

SONY

X-OCN

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INTRODUCTION

Since 2000, Sony has been working on developing Digital Motion Picture Camera Systems for cinema industry under the “CineAlta” line over more than 20 years. Starting with the first CineAlta camera, F900, many models have been introduced to the market until now.

We introduced a lot of key technologies such as 24p, RGB444 system, Super35mm image sensor, 4K resolution in F55, and 8K resolution in F65. These models have been contributing to the high-end content creation market such as feature film, TV drama and commercials.

In 2017, we launched the latest cinema camera VENICE equipped with 36x24mm Full-Frame CMOS image sensor.

At the same time as the development of these cinema cameras, we have introduced video formats such as HDCAM and HDCAM-SR, providing YPbPr422 and RGB444 capability.

And then, we evolved RAW format which is native signal data from CMOS sensor before the process of generating video signals.

16 bit	RAW	X-OCN
10 bit	XAVC	HDCAM SR
8 bit	AVCHD	MPEG HD422

In 2016, Sony has released new recording format **X-OCN (eXtended tonal range Original Camera Negative)** – that is Sony’s original compressed RAW format.

This format further enhances the compression efficiency of Sony RAW, which delivers visually loss-less image quality.

X-OCN offers uncompromising image capture performance with the power of 16 bits, at low data rates. It processes camera original image data by utilizing a unique algorithm from Sony.

KEY ADVANTAGE OF X-OCN

- Exceptional quality with the power of 16 bits
- Smaller files, Longer recording times
- Greater decision-making flexibility in post-production
- Stable image quality with robust encoding
- Easy to work with full third-party support

Exceptional quality with the power of 16 bits

By combining superlative 16-bit precision with surprisingly moderate bit rates, X-OCN opens up powerful new production possibilities. X-OCN produces file sizes much smaller than typical camera RAW, but unlike conventional codecs, X-OCN offers 16-bit scene linear encoding. So, you get the ultimate in tonal expression, longer recording times, faster file transfers and more economical post-production.

Supported by Sony VENICE 2 (natively), VENICE and PMW-F55/F5 cameras (in combination with AXS-R7 recorder), the X-OCN format is a game changer achieving up to 8K resolution and High Dynamic Range while maintaining reasonable bitrates.

In this way, X-OCN is ideal for the most advanced workflows, including ACES, Rec.2020, SMPTE ST2084, the extended color space of Sony's S-Gamut3 color and High Dynamic Range tone mapping.

VENICE 2 builds upon X-OCN's proven success by offering internal 16-bit X-OCN recording without need for an external recorder, dramatically shrinking the form factor while still offering the full dynamic range and color reproduction of the sensor.

Far exceeding 10 and 12-bit formats, 16-bit X-OCN records 65,536 tonal gradations per color component, or over 280 trillion individual shades of color. This is the ultimate in grayscale expression, creating an enormous palette for extreme subtleties in grading and far greater flexibility for colorists and editors alike.

Smaller files, Longer recording times

X-OCN combines the quality and versatility of RAW with the easy playback and smaller files of traditional codecs. You get longer recording times, faster file transfers and more cost-effective postproduction.

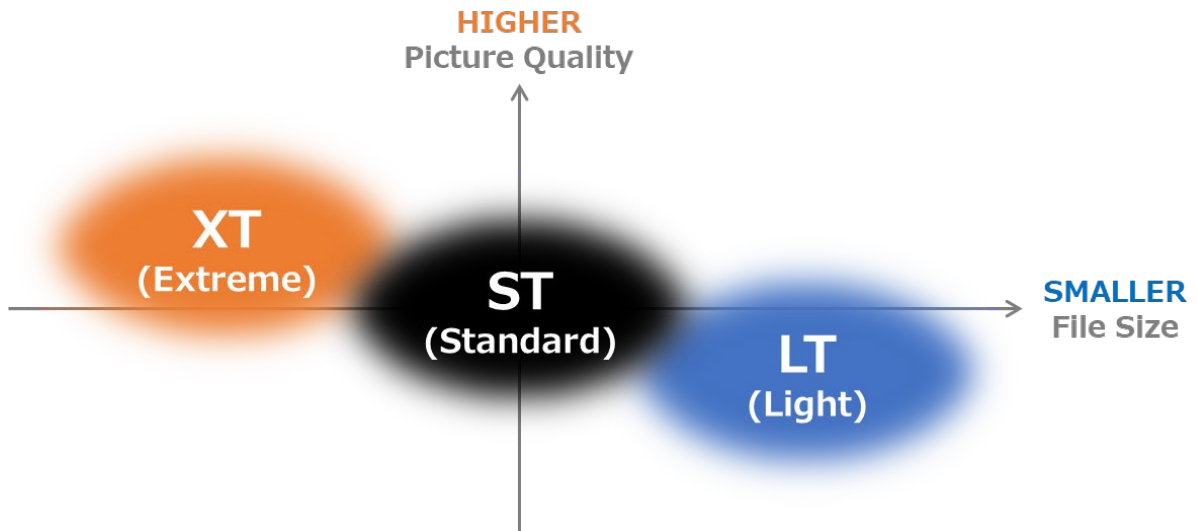
In most cases such as Feature Film, TV Drama or Commercial, Sony would recommend **X-OCN ST** which provides best balance between picture quality and file transfer time / storage size.

