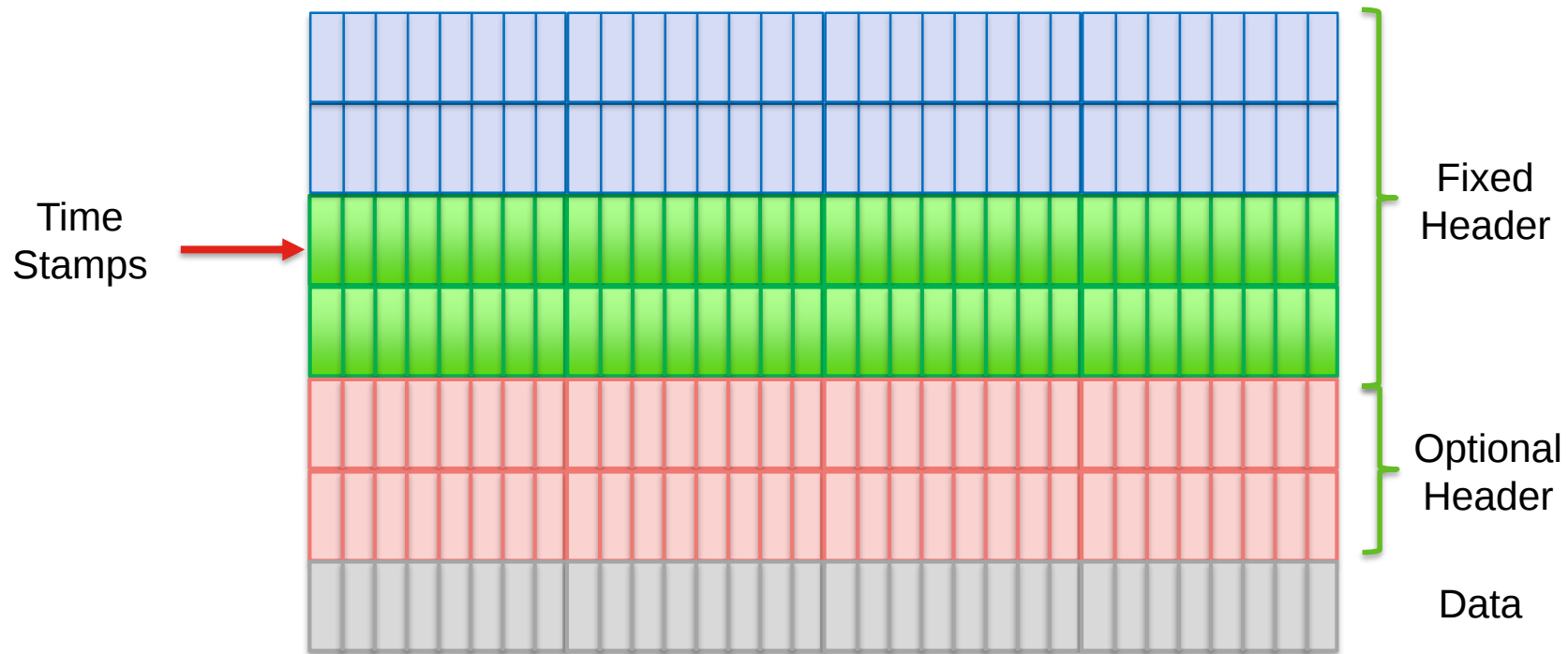
ST 2059 PTP Precision Time Protocol

- PTP provides a time reference that can be used to synchronize data streams
- The 64 bit count of the 1ns clock defines a 136 year duration (starting at 1970 Jan 1)
- This count can be used to define any point in time during this period with 1ns accuracy
- The number can be split into Years, Months, Days, Hours, Minutes, Seconds, Frames, Lines and Pixels for any standard
- It allows for Drop Frame as well as the Daily Jam of timecode generators
- It also allows for Daylight Savings Time changes
- Can also be used in sync generators to generate TLS or Black Burst



Time Stamps

- Time Stamp
- The 64 bit count indicating when a stream is produced is included in the fixed header part of each stream



ST2110-20 Video Standard

- ST 2110-20 – Video
 - Only 'Active' video is sent
 - No more blanking information!
 - Saves 16-40% BW, depending on format
 - I.e. 1080p/60 is reduced from 3.17 Gbps to 2.67 Gbps
 - Image sizes can be up to 32k x32k
 - Covers SD, 720, 1080, 4K, 8K and 16K
 - Supports other color spaces besides Y,Cb,Cr, and RGB
 - Supports 4:2:2/10, 4:2:2/12, 4:4:4/16
 - Supports HDR (PG and HLG)

ST 2110-30 Audio Standard

- ST 2110-30 – PCM Audio
 - Based on AES-67
 - These are required functions of a receiver:
 - 48 Khz sampling
 - 1ms packet time
 - 1-8 channels
 - 16 & 24 bit depth
- ST 2110-31 – AES3 Audio
 - Can handle non PCM audio
 - Includes User bits and C, V bits
 - Always Stereo

ST 2110 - 40 ANC Standard

- ST 2110-40 – ANC Data
 - Timecode
 - Teletext
 - Cue tones
 - Advertising
 - Machine triggers
 - Custom
- Do not use for Audio!

