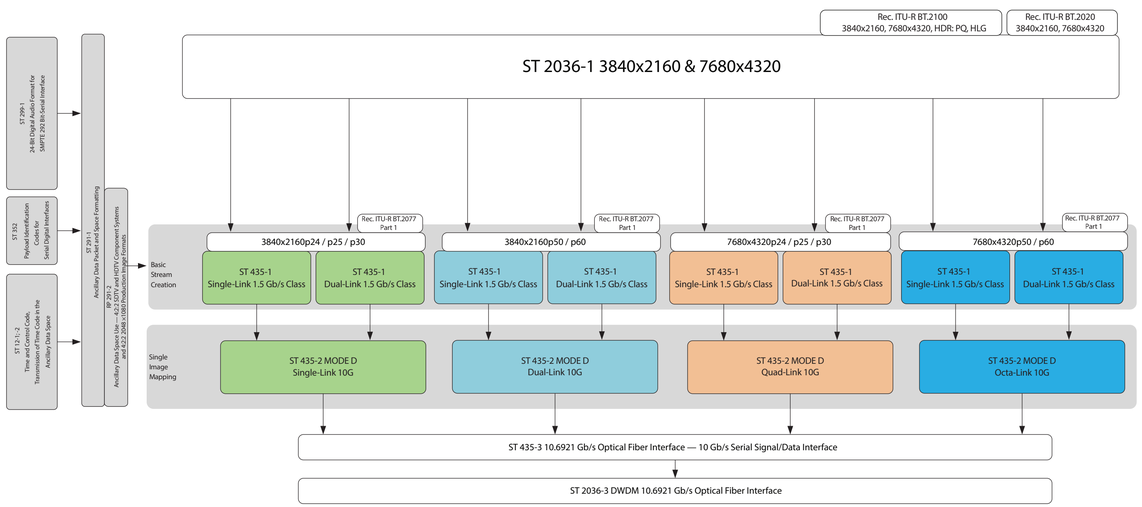
SMPTE EG 2111-3:2021 10G-SDI Standards Roadmap

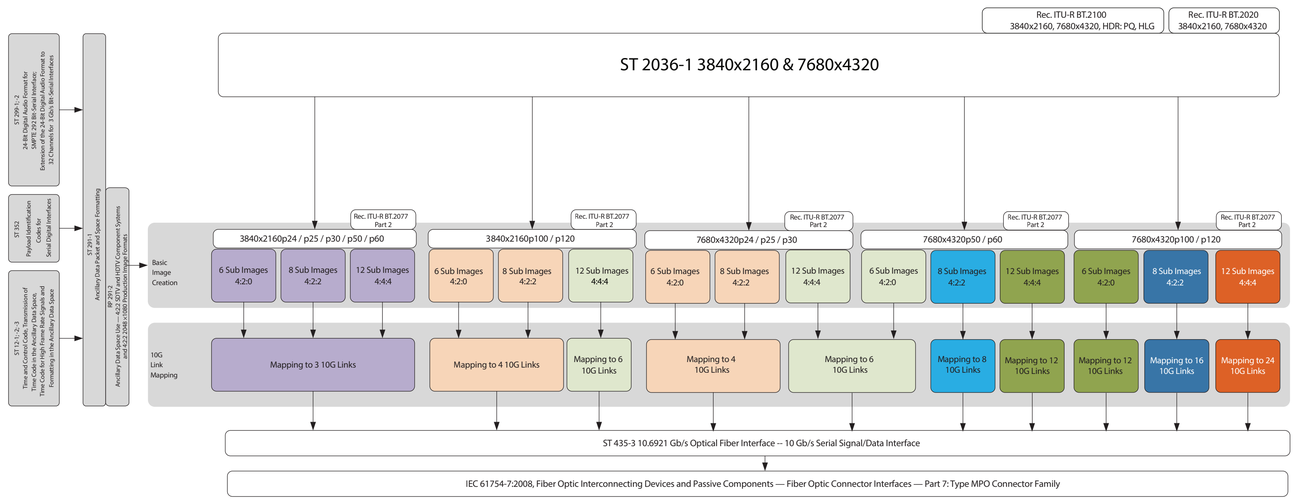
ST 2036-3 Multi-Link 10.692G / Rec. ITU-R BT.2077 Part 1