For special cases such as visual effects work or contents creation for giant screen, **X-OCN XT** is ideal as it captures the highest quality imagery.

For Mid-Low budget cinema (including TV Drama), Documentary or productions requiring long recording time, **X-OCN LT** is a good option as it provides even smaller file size than X-OCN ST – while preserving the benefit of 16-bit scene linear.

Mode	Major Applications*	Description
X-OCN XT (Extreme)	<ul style="list-style-type: none"> • Giant Screen • Visual Effects • Feature Film 	<ul style="list-style-type: none"> • Even higher picture quality than X-OCN ST, exceeding Sony RAW quality
X-OCN ST (Standard)	<ul style="list-style-type: none"> • Feature Film • Episodic Television • Commercials • Documentary 	<ul style="list-style-type: none"> • Best balance between picture quality and file transfer time / storage size, providing best efficiency in post-production • Equivalent quality to Sony RAW, even with 30% smaller file size
X-OCN LT (Light)	<ul style="list-style-type: none"> • Indy Feature • Episodic Television • Commercials • Documentary • Live Events 	<ul style="list-style-type: none"> • Even smaller file size than X-OCN ST (with 60% smaller than Sony RAW), while preserving processing flexibility provided by 16-bit scene linear

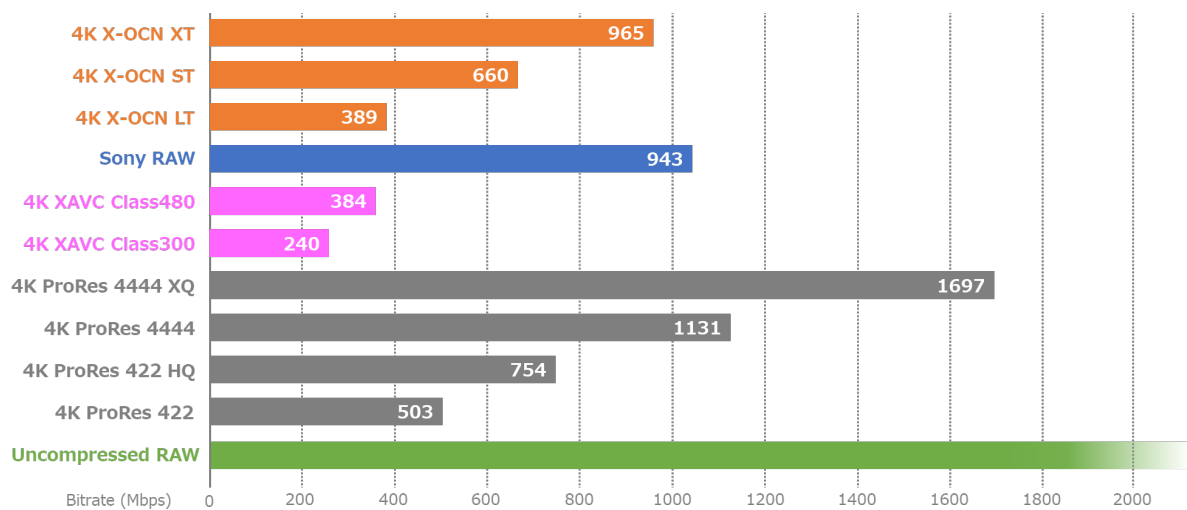
*Actual examples, not meaning each mode is appropriate only for these applications



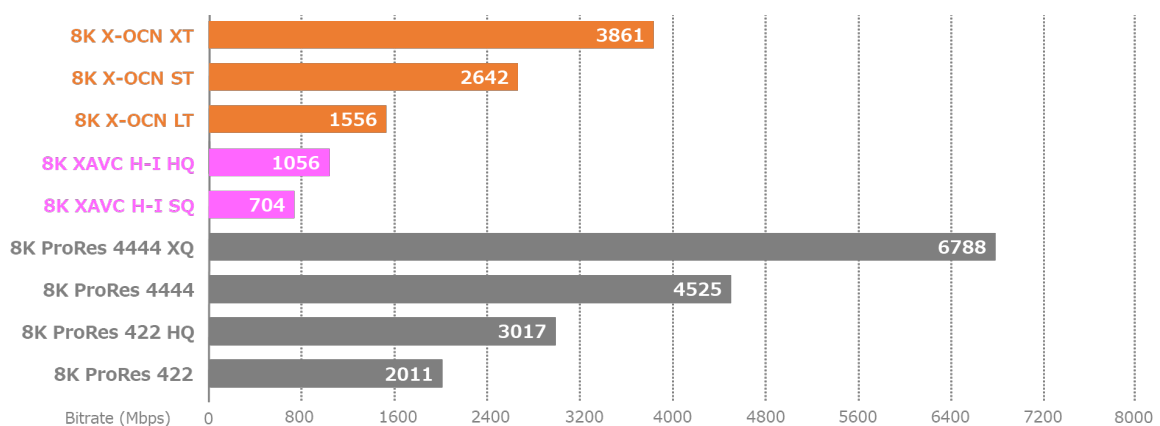
The following bar charts show how the bitrate of X-OCN (Sony’s original compressed RAW) is compared to other formats at 4K/24p and 8K/24p.

When it comes to 4K X-OCN LT (389Mbps), it can offer stunning RAW quality with 16-bit scene linear at almost equivalent bitrate to 4K XAVC Class480 (384Mbps) and even at lower bitrate than 4K ProRes 422 (503Mbps).