ST 2110-50 Combined Video Data

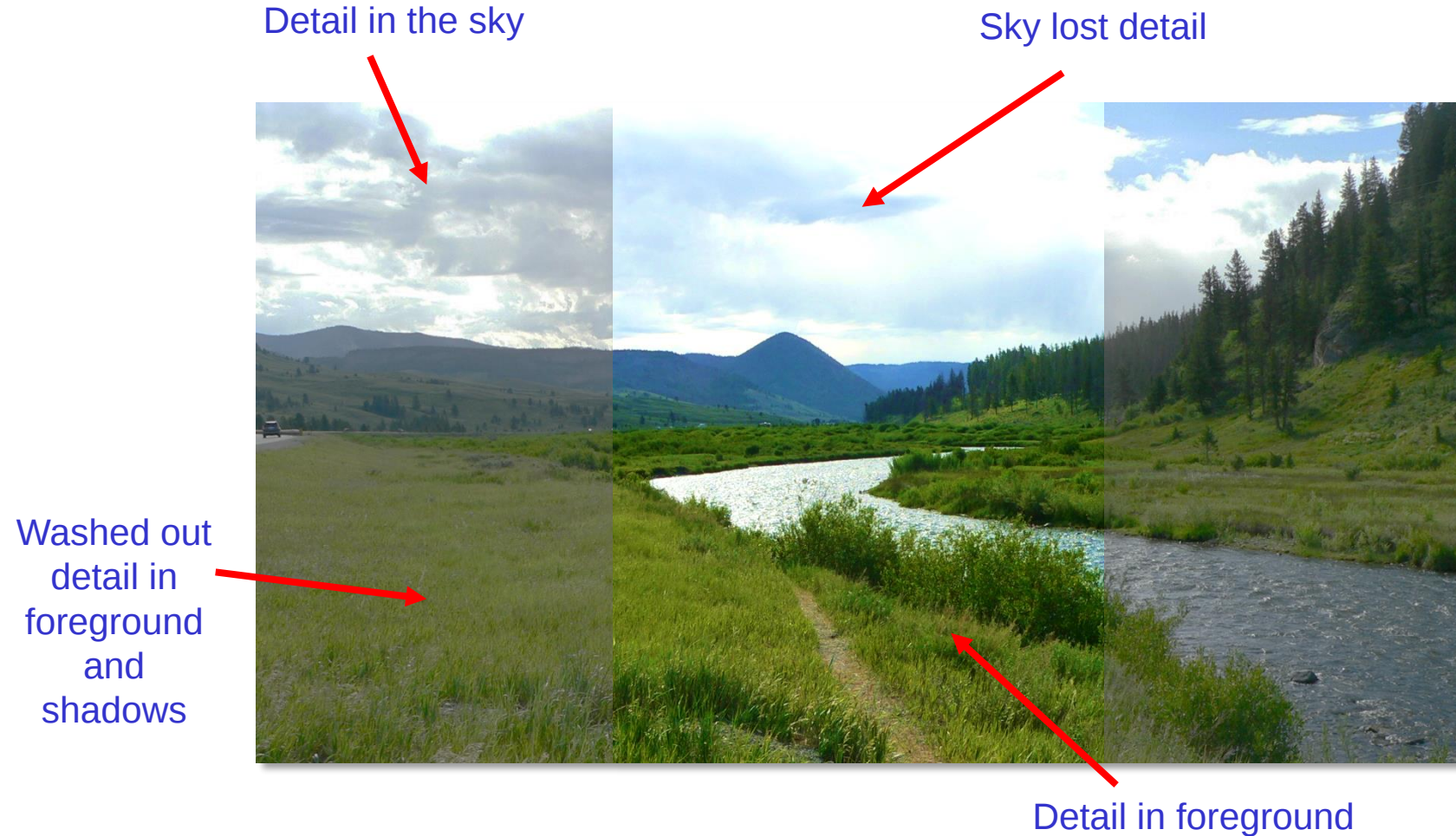
- ST 2110-50 – Combined Data
 - Supports ST 2022-6 the existing standard for transmitting uncompressed SDI media as used on existing GV switchers using the modular IP I/O boards
 - The current format is essentially raw SDI video inserted into an IP stream
 - This includes the Blanking and Embedded Audio and any Ancillary data
- By supporting this standard as well as ST 2110-20 and SDI a K-Frame X switcher can be incorporated into an exiting facility and accept any signal format for the covered frame and line rates

