

XAVC

XAVC S

XAVC H

XAVC HS

XAVC Profiles and Operating Points

(Informative)

Version 2.20

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Sony Corporation

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1 General

1.1 Scope

This document explains the XAVC Profiles and Operating Points defined in the XAVC Format: XAVC File Format Specifications version 2.20.

1.2 Definition of acronyms and terms

Acronyms and terms used in this document are defined in this section.

AAC	Advanced Audio Coding
AAC LC	AAC Low Complexity profile
AVC	H.264/ MPEG-4 Part10 Advanced Video Coding
CBG	Constrained Bytes per GOP
GOP	Group of Pictures
HEVC	H.265/ MPEG-H Part2 High Efficiency Video Coding
Long GOP	A type of video compression using inter-frame compression.
LPCM Audio	Linear Pulse Code Modulation Audio
Main-Stream AV	Full bit rate audio-visual data stream
MPEG	Moving Picture Experts Group
MP4	A multimedia wrapper format standard specified in ISO/IEC 14496-14
MXF	Material eXchange Format defined by a set of SMPTE standards as a wrapper format for professional digital video, audio and metadata material
Operating Points	Restrictions on the signal standard, resolution, frame rate, bit rate, etc. of the audio and video format, to maintain operational interoperability between applications.
Sub-Stream AV	Subsidiary and lower bit rate audio-visual data stream
VBR	Variable Bit Rate

2 Design of XAVC, XAVC H, XAVC S and XAVC HS

Table 1 shows the file wrapper, video and audio format used in XAVC and XAVC H, and Table 2 shows the file wrapper, video and audio format used in XAVC S and XAVC HS. XAVC H includes all the Formats and Profiles used in XAVC, plus the Video Profiles for HEVC. XAVC HS includes all the Formats and Profiles used in XAVC S, plus the Video Profiles for HEVC and Advanced LPCM Audio.

Table 1 – Design of XAVC and XAVC H

	XAVC H		
	XAVC		
Main-Stream AV file	XAVC MXF File Format		
Sub-Stream AV file	MXF File Format for MPEG HD422	XAVC MXF File Format	XAVC MP4 File Format
Main-Stream Video	XAVC HD Profile XAVC 4K Profile XAVC HD Intra Profile XAVC 4K Intra Profile		
Main-Stream Audio	Uncompressed Audio - AES3		
Sub-Stream Video	MPEG HD422	XAVC HD Profile	XAVC Sub-Stream Profile
Sub-Stream Audio	Uncompressed Audio - AES3	Uncompressed Audio - AES3	Compressed Audio - AAC-LC

Table 2 – Design of XAVC S and XAVC HS

	XAVC HS	
	XAVC S	
Main-Stream AV file	XAVC MP4 File Format	
Sub-Stream AV file	XAVC MP4 File Format	
Main-Stream Video	XAVC HD Profile XAVC 4K Profile XAVC HD Intra Profile XAVC 4K Intra Profile	XAVC HE-4K Main Profile XAVC HE-4K Ext. Profile XAVC HE-8K Main Profile XAVC HE-8K Ext. Profile
Main-Stream Audio	Uncompressed Audio - LPCM Compressed Audio - AAC-LC	Uncompressed Audio – Advanced LPCM
Sub-Stream Video	XAVC Sub-Stream Profile	XAVC HE-Sub-Stream Profile
Sub-Stream Audio	Compressed Audio - AAC-LC	

3 XAVC Video Profiles

The XAVC Format covers a wide range of video format using MPEG-4 AVC/H.264 Video compression and MPEG-H HEVC/H.265 Video compression. It is categorized into the XAVC Video Profiles. Table 3 and Table 4 shows the XAVC Video Profiles currently introduced and the range of video format supported by.