Bitrate Comparison at 4096 x 2160 / 24p



Bitrate Comparison at 8192 x 4320 / 24p



Greater decision-making flexibility in post-production

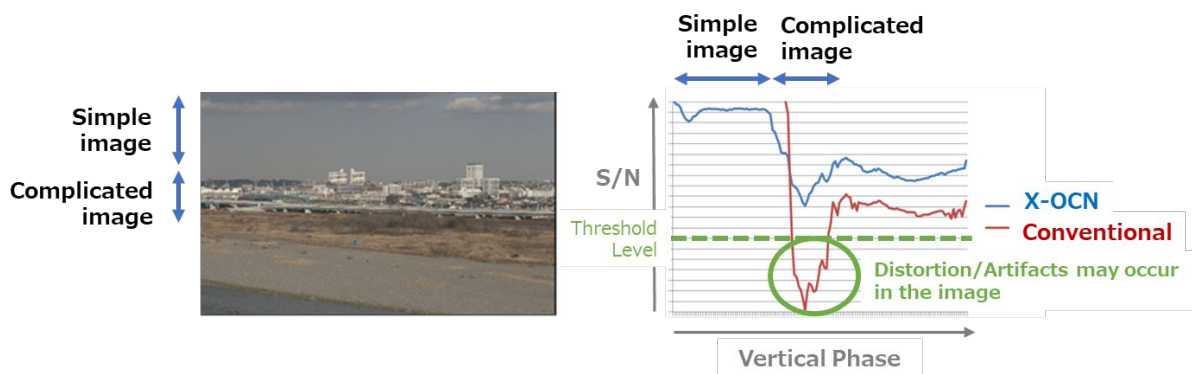
Instead of “baking in” your settings for Exposure Index, color space, LUTs, gamma, log and others, X-OCN captures these parameters as monitoring settings.

This process is completely non-destructive, delivering the full potential of the original sensor data into post-production but with the added advantage of efficient file sizes.

As a result, your colorist and editor are empowered with far greater decision-making flexibility than is possible with conventional video.

Stable image quality with robust encoding

X-OCN adopts an encoding algorithm which allows to secure uniform picture quality within each frame. It contributes to minimizing risks on any distortion or artifacts in the image, that may be caused by a limitation of conventional encoding.



- **Over threshold level** : No negative effect visually in the image
- **Under threshold level** : Distortion/Artifacts may occur in the image

In addition, X-OCN uses CBR (Constant Bit Rate) encoding, where the output remains constant regardless of the complexity of the image. It provides consistent picture quality between all frames.

These robust encoding technologies ensure stable image quality, that is crucial especially in high-end content creation including feature film.

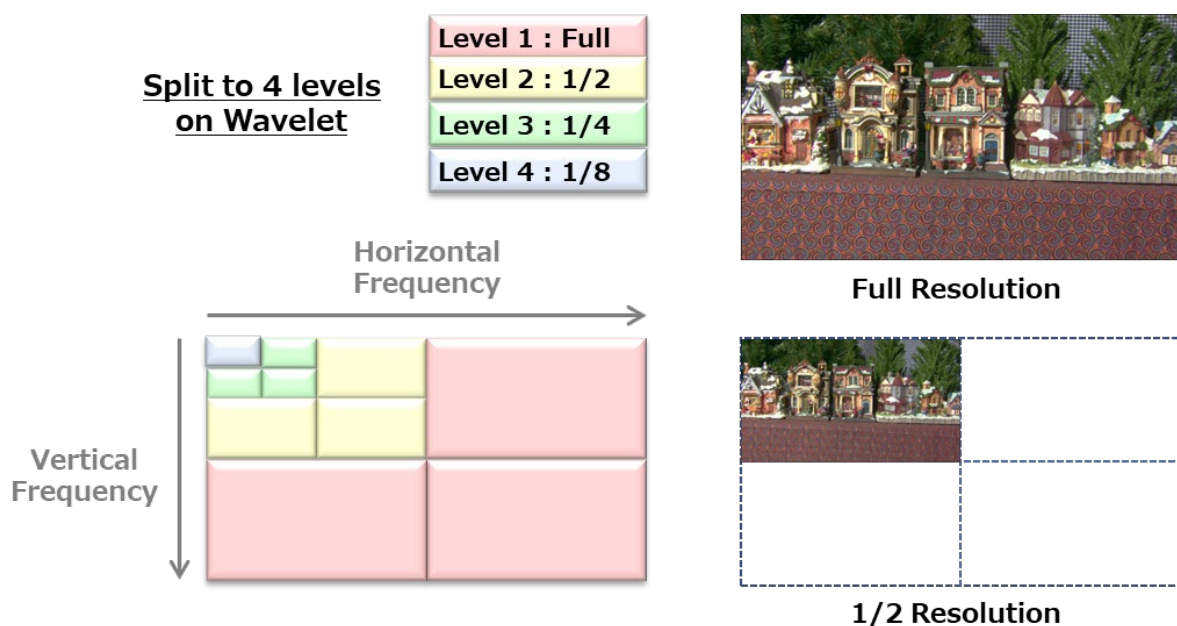
Easy to work with full third-party support

X-OCN is as easy to work with as Sony RAW, with files that playback in real-time on most laptop computers. You get a choice of tools for viewing, editing, grading and file management.