UHDTV1 Production				Number of Links	
System Nomenclature	Horizontal Pixels	Vertical Pixels	Frames Per Second (nominal)	10-bit 4:2:0 10-bit 4:2:2 10-bit 4:4:4	12-bit 4:2:0 12-bit 4:2:2 12-bit 4:4:4
2160p60/59.94	3840 / 4096	2160	60	Dual-Link 10G (21.384Gb/s)	
2160p50	3840 / 4096	2160	50		
2160p30/29.97	3840 / 4096	2160	30	Single-Link 10G (10.692Gb/s)	
2160p25	3840 / 4096	2160	25		
2160p24/23.98	3840 / 4096	2160	24		

UHDTV2 Production				Number of Links	
System Nomenclature	Horizontal Pixels	Vertical Pixels	Frames Per Second (nominal)	10-bit 4:2:0 10-bit 4:2:2 10-bit 4:4:4	12-bit 4:2:0 12-bit 4:2:2 12-bit 4:4:4
4320p60/59.94	7680	4320	60	Octa-Link 10G (85.5Gb/s)	
4320p50	7680	4320	50		
4320p30/29.97	7680	4320	30	Quad-Link 10G (42.768Gb/s)	
4320p25	7680	4320	25		
4320p24/2398	7680	4320	24		

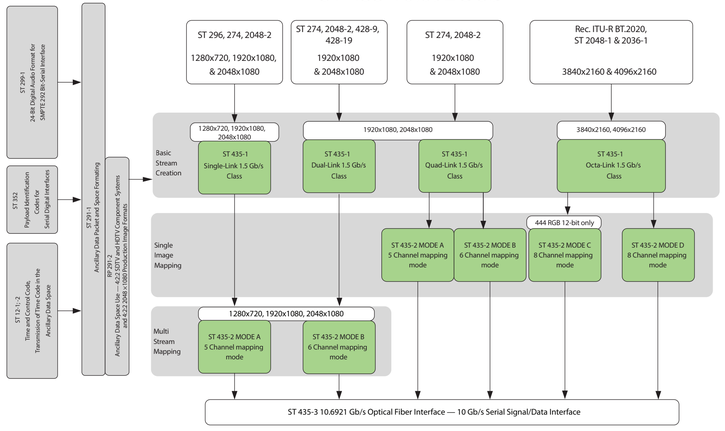
ST 2036-4 Multi-Link 10.692G / Rec. ITU-R BT.2077 Part 2



UHDTV1 Production				Number of Links	
System Nomenclature	Horizontal Pixels	Vertical Pixels	Frames Per Second (nominal)	10-bit / 12-bit 4:2:0 / 4:2:2	10-bit / 12-bit 4:4:4
2160p120/119.88	3840	2160	120	4 Link 10G (42.768Gb/s)	6 Link 10G (64.152Gb/s)
2160p100	3840	2160	100		
2160p60/59.94	3840	2160	60	3 Link 10G (32.076Gb/s)	
2160p50	3840	2160	50		
2160p30/29.97	3840	2160	30		
2160p25	3840	2160	25		
2160p24/2398	3840	2160	24		

UHDTV2 Production				Number of Links		
System Nomenclature	Horizontal Pixels	Vertical Pixels	Frames Per Second (nominal)	10-bit / 12-bit 4:2:0	10-bit / 12-bit 4:2:2	10-bit / 12-bit 4:4:4
4320p120/119.88	7680	4320	120	12 Link 10G (128.304Gb/s)	16 Link 10G (171.072Gb/s)	24 Link 10G (256.608Gb/s)
4320p100	7680	4320	100			
4320p60/59.94	7680	4320	60	6 Link 10G (64.152Gb/s)	8 Link 10G (85.536Gb/s)	12 Link 10G (128.304Gb/s)
4320p50	7680	4320	50			
4320p30/29.97	7680	4320	30	4 Link 10G (42.768Gb/s)		6 Link 10G (64.152Gb/s)
4320p25	7680	4320	25			
4320p24/23.98	7680	4320	24			