High Dynamic Range (HDR)

- HDR provides for a larger dynamic range from black to white than was supported by the earlier standard
- However there are multiple HDR formats!
- HDR for still images is also different than HDR for Video
- HDR for still images
 - Images taken in HDR for stills (such as on an iphone) captures 3 images with different exposures and then combines them to produce a composite with a wider dynamic range
- HDR for video
 - Uses a different technique that allows the higher dynamic range to be passed through a standard 10 bit digital pathway

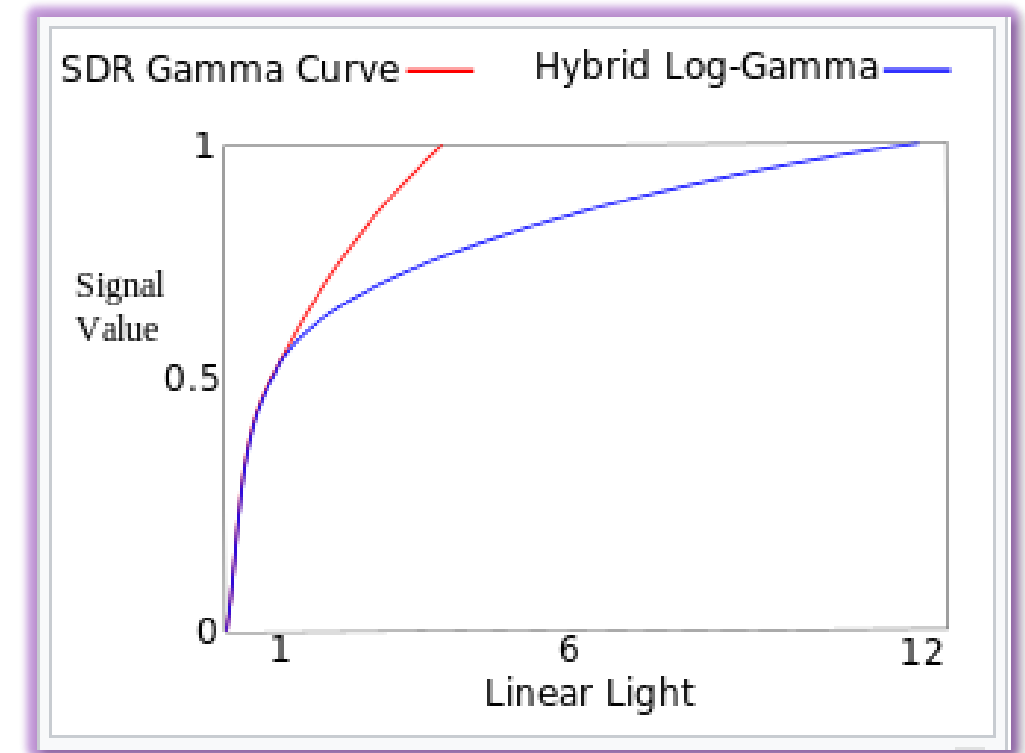
High Dynamic Range (HDR)

- Comparison of dynamic range issues



High Dynamic Range (HDR)

