



XAVC Profiles and Operating Points

(Informative)

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XAVC Profiles and Operating Points

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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 1.20 Amendment 1.

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
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 and XAVC S

Table 1 shows the file wrapper, video and audio format used in XAVC and XAVC S.

Table 1 – Design of XAVC and XAVC S

	XAVC		XAVC S
Main-Stream AV file	XAVC MXF File Format		XAVC MP4 File Format
Sub-Stream AV file	MXF File Format for MPEG HD422	XAVC MP4 File Format	XAVC MP4 File Format
Main-Stream Video	XAVC HD Profile XAVC 4K Profile XAVC HD Intra Profile XAVC 4K Intra Profile		XAVC HD Profile XAVC 4K Profile XAVC HD Intra Profile
Main-Stream Audio	Uncompressed Audio - AES3		Uncompressed Audio - LPCM or Compressed Audio - AAC-LC
Sub-Stream Video	MPEG HD422	XAVC Sub-Stream Profile	XAVC Sub-Stream Profile
Sub-Stream Audio	Uncompressed Audio - AES3	Compressed Audio - AAC-LC	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. It is categorized into the XAVC Video Profiles. Table 2 shows the XAVC Video Profiles currently introduced and the range of video format supported by.

Table 2 – XAVC Video Profiles

	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	23.98p, 24p, 25p, 29.97p, 50p, 59.94p
Bit rate	up to maximum value of Level 5.2	960Mbps 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	240Mbps or less	440Mbps 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	28Mbps or less

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

4 Operating Points

This section explains the Operating Points which have been introduced in the XAVC File Format Specifications version 1.20 Amendment 1.

4.1 Operating Points of Main-Stream video

4.1.1 XAVC Intra

There are two compression types of the XAVC Intra, CBG compression and VBR compression. Table 3 indicates supported compressions for the XAVC File Formats.

Table 3 – Supported XAVC Intra Profiles 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 4 and Table 5 indicate the Operating Points of XAVC HD Intra Profile.

Table 4 – 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	54			54			
			271,360	43				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 5 – 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 6 and Table 7 indicate the Operating Points of XAVC 4K Intra Profile.

Table 6 – 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 7 – 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

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

4.1.2 XAVC Long GOP

Table 8 to Table 10 indicate the Operating Points of XAVC HD Profile.

Table 8 – Operating Points of XAVC HD Profile for the XAVC MXF File Format

Video Resolution	Chroma sampling/ Bit depth	Max Bit Rate [Mbps]	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	50
1920 x 1080	4:2:2/ 10bit	80	25	25	25		25	25	35	35
			35	35	35		35	35	50	50
			50	50	50		50	50	50	50

Table 9 – Operating Points of XAVC HD Profile / Class I for the XAVC MP4 File Format

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 10 – Operating Points of XAVC HD Profile / Class II for the XAVC MP4 File Format,

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			✓	✓

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1920 x 1080	4:2:0/ 8bit	156	✓	✓		
1920 x 1080	4:2:0/ 8bit	188			✓	✓

Table 11 to Table 13 indicate the Operating Points of XAVC 4K Profile.

Table 11 – Operating Points of XAVC 4K Profile 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 12 – Operating Points of XAVC 4K Profile for the XAVC MXF File Format using AVC High 4:2:2 Profile

Video Resolution	Chroma sampling/ Bit depth	Max Bit Rate [Mbps]	Frame Rate and Predefined Bit Rate [Mbps]					
			23.98p	24p	25p	29.97p	50p	59.94p
3840 x 2160	4:2:2/ 10bit	240	100		100	100		
			140		140	140		
			200		200	200		
3840 x 2160	4:2:2/ 10bit	300				140 200	140 200	

Table 13 – Operating Points of XAVC 4K Profile for the XAVC MP4 File Format

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					✓	✓

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.

4.2 Operating Points of Main-Stream audio

Table 14 indicates the Operating Points of XAVC Main-Stream audio.

Table 14 – Operating Points of XAVC Main-Stream audio

	XAVC MXF File Format	XAVC MP4 File Fromat	
	AES3 Audio	Uncompressed Audio	MPEG-4 AAC Audio
Sampling	48 kHz	48 kHz	48 kHz
Sample word length	24 bits	16 bits	16 bits
Bit rate	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	2 (stereo) or 6 (5.1 channels) per track

4.3 Operating Points of Sub-Stream video

4.3.1 XAVC Long GOP

Table 15 indicates the Operating Points of XAVC Sub-Stream Profile.

Table 15 – 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	✓	✓	✓		✓	✓	✓	✓		

4.4 Operating Points of Sub-Stream audio

Table 16 indicates the Operating Points of XAVC Sub-Stream audio.

Table 16 – 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