For additional simplicity, X-OCN uses the same industry-standard OP1a MXF wrapper as Sony RAW, XAVC, SR and MPEG2 formats. Picture, Sound and Metadata are contained within one file wrapper for easy file management.

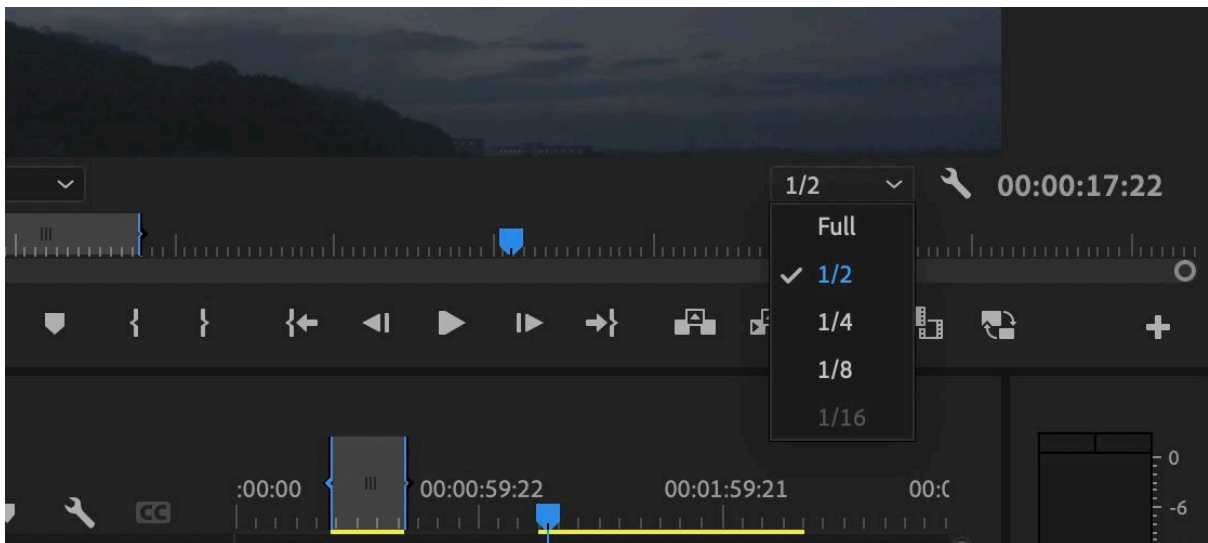
As another benefit, X-OCN adopts a wavelet transform as part of the image compression – that allows to offer great flexibility in viewing performance.

Even if a less powerful laptop computer needs to be used, you can still playback X-OCN clips smoothly in real-time by selecting 1/2 or 1/4 resolution (or even less if supported) on application software – thanks to hierarchical decoding capability.

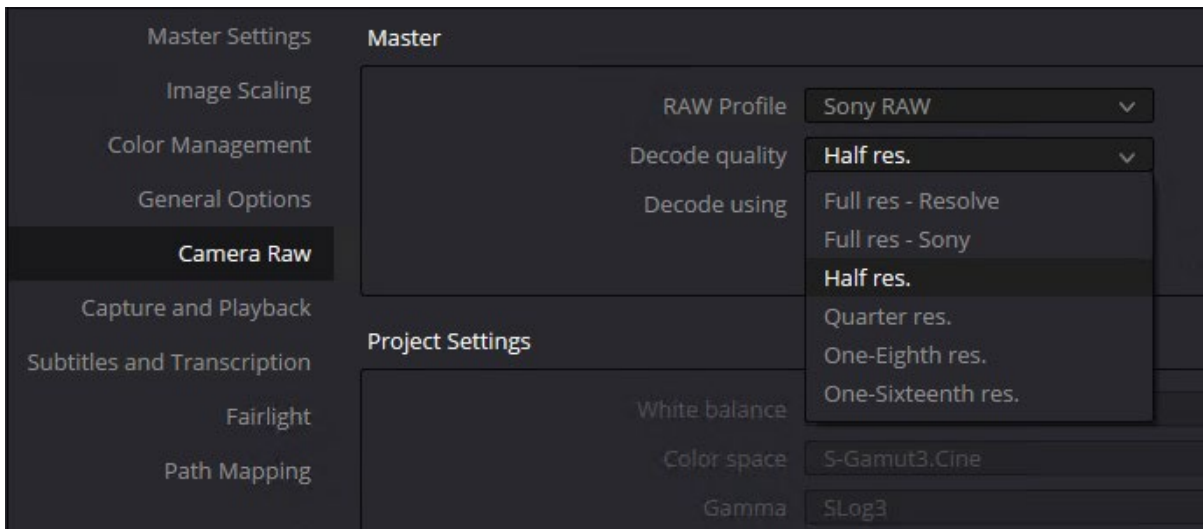


These are examples of decode setting for playback, which are available for Sony X-OCN clips on major third-party application software :