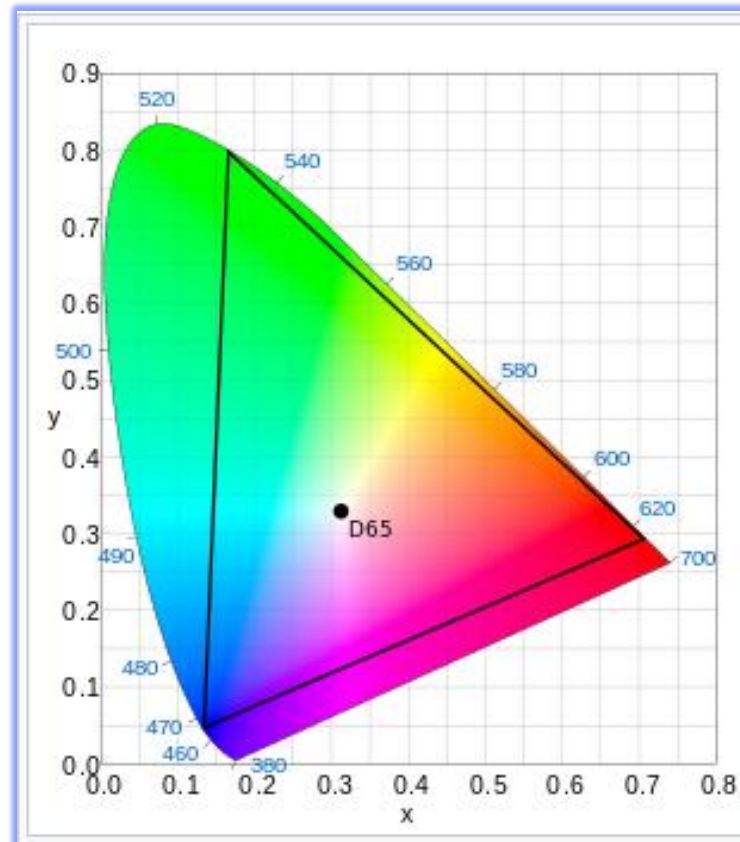
- HDR Images require a special display that enables the full resolution of the additional data to be displayed
- PQ (Perceptual Quantizing)
The transfer function used
- HLG (Hybrid Log Gamma)
A combination of both Gamma and logarithmic transfer curve
- HDR 10
The current standard used for 4K format
- HDR 10+
Adds meta data support
- Dolby Vision
A proprietary 12 bit system



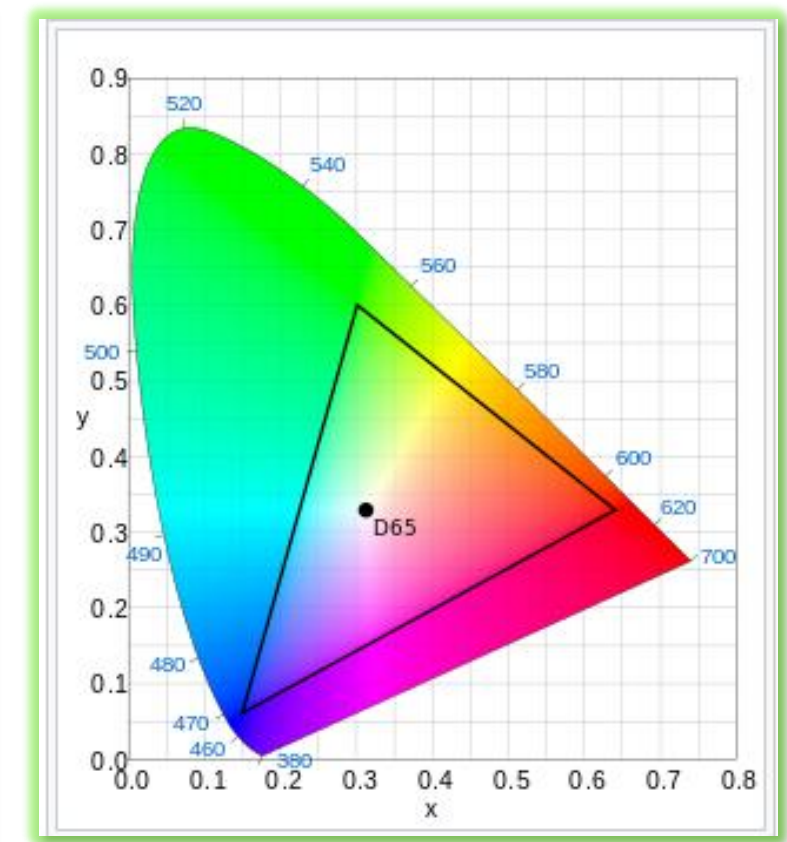
Color Space

- HDR video systems use the new Color Space (Rec 2020)
This increases the color range from the earlier Rec 709 color space used in Analog TV systems
- Rec 709 was based on the technology at the time and the colors that could be produced by displays
- New display devices (LCD, OLED etc) can produce a wider range of colors

Rec 2020 Color Space



Rec 709 Color Space (1990)



HDR 10 v Dolby Vision

- HDR 10 is a 10 bit system limited to a dynamic range of 1,000 nits
- Dolby Vision uses 12 bits and provides a dynamic range of 10,000 nits
- There are a few issues
 - While Dolby Vision provides a better dynamic range it is proprietary and costs more for manufacturers to add it to their system
 - HDR 10 is an open platform and provides benefits that equal what Dolby provides, with today's display technology
 - HDR 10 is already in use and supported by many consumer TV's
 - The two systems are not compatible but TV sets are already available that support both formats
- Within a TV station, based on 10 bit SDI digital video technology, it is better suited to HDR 10