Table 3 – XAVC Video Profiles using MPEG-4 AVC/H.264

	XAVC 4K Profile	XAVC 4K Intra Profile
AVC Profile, Level	High Profile, High 4:2:2 Profile, Level 4.2 or more	High Profile, High 4:2:2 Intra Profile, Level 4.2 or more
Video resolution	2048x1080, 3840x2160, 4096x2160	2048x1080, 3840x2160, 4096x2160
Chroma sample	4:2:0, 4:2:2	4:2:0, 4:2:2
Bit depth	8bit, 10bit	8bit, 10bit
Frame rate	23.98p, 25p, 29.97p, 50p, 59.94p, 100p, 119.88p, 200p, 239.76p	23.98p, 24p, 25p, 29.97p, 50p, 59.94p
Bit rate	600 Mbps or less	960 Mbps or less

	XAVC HD Profile	XAVC HD Intra Profile
AVC Profile, Level	Main Profile, High Profile, High 4:2:2 Profile, Level 4 or more	High 10 Intra Profile, High 4:2:2 Intra Profile, Level 4 or more
Video resolution	1280x720, 1440x1080, 1920x1080	1280x720, 1440x1080, 1920x1080
Chroma sample	4:2:0, 4:2:2	4:2:0, 4:2:2
Bit depth	8bit, 10bit	8bit, 10bit
Frame rate	50i, 59.94i, 23.98p, 25p, 29.97p, 50p, 59.94p, 100p, 119.88p, 200p, 239.76p	50i, 59.94i, 23.98p, 24p, 25p, 29.97p, 50p, 59.94p
Bit rate	240 Mbps or less	440 Mbps or less

	XAVC Sub-Stream Profile
AVC Profile, Level	Main Profile, High Profile, Level 2.1 to 4.2
Video resolution	1920x1080 or smaller
Chroma sample	4:2:0
Bit depth	8bit
Frame rate	50i, 59.94i, 23.98p, 25p, 29.97p, 50p, 59.94p
Bit rate	28 Mbps or less

Note: The XAVC 4K444 Intra Profile and XAVC HD444 Intra Profile are reserved.

Table 4 – XAVC Video Profiles using MPEG-H HEVC/H.265

		XAVC HE-8K Intra Extension Profile
HEVC Profile, Level, Tier		Main 422 10 Intra Profile, Level 6 to 6.3, MainTier or High Tier
Video resolution		7680x4320, 8192x4320
Chroma sample		4:2:2
Bit depth		10bit
Frame rate		23.98p, 24p, 25p, 29.97p, 50p, 59.94p, 100p, 119.88p
Bit rate		up to maximum value of Level 6.3

	XAVC HE-8K Main Profile	XAVC HE-8K Extension Profile
HEVC Profile, Level, Tier	Main Profile, Main 10 Profile, Level 6 to 6.2, MainTier or High Tier	Main 422 10 Profile, Level 6 to 6.2, MainTier or High Tier
Video resolution	7680x4320, 8192x4320	7680x4320, 8192x4320
Chroma sample	4:2:0	4:2:2
Bit depth	8bit, 10bit	10bit
Frame rate	23.98p, 25p, 29.97p, 50p, 59.94p, 100p, 119.88p	23.98p, 25p, 29.97p, 50p, 59.94p, 100p, 119.88p
Bit rate	480 Mbps or less	800 Mbps or less

	XAVC HE-4K Main Profile	XAVC HE-4K Extension Profile
HEVC Profile, Level, Tier	Main Profile, Main 10 Profile, Level 5 to 6.1, MainTier or High Tier	Main 422 10 Profile, Level 5 to 6.1, MainTier or High Tier
Video resolution	2048x1080, 3840x2160, 4096x2160	2048x1080, 3840x2160, 4096x2160
Chroma sample	4:2:0	4:2:2
Bit depth	8bit, 10bit	10bit
Frame rate	23.98p, 25p, 29.97p, 50p, 59.94p, 100p, 119.88p, 200p, 239.76p	23.98p, 25p, 29.97p, 50p, 59.94p, 100p, 119.88p, 200p, 239.76p
Bit rate	480 Mbps or less	800 Mbps or less