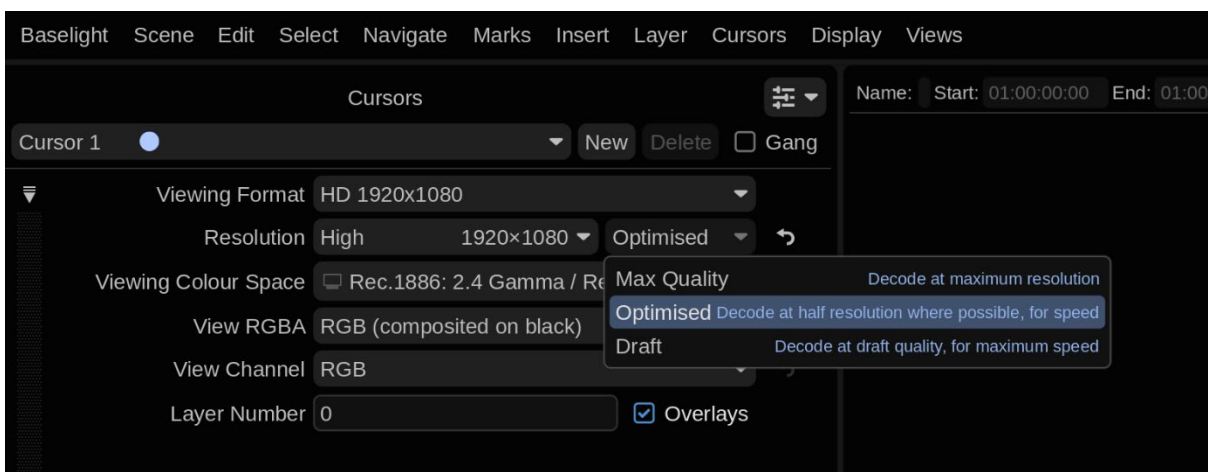
Adobe Premiere Pro :



Blackmagic DaVinci Resolve :



Filmlight Baselight :



X-OCN SPECIFICATIONS ON VENICE 2 CAMERA

- Recording Bitrate
- Recording Time
- FPS in AXS Memory Card

Recording Bitrate

VENICE 2 23.98/24.0p Recording format in V2.0

VENICE 2 with 8K image sensor (Mbps)

Format	Profile	8.6K 3:2	8.6K 17:9	8.2K 2.39:1	8.2K 17:9	8.1K 16:9	7.6K 16:9	5.8K 6:5	5.8K 4:3	5.8K 17:9	5.5K 2.39:1	5.4K 16:9
X-OCN	X-OCN XT	5,345	4,233	3,079	3,861	4,233	3,861	3,040	2,676	1,919	1,446	1,919
	X-OCN ST	3,658	2,897	2,107	2,642	2,897	2,642	2,080	1,832	1,313	990	1,313
	X-OCN LT	2,155	1,706	1,241	1,556	1,706	1,556	1,225	1,079	773	583	773

VENICE 2 with 6K image sensor (Mbps)

Format	Profile	6K 3:2	6K 1.85:1	6K 17:9	6K 2.39:1	5.7K 16:9	4K 6:5	4K 4:3	4K 4:3 SV	4K 17:9	4K 17:9 SV	4K 2.39:1	3.8K 16:9	3.8K 16:9 SV
X-OCN	X-OCN XT	2,631	2,143	2,091	1,665	2,091	1,525	1,342	1,342	965	965	770	965	965
	X-OCN ST	1,800	1,467	1,431	1,140	1,431	1,044	919	919	661	661	527	661	661
	X-OCN LT	1,061	864	843	671	843	615	541	541	389	389	310	389	389

VENICE 2 60p Recording format in V2.0

VENICE 2 with 8K image sensor (Mbps)

Format	Profile	8.6K 3:2	8.6K 17:9	8.2K 2.39:1	8.2K 17:9	8.1K 16:9	7.6K 16:9	5.8K 6:5	5.8K 4:3	5.8K 17:9	5.5K 2.39:1	5.4K 16:9
X-OCN	X-OCN XT	-	-	-	-	-	-	6,691	4,796	3,616	4,796	
	X-OCN ST	-	-	5,268	6,606	-	6,606	4,579	3,282	2,474	3,282	
	X-OCN LT	-	-	3,102	3,891	-	3,891	2,697	1,934	1,458	1,934	

VENICE 2 with 6K image sensor (Mbps)

Format	Profile	6K 3:2	6K 1.85:1	6K 17:9	6K 2.39:1	5.7K 16:9	4K 6:5	4K 4:3	4K 4:3 SV	4K 17:9	4K 17:9 SV	4K 2.39:1	3.8K 16:9	3.8K 16:9 SV
X-OCN	X-OCN XT	6,577	5,357	5,227	4,163	5,227	3,813	3,355	-	2,413	-	1,924	2,413	-
	X-OCN ST	4,500	3,667	3,577	2,850	3,577	2,610	2,296	-	1,652	-	1,317	1,652	-
	X-OCN LT	2,651	2,160	2,108	1,678	2,108	1,537	1,353	-	973	-	776	973	-

Recording Time

VENICE 2 with 8K image sensor (by AXS-1TS66, 1TB memory)