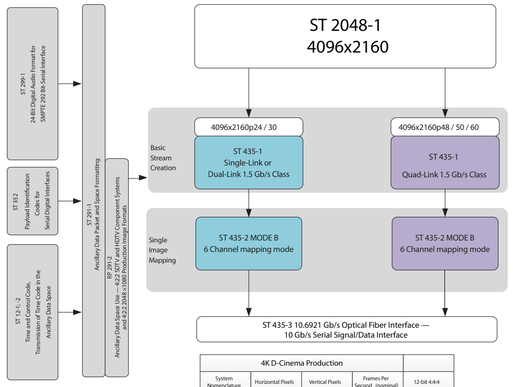
ST 435 10.692G SDI



HDTV and 2K D-Cinema Production				SDI Mapping Standard	
System Nomenclature	Horizontal Pixels	Vertical Pixels	Frames Per Second (nominal)	10-bit 4:2:2	12-bit 4:2:2 12-bit 4:4:4
1080p60/59.94	1920 / 2048	1080	60	ST 435 -1 Dual-Link 1.5G 2 channels MODE A or MODE B	ST 435 -1 Quad-Link 1.5G MODE A or MODE B
1080p50	1920 / 2048	1080	50		
1080p48/47.95	2048	1080	48		
1080i60/59.94	1920 / 2048	1080	30	ST 435 -1 Single-Link 1.5G 4channels MODE A or 4 channels MODE B	ST 435 -1 Dual-Link 1.5G 4 channels MODE A or MODE B
1080i50	1920 / 2048	1080	25		
1080p30/29.97	1920 / 2048	1080	30		
1080p25	1920 / 2048	1080	25		
1080p24/23.98	1920 / 2048	1080	24		
720p60/59.94	1280	720	60		
720p50	1280	720	50		
720p30/29.97	1280	720	30		
720p25	1280	720	25		
720p24/23.98	1280	720	24		

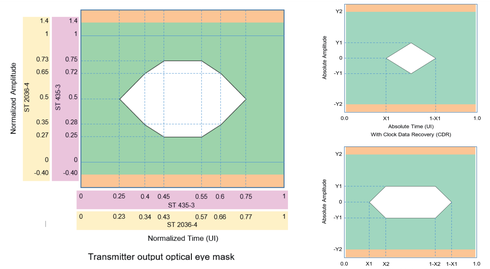
UHDTV1 and 4K D-Cinema Production				SDI Mapping Standard	
System Nomenclature	Horizontal Pixels	Vertical Pixels	Frames Per Second (nominal)	10-bit 4:2:2	12-bit 4:2:2 12-bit 4:4:4
2160p60/59.94	3840 / 4096	2160	60	ST 435-1 Octa-Link 1.5G MODE D	
2160p50	3840 / 4096	2160	50		
2160p30/29.97	3840 / 4096	2160	30		
2160p25	3840 / 4096	2160	25		
2160p24/23.98	3840 / 4096	2160	24		ST 435-1 Octa-Link 1.5G MODE C

ST 2048-3 Multi-Link 10.692G SDI



4K D-Cinema Production				
System Nomenclature	Horizontal Pixels	Vertical Pixels	Frames Per Second (nominal)	12-bit 4:4:4
2160p60/59.94	4096	2160	60	ST 2048-3 Triple-Link 10G (32.076Gb/s)
2160p50	4096	2160	50	
2160p48/47.95	4096	2160	48	
2160p30/29.97	4096	2160	30	ST 2048-3 Dual-Link 10G (21.384Gb/s)
2160p25	4096	2160	25	
2160p24/23.98	4096	2160	24	