	XAVC HE-Sub-Stream Profile
HEVC Profile, Level, Tier	Main Profile, Main 10 Profile, Level 2.1 to 5.1, MainTier
Video resolution	1920x1080 or smaller
Chroma sample	4:2:0
Bit depth	8bit, 10bit
Frame rate	23.98p, 25p, 29.97p, 50p, 59.94p, 100p, 119.88p, 200p, 239.76p
Bit rate	40 Mbps or less

4 Operating Points

This section explains the Operating Points which have been introduced in the XAVC File Format Specifications version 2.20.

4.1 Operating Points of Main-Stream video

4.1.1 XAVC AVC Intra

There are two compression types of the XAVC AVC Intra, CBG compression and VBR compression. Table 5 indicates supported compressions for the XAVC File Formats.

Table 5 – Supported XAVC Intra Profiles for AVC and compression types for the XAVC File Formats.

XAVC Profiles	Compression types	XAVC MXF File Format	XAVC MP4 File Format
XAVC HD Intra	CBG compression	✓	
	VBR compression		✓
XAVC 4K Intra	CBG compression	✓	
	VBR compression	✓	✓

Table 6 and Table 7 indicate the Operating Points of XAVC HD Intra Profile.

Table 6 – Operating Points of XAVC HD Intra Profile for the XAVC MXF File Format (Intra CBG)

Video Resolution	Chroma sampling/ Bit depth	RP 2027	Coded frame size [bytes]	Frame Rate and Bit Rate [Mbps]							
				50i	59.94i	23.98p	24p	25p	29.97p	50p	59.94p
1280 x 720	4:2:2/ 10bit	Class 100	230,912								111
			279,040							112	
1440 x 1080	4:2:0/ 10bit	Class 50	223,232		54	43			54		
			271,360	54				54			
1920 x 1080	4:2:2/ 10bit	Class 100	462,848		111	89			111		222
			559,104	112				112		223	
	4:2:2/ 10bit	Class 200	943,104		226	181			226		452
			1,134,592	227				227		454	

Note: The coding specifications of these Operating Points conform to Class 50, Class 100 and Class 200 of SMPTE RP 2027.

Table 7 – Operating Points of XAVC HD Intra Profile for the XAVC MP4 File Format (Intra VBR)

Video Resolution	Chroma sampling/ Bit depth	Class	Max coded frame size [bytes]	Frame Rate and Bit Rate [Mbps]							
				50i	59.94i	23.98p	24p	25p	29.97p	50p	59.94p
1280x720	4:2:2/ 10bit	Class 100	230,912			44		46	55	92	111
1920 x 1080	4:2:2/ 10bit	Class 100	462,848			89		93	111	185	222

Note: The class number represents the approximate bitrate value at 59.94p for 1280x720 or at 29.97p for 1920x1080.

Table 8 to Table 10 indicate the Operating Points of XAVC 4K Intra Profile.

Table 8 – Operating Points of XAVC 4K Intra Profile for the XAVC MXF File Format (Intra CBG)

Video Resolution	Chroma sampling/ Bit depth	Class	Coded frame size [bytes]	Frame Rate and Bit Rate [Mbps]							
				50i	59.94i	23.98p	24p	25p	29.97p	50p	59.94p
2048 x 1080	4:2:2/ 10bit	Class 100	462,848			89	89	93	111	185	222
3840 x 2160	4:2:2/ 10bit	Class 300	1,250,304			240		250	300	500	600
		Class 480	1,999,872			384		400	480	800	960
4096 x 2160	4:2:2/ 10bit	Class 300	1,250,304			240	240	250	300	500	600
		Class 480	1,999,872			384	384	400	480	800	960

Table 9 – Operating Points of XAVC 4K Intra Profile for the XAVC MXF File Format (Intra VBR)