Imager mode	Project FPS	X-OCN XT	X-OCN ST	X-OCN LT
5.4K 16:9	23/24	65 min	95 min	160 min
	25	62	91	154
	29	52	76	128
	50	31	45	77
	59	26	38	64
5.8K 17:9	23/24	65	95	160
	25	62	91	154
	29	52	76	128
	47	32	47	80
	50	31	45	77
5.8K 6.5	23/24	86	126	212
	25	82	121	204
	29	69	100	170
	47	43	63	106
	50	41	60	102
5.8K 4:3	23/24	41	60	102
	25	39	57	98
	29	33	48	81
	47	20	30	51
	50	18	27	46
7.6K 16:9	23/24	32	47	80
	25	31	45	77
	29	25	37	64
	50	-	22	38
	59	-	18	32
8.1K 16:9	23/24	29	43	73
	25	28	41	70
	29	23	34	58
	23/24	32	47	80
	25	31	45	77
8.2K 17:9	23/24	29	43	73
	25	28	41	70
	29	23	34	58
	47	-	23	40
	50	-	22	38
8.2K 2.39:1	23/24	40	59	100
	25	39	57	96
	29	32	47	80
	47	20	29	50
	50	19	28	48
8.6K 17:9	23/24	29	43	73
	25	28	41	70
	29	23	34	58
	47	-	21	36
	50	-	20	35
8.6K 3:2	23/24	23	34	58
	25	22	32	55
	29	18	27	46
	47	-	18	32
	50	-	17	31

VENICE 2 with 6K image sensor (by AXS-1TS66, 1TB memory)

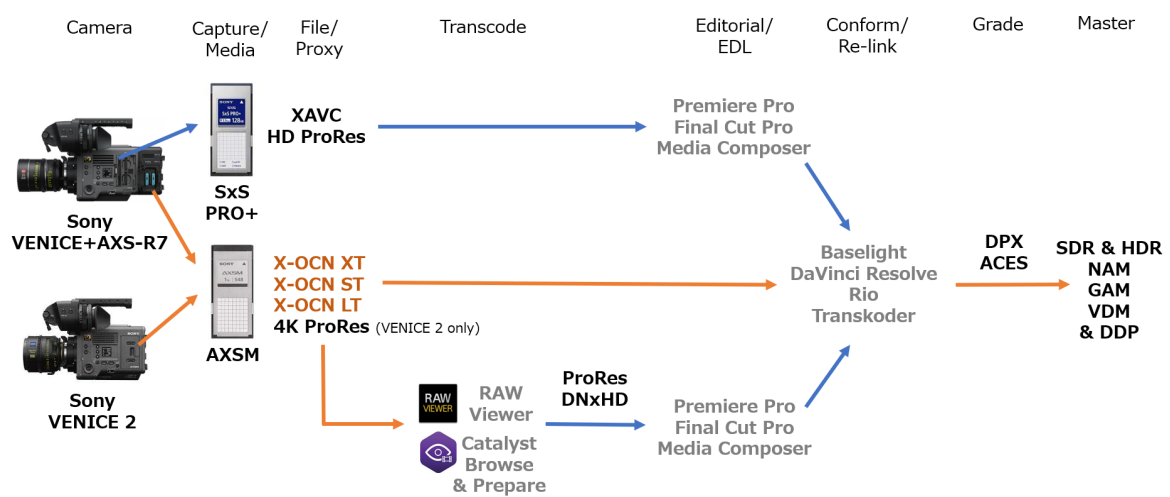
Imager mode	Project FPS	X-OCN XT	X-OCN ST	X-OCN LT
3.8K 16:9	23/24	129 min	188 min	316 min
	25	124	180	304
	29	103	150	254
	50	62	90	153
	59	51	75	127
4K 2.39:1	23/24	161	235	395
	25	155	225	380
	29	129	188	317
	47	81	118	199
	50	77	113	191
4K 17:9	23/24	129	188	316
	25	124	180	304
	29	103	150	254
	47	64	94	159
	50	62	90	153
4K 4:3	23/24	93	135	229
	25	89	130	220
	29	74	108	183
	47	46	68	115
	50	44	65	110
4K 6.5	23/24	81	119	201
	25	78	114	193
	29	65	95	161
	47	41	59	101
	50	39	57	97
5.7K 16:9	23/24	59	87	147
	25	57	83	141
	29	47	69	118
	50	28	42	71
	59	23	35	59
6K 2.39:1	23/24	75	109	185
	25	72	105	177
	29	60	87	148
	47	37	54	92
	50	36	52	89
6K 17:9	23/24	59	87	147
	25	57	83	141
	29	47	69	118
	47	29	43	74
	50	28	42	71
6K 1.85:1	23/24	58	85	144
	25	56	81	138
	29	46	68	115
	47	29	42	72
	50	28	40	69
6K 3:2	23/24	47	69	117
	25	45	66	112
	29	38	55	94
	47	23	34	58
	50	22	33	56

*Recording one clip. When several clips are recorded, time should be shorter than the chart.

X-OCN WORKFLOW

- Workflow Overview (from Capture to Master)
- Sony RAW Viewer
- Sony RAW SDK
- Full Third-party Support
- Metadata

Workflow Overview (from Capture to Master)