Electrical / Optical Parameters



Transmitter output optical eye mask

Optical transmitter characteristics				
	SMPTE ST 2036-4	SMPTE ST 435-3		
Optical Wavelength	840 nm to 860 nm	1310 nm	1550 nm	1550 nm DWDM applications
Spectral with (max)	(RMS) 0.65 nm	(-20 dB) 1 nm	(-20 dB) 1 nm	(-20 dB) 1 nm
Wavelength accuracy		NA	NA	- 100 pm to +100 pm
Average launch power (max)	+ 2.4 dBm	+ 0.5 dBm	+ 4 dBm	+ 4 dBm
Average launch power (min)	- 7.6 dBm	- 5.5 dBm	- 4.7 dBm	- 1 dBm
Extinction Ratio (min)	3 dB	6 dB	6 dB	8.2 dB
Maximum reflected power	- 12 dB	- 12 dB	- 21 dB	- 21 dB
Electrical / optical transfer function	Logic '1' maximum intensity / Logic '0' minimum intensity			

Nominal central wavelength of DWDM				
	SMPTE ST 2036-3			
Nominal wavelength for 4 ch and 8 ch Interfaces	Link No 1 1557.36 nm	Link No 2 1556.55 nm	Link No 3 1555.75 nm	Link No 4 1554.94 nm
Nominal wavelength for 8 ch Interfaces	Link No 5 1554.13 nm	Link No 6 1553.33 nm	Link No 7 1552.52 nm	Link No 8 1551.72 nm

Optical receiver characteristics				
	SMPTE ST 2036-4	SMPTE ST 435-3		
Optical Wavelength	840 nm to 860 nm	1310 nm	1550 nm	1550 nm DWDM applications
Average receive power (max)	+ 2.4 dBm	+ 0.5 dBm	- 1 dBm	- 1 dBm
Average receive power (min)	- 9.5 dBm	- 13.5 dBm	- 13.5 dBm	- 13.5 dBm
Detector damage threshold (min)	+ 3.4 dBm	+ 1 dBm	+ 4 dBm	+ 4 dBm

Transmitter differential input electrical eye mask		
	SMPTE ST 435-3	
Clock Data Recovery (CDR)	With CDR	Without CDR
Eye Mask X1	0.305 UI max	0.12 UI max
Eye Mask X2	NA	0.33 UI max
Eye Mask Y1	60 mV min	95 mV min
Eye Mask X2	410 mV max	350 mV max

Receiver differential output eye mask specifications		
	SMPTE ST 435-3	
Clock Data Recovery (CDR)	With CDR	Without CDR
Eye Mask X1	0.17 UI max	0.35 UI max
Eye Mask X2	0.42 UI max	NA
Eye Mask Y1	170 mV min	150 mV min
Eye Mask X2	425 mV max	425 mV max

Optical transmitter input, receiver output electrical specifications		
	SMPTE ST 435-3	
Clock Data Recovery (CDR)	With CDR	Without CDR
Differential Input / Output Impedance	100 Ohm	100 Ohm
Termination Mismatch	5%	5%
Differential Input / Output Return Loss (min) SDD11 / SDD22 (insert f in GHz)	20 dB (0.05 - 0.1 GHz) 8 dB (0.1 - 5.5 GHz) 8 - 20.66 x $\log_{10}$ (f/5.5) dB (5.5 - 12 GHz)	12 - 2 x SQRT(f) dB (0.01 - 4.1 GHz) 6.3 - 13 x $\log_{10}$ (f/5.5) dB (5.5 - 12 GHz)
Common Mode Input / Output Return Loss (min) SCC11 / SCC22 (insert f in GHz)	3 dB (0.1 - 15 GHz)	7 - 1.6 x f dB (0.01 - 2.5 GHz) 3 dB (2.5 - 11.1 GHz)

Serial Fiber Interface Jitter Specification		
	SMPTE ST 435-3 / SMPTE ST 2036-4	
Description	Parameter	Value
Low-frequency specification limit	f1	10 Hz
Upper band edge for A1	f2	20 kHz
Lower band edge for A2	f3	4 MHz
High--frequency specification limit	f4	> 1/10 the clock rate
Timing jitter: Sinusoidal jitter amplitude shall be less than 2 x 10^3/f +0.1 UI at 20 kHz < f ≤4 MHz	A1	10 UI
Alignment jitter: Sinusoidal jitter amplitude shall be less than 0.15 UI at f > 4 MHz	A2	0.15 UI