Video Resolution	Chroma sampling/ Bit depth	Class	Max coded frame size [bytes]	Frame Rate and Bit Rate [Mbps]							
				50i	59.94i	23.98p	24p	25p	29.97p	50p	59.94p
2048 x 1080	4:2:2/ 10bit	Class 100	462,848			89	89	93	111	185	222
3840 x 2160	4:2:2/ 10bit	Class 300	1,250,304			240		250	300	500	600
		Class 480	1,999,872			384		400	480	800	960
4096 x 2160	4:2:2/ 10bit	Class 300	1,250,304			240	240	250	300	500	600
		Class 480	1,999,872			384	384	400	480	800	960

Table 10 – Operating Points of XAVC 4K Intra Profile for the XAVC MP4 File Format (Intra VBR)

Video Resolution	Chroma sampling/ Bit depth	Class	Max coded frame size [bytes]	Frame Rate and Bit Rate [Mbps]							
				50i	59.94i	23.98p	24p	25p	29.97p	50p	59.94p
3840 x 2160	4:2:2/ 10bit	Class 300	1,250,304			240		250	300	500	600
		Class 480	1,999,872			384		400	480	800	960
4096 x 2160	4:2:2/ 10bit	Class 300	1,250,304			240	240	250	300	500	600

Note: The class number represents the approximate bitrate value at 29.97p.

4.1.2 XAVC AVC Long GOP

Table 11 to Table 14 indicate the Operating Points of XAVC HD Profile.

Table 11 – Operating Points of XAVC HD Profile / Class I for the XAVC MXF File Format using AVC High 4:2:2 Profile

Video Resolution	Chroma sampling/ Bit depth	Frame Rate and Predefined Bit Rate [Mbps]							
		50i	59.94i	23.98p	24p	25p	29.97p	50p	59.94p
1280 x 720	4:2:2/ 10bit							50	50
1920 x 1080	4:2:2/ 10bit	25	25	25		25	25		
		35	35	35		35	35	35	35
		50	50	50		50	50	50	50

Table 12 – Operating Points of XAVC HD Profile / Class I for the XAVC MP4 File Format using AVC High 4:2:2 Profile

Video Resolution	Chroma sampling/ Bit depth	Frame Rate and Predefined Bit Rate [Mbps]							
		50i	59.94i	23.98p	24p	25p	29.97p	50p	59.94p
1280 x 720	4:2:2/ 10bit							50	50
1920 x 1080	4:2:2/ 10bit			25		25	25		
				35		35	35	35	35
				50		50	50	50	50

Table 13 – Operating Points of XAVC HD Profile / Class I for the XAVC MP4 File Format using AVC Main or High Profile

Video Resolution	Chroma sampling/ Bit depth	Max Bit Rate [Mbps]	Frame Rate							
			50i	59.94i	23.98p	24p	25p	29.97p	50p	59.94p
1280 x 720	4:2:0/ 8bit	40			✓		✓	✓	✓	✓
1440 x 1080	4:2:0/ 8bit	80			✓		✓	✓	✓	✓
1920 x 1080	4:2:0/ 8bit	80			✓		✓	✓	✓	✓

Table 14 – Operating Points of XAVC HD Profile / Class II for the XAVC MP4 File Format using AVC Main or High Profile

Video Resolution	Chroma sampling/ Bit depth	Max Bit Rate [Mbps]	Frame Rate			
			100p	119.88p	200p	239.76p
1280 x 720	4:2:0/ 8bit	80	✓	✓		
1280 x 720	4:2:0/ 8bit	126			✓	✓
1920 x 1080	4:2:0/ 8bit	156	✓	✓		
1920 x 1080	4:2:0/ 8bit	188			✓	✓

Table 15 to Table 19 indicate the Operating Points of XAVC 4K Profile.