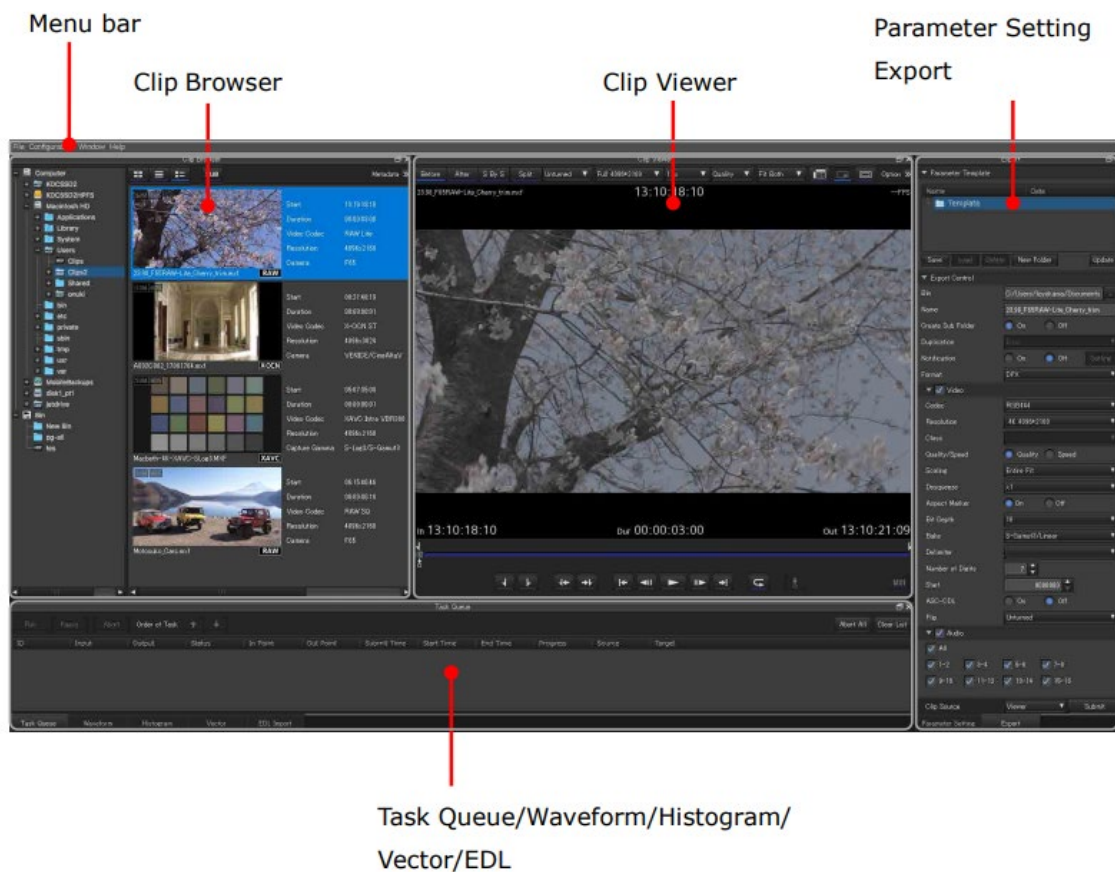


Sony RAW Viewer

RAW Viewer is free application software that allows you to view RAW, X-OCN and XAVC files recorded with Sony VENICE 2, VENICE and other cameras as well as AXS-R7 recorder.

With its intuitive user interface, you can view and perform basic color grading on files transferred to your computer, or files stored on a memory card inserted to AXS-AR3 or other card reader.

In addition, you can also export RAW, X-OCN and XAVC files to DPX, OpenEXR, XAVC or ProRes (only for Mac) format to facilitate file based post-production workflow.



Sony RAW SDK

Sony offers a license program to support third-party development for X-OCN format. This program includes supply of technical documents and SDK.

Over 50 third-party companies already take part in this program to support X-OCN on their own products.

For more information, please contact : psg-biz-alliance-agrmnt@sony.com

Full Third-party Support

X-OCN is supported by leading non-linear editing software and color grading tools such as Adobe Premiere Pro, Avid Media Composer via nablet Sony RAW AMA plugin, Blackmagic DaVinci Resolve, Colorfront OSD and Filmlight Baselight, to name a few.

For more details, please refer to another document :

X-OCN Supported Products by Alliance Partners

Metadata

X-OCN is a very easy and flexible format to work with Metadata that reflects the setup of the camera is recorded alongside the image information.

In post-production this metadata is automatically applied to the 16-bit linear recordings so that what you see in the edit or grading suite accurately reflects the way the camera was set. However, in post-production you can override the metadata settings for color temperature, Exposure Index and sharpness etc* to alter the way the data is processed.

This gives a tremendous degree of flexibility while retaining the exceptional quality of the 16-bit recording.

*The controls available depends on the software used

The following information is a list of metadata recorded as embedded in X-OCN MXF files, as well as recorded in XML files at the same time :

Table legend

Opt: Included if information is available (optional)