Table 15 – Operating Points of XAVC 4K Profile / Class I for the XAVC MXF File Format using AVC High Profile

Video Resolution	Chroma sampling/ Bit depth	Max Bit Rate [Mbps]	Frame Rate					
			23.98p	24p	25p	29.97p	50p	59.94p
3840 x 2160	4:2:0/ 8bit	188	✓		✓	✓		
3840 x 2160	4:2:0/ 8bit	300					✓	✓

Table 16 – Operating Points of XAVC 4K Profile / Class I for the XAVC MXF and MP4 File Format using AVC High 4:2:2 Profile

Video Resolution	Chroma sampling/ Bit depth	Frame Rate and Predefined Bit Rate [Mbps]					
		23.98p	24p	25p	29.97p	50p	59.94p
3840 x 2160	4:2:2/ 10bit	100 140 200		100 140 200	100 140 200		
3840 x 2160	4:2:2/ 10bit					140 200	140 200

Table 17 – Operating Points of XAVC 4K Profile / Class II for the XAVC MP4 File Format using AVC High 4:2:2 Profile

Video Resolution	Chroma sampling/ Bit depth	Frame Rate			
		100p	119.88p	200p	239.76p
3840 x 2160	4:2:2/ 10bit	280 400	280 400		

Table 18 – Operating Points of XAVC 4K Profile / Class I for the XAVC MP4 File Format using AVC High Profile

Video Resolution	Chroma sampling/ Bit depth	Max Bit Rate [Mbps]	Frame Rate					
			23.98p	24p	25p	29.97p	50p	59.94p
3840 x 2160	4:2:0/ 8bit	188	✓		✓	✓		
3840 x 2160	4:2:0/ 8bit	300					✓	✓

Table 19 – Operating Points of XAVC 4K Profile / Class II for the XAVC MP4 File Format using AVC High Profile

Video Resolution	Max Bit Rate [Mbps]	Frame Rate			
		100p	119.88p	200p	239.76p
3840 x 2160	300	✓	✓		

Note: The Max Bit Rate is defined as the maximum value and the Predefined Bit Rates are actually-usable values of Bitrate[SchedSelIdx] for both VCL and NAL HRD parameters. If one or more Predefined Bit Rate(s) is/are specified, XAVC Recorders and Players should support the bit rate(s) and should not use other bit rate(s) in each Operating Point.

4.1.3 XAVC HEVC Intra

Table 20 indicates the Operating Points of XAVC HE-8K Extension Profile for the XAVC MXF File Format.

Table 20 – Operating Points of XAVC HE-8K Intra Extension Profile for the XAVC MXF File Format

Video Resolution	Class	Target coded frame size [bytes]	Frame Rate							
			23.98p	24p	25p	29.97p	50p	59.94p	100p	119.88p
7680 x 4320	SQ	3,333,120	✓		✓	✓				
	HQ	4,999,680	✓		✓	✓				
8192 x 4320	SQ	3,333,120	✓	✓	✓	✓				
	HQ	4,999,680	✓	✓	✓	✓				

4.1.4 XAVC HEVC Long GOP

Table 21 indicate the Operating Points of XAVC HE-4K Main Profile for the XAVC MP4 File Format.

Table 21 – Operating Points of XAVC HE-4K Main Profile for the XAVC MP4 File Format

Video Resolution	Max Bit Rate [Mbps]	Frame Rate									
		23.98p	24p	25p	29.97p	50p	59.94p	100p	119.88p	200p	239.76p
3840 x 2160	100	✓		✓	✓						
3840 x 2160	160					✓	✓				
3840 x 2160	240							✓	✓		

Table 22 indicates the Operating Points of XAVC HE-4K Extension Profile for the XAVC MP4 File Format.

Table 22 – Operating Points of XAVC HE-4K Extension Profile for the XAVC MP4 File Format

Video Resolution	Max Bit Rate [Mbps]	Frame Rate									
		23.98p	24p	25p	29.97p	50p	59.94p	100p	119.88p	200p	239.76p
3840 x 2160	166	✓		✓	✓						
3840 x 2160	240					✓	✓				
3840 x 2160	400							✓	✓		

Table 23 indicates the Operating Points of XAVC HE-8K Main Profile for the XAVC MP4 File Format.