Yes: Defined

-: Not defined

Item	Notation example in RAW Viewer	RAW/X-OCN MXF	RAW/X-OCN XML
Creation Date	2021-10-29 11:04:05	Yes	Yes
Last Update	2021-10-30 11:04:05	-	Yes
UMID	060A2B340101010501010D4313000000070BF4 1D2F494EB7A16DD045A68CDF2E	Yes	Yes
Start	03:36:29:20	Yes	Yes
End	03:36:32:19	Yes	Yes
Duration	00:00:03:00	Yes	Yes
Poster Frame		-	-
Recording Mode		-	Yes
Drop Frame	NDF	Yes	Yes
Camera	VENICE/CineAltaV	Yes	Yes
Video Codec	X-OCN XT	Yes	Yes
Resolution	6048×4032	Yes	Yes
Aspect Ratio	3:2	Yes	Yes
Format FPS	23.98p	Yes	Yes
Capture FPS	23.98p	Yes	Yes
Pixel Aspect	1:1	-	Yes
Flip	normal	-	Yes
Number of Audio Channels	4	Yes	Yes
Audio Codec	LPCM	Yes	Yes
Audio Bit Depth	24	Yes	Yes
Audio Sampling Rate	48000	Yes	Yes
Auto Exposure Mode	ManualExposureMode	Yes	-
Exposure Index	500	Yes	Yes
Auto Focus Sensing Area Setting	ManualFocusMode	Opt	-
ND Filter Wheel	1/4	Yes	Yes
Image Sensor Dimension Effective Width	35925um	Yes	-
Image Sensor Dimension Effective Height	23950um	Yes	-
Image Sensor Readout Mode	ProgressiveFrame	Yes	Yes
Shutter Speed Angle	172.50deg	Yes	Yes
Shutter Speed Time	1/50sec	Yes	-
Camera Master Gain Adjustment	0.00dB	Yes	-
ISO Sensitivity	500	Yes	Yes
Electrical Extender Magnification	100%	Yes	-

Item	Notation example in RAW Viewer	RAW/X-OCN MXF	RAW/X-OCN XML
Auto White Balance Mode	PresetWhiteBalanceSetup	Yes	-
White Balance	5500	Yes	Yes
Tint Correction	0.00000	Yes	-
Camera Master Black Level	3.0%	-	-
Capture Gamma Equation	scene-linear	Yes	Yes
Gamma for CDL	rec709	Yes	Yes
Color Primaries (Capture Color Primaries)		-	-
Camera Attributes	MPC-3628999999Version5.00	Yes	Yes
Effective Marker Aspect Ratio	6048:3202	Yes	Yes
User Frame Line 1	1920x1080+0+0	Yes	-
User Frame Line 2	1920x1080+0+0	Yes	-
Active Area Aspect Ratio	6048:4032	Yes	Yes
Pixel Aspect Ratio	1:1	Yes	Yes
Image Orientation	normal	Yes	-
Raw Black Code	512	Yes	Yes
Raw Gray Code	1504	Yes	Yes
Raw White Code	5472	Yes	Yes
Gamma for Look	s-log3-cine	Yes	Yes
Color for Look	s-gamut3-cine	Yes	Yes
Pre-CDL Transform	LUT:SL3SG3Ctos709.cube	Yes	Yes
Post-CDL Transform	none	Yes	Yes
Look Process Baked	false	Yes	Yes
Monitoring Characteristics	rec709	Yes	Yes
Monitoring Base Curve	rec709	Yes	Yes
Monitoring Color Primaries	rec709	Yes	Yes
Monitoring Coding Equations	rec709	Yes	Yes
Monitoring Descriptions	LUT:SL3SG3Ctos709.cube	Yes	Yes
Camera Tilt Angle	2.70000	Yes	-
Camera Roll Angle	1.30000	Yes	-
Focus Distance	2296mm	Opt	-
Aperture Value	3.14	Opt	-
Aperture Ring T Stop Position	2.8 + 3/10	Opt	-
Current Focal Length	0mm	Opt	-
Hyperfocal Distance	219224mm	Opt	-
Near Focus Distance	2273mm	Opt	-
Far Focus Distance	2319mm	Opt	-
Horizontal Field of View	27.9deg	Opt	-

Item	Notation example in RAW Viewer	RAW/X-OCN MXF	RAW/X-OCN XML
Entrance Pupil Position	+51mm	Opt	-
Normalised Zoom Value	0.000	Opt	-
Lens Serial Number	xxxxxxxx	Opt	-
Iris F-Number	2.87	Opt	-
Iris T-Number	3.1	Opt	-
Iris Ring Position		Opt	-
Focus Position from Image Plane	2.296m	Opt	-
Focus Ring Position		Opt	-
Macro Setting	OFF	Opt	-
Lens Zoom 35mm Still Camera Equivalent	85mm	Opt	-
Lens Zoom Actual Focal Length	85mm	Opt	-
Zoom Ring Position		Opt	-
Anamorphic Lens Squeeze Ratio		Opt	-
Optical Extender Magnification	100%	Opt	-
Lens Attributes	xxxxxxxx	Opt	Opt
Cooke /i technology		Opt	-
Cooke /i2 technology		Opt	-
Cooke /i3 technology		Opt	-
Zeiss eXtended metadata		Opt	-
Description		-	-
Circle		-	-
Project		-	-
Director Name		-	-
Director of Photography Name		-	-
Production		-	-
Camera Index		-	Yes
Reel		-	Yes
Scene		-	-
Cut		-	-
Take		-	-
Shot		-	Yes
Mark In		-	-
Mark Out		-	-

CONCLUSION

X-OCN (Sony's original compressed RAW format) gives you all the benefits of a RAW workflow but without huge file sizes normally associated with uncompressed RAW. It takes everything that the sensor captures and uses a clever encoding process to store that information in a user friendly, compact, 16-bit MXF file.

The 16-bit scene linear files ensure that you are recording every nuance and every subtle texture that the camera can deliver, maximizing your grading and post-production possibilities. At the same time the compact file size delivers a fast and efficient workflow. Transfer times are faster and storage requirements significantly reduced compared to other uncompressed workflows.

X-OCN files are computer friendly, allowing for fast workflows even with modest post-production hardware.