Table 23 – Operating Points of XAVC HE-8K Main Profile for the XAVC MP4 File Format

Video Resolution	Max Bit Rate [Mbps]	Frame Rate								
		23.98p	24p	25p	29.97p	50p	59.94p	100p	119.88p	
7680x4320	400	✓		✓	✓					

Table 24 and Table 25 indicate the Operating Points of XAVC HE-8K Extension Profile.

Table 24 – Operating Points of XAVC HE-8K Extension Profile for the XAVC MP4 File Format

Video Resolution	Max Bit Rate [Mbps]	Frame Rate								
		23.98p	24p	25p	29.97p	50p	59.94p	100p	119.88p	
7680x4320	520	✓		✓	✓					

Table 25 – Operating Points of XAVC HE-8K Extension Profile for the XAVC MXF File Format

Video Resolution	Frame Rate and Predefined Bit Rate [Mbps]								
	23.98p	24p	25p	29.97p	50p	59.94p	100p	119.88p	
7680 x 4320	520		520	520					

4.2 Operating Points of Main-Stream audio

Table 26 indicates the Operating Points of XAVC Main-Stream audio.

Table 26 – Operating Points of XAVC Main-Stream audio

	XAVC MXF File Format	XAVC MP4 File Fromat		
	AES3 Audio	Uncompressed Audio	Uncompressed Advanced Audio	MPEG-4 AAC Audio
Sampling	48 kHz	48 kHz	48 kHz, 96 kHz or 192 kHz	48 kHz
Sample word length	24 bits	16 bits	24 bits	16 bits
Bit rate	uncompressed	uncompressed	uncompressed	Average 256 kbps for stereo and 640 kbps for 5.1 channels. Peak 384 kbps for stereo and 960 kbps for 5.1 channels.
Channel	Monaural even number up to 16 tracks Typically 8 tracks	2 (stereo) per track	1 (monaural) or 2 (stereo) per track	2 (stereo) or 6 (5.1 channels) per track

4.3 Operating Points of Sub-Stream video

4.3.1 XAVC AVC Long GOP

Table 27 indicates the Operating Points of XAVC Sub-Stream Profile.

Table 27 – Operating Points of XAVC Sub-Stream Profile

Video Resolution	Max Bit Rate [Mbps]	Frame Rate									
		50i	59.94i	23.98p	24p	25p	29.97p	50p	59.94p	100p	119.88p
480 x 270	4			✓		✓	✓	✓	✓		
640 x 360	10			✓		✓	✓	✓	✓		
720 x 480	16		✓								
720 x 576	16	✓									
1280 x 720	28			✓		✓	✓	✓	✓		
1920 x 1080	28	✓	✓	✓		✓	✓	✓	✓		

4.3.2 XAVC HEVC Long GOP

Table 28 indicates the Operating Points of XAVC HE-Sub-Stream Profile.

Table 28 – Operating Points of XAVC HE-Sub-Stream Profile.

Video Resolution	Max Bit Rate [Mbps]	Frame Rate									
		50i	59.94i	23.98p	24p	25p	29.97p	50p	59.94p	100p	119.88p
1920x1080	16			✓		✓	✓	✓	✓		
1920x1080	25									✓	✓

4.4 Operating Points of Sub-Stream audio

Table 29 indicates the Operating Points of XAVC Sub-Stream audio.

Table 29 – Operating Points of XAVC Sub-Stream audio

	XAVC MP4 File Fromat
	MPEG-4 AAC Audio
Sampling	48 kHz
Sample word length	16 bits
Bit rate	Average 256 kbps for stereo and 640 kbps for 5.1 channels. Peak 384 kbps for stereo and 960 kbps for 5.1 channels.
Channel	2 (stereo) or 6 (5.1 channels) per track