QuBE / aMS / aVS Supported Formats

Detailed definition of the file and essence formats supported by the aQ Server Firmware, version 4:
Broadcast Engine (QuBE), Media System (aMS) and Video Server (aVS)

CONFIDENTIAL DOCUMENT

Updated: 19/07/2016 17:41

Prepared by: Geoff Back

aQ Broadcast Limited

T: +44 (0) 118 324 0404

E: support@aq-broadcast.com

W: www.aq-broadcast.com

aQ Supported Formats

TABLE OF CONTENTS

1   INTRODUCTION

This document provides technical details about the AMS environment's media processing capabilities, including file and essence formats supported by the AMS.

Note that support of a given file for playback requires two things:

1.   The file's container format (or "file type") must be one that is supported.

2.   The file's essence (video, audio, captions, etc) must be stored using a supported encoding.
     For example, video essence might be stored using DNxHD or MPEG-2 encoding.

1.1   APPLICABLE VERSION

The range and extent of support is continuously changing. This document version details the support level as of version 4.80 of the AMS firmware.

2   CORE SYSTEM CHARACTERISTICS

2.1   VIDEO PROCESSING

Internal video processing within the AMS is performed in 4:4:4 either RGB or YUV depending on circumstances. Most processing is 32-bit RGB by default. YUV where used defaults to 10 bits per element. External SDI interfaces are 10-bit YUV 4:2:2 on default hardware.

Support for processing RGB/YUV 4:4:4:4 (i.e. with alpha) is available on specific hardware, including the ability to output paired key/fill signals.

Chroma subsampling and sample widths stored in files depends on the video encoding in use, but where the codecs are capable, full support for 10-bit, or wider YUV (or RGB) is provided.

Internal processing paths can be configured to wider RGB and YUV widths on specific hardware.

Automatic colour space conversion is included as standard.

2.2   SUPPORTED VIDEO MODES

Standard units support the following video modes by default:

−   SD PAL (720 x 576) interlaced, 4:3 or 16:9 aspect ratio, 25 frames per second

−   SD NTSC (720 x 480) interlaced, 4:3 or 16:9 aspect ratio, 29.97 frames per second

−   HD 720p (1280 x 720) progressive, 16:9, 50 / 59.94 / 60 frames per second

−   HD 1080 (1920 x 1080) interlaced or progressive, 16:9, 25 / 29.97 / 30 frames per second.

Standard units include SDI (270 Mbps and 1.5 Gbps) interfaces.

On appropriate hardware, support is available for 3G-SDI (3.0 Gbps) interfaces along with the corresponding extended video modes:

- HD (1920 x 1080) progressive at 50 / 59.94 / 60 fps

- 2K (2048 x 1080) progressive @ 23.98 / 24 / 25 fps

2.3   PLAYBACK VIDEO CONVERSION

Automatic frame rate conversion is applied on playback using frame doubling / skipping by default. Smoothed conversion is available as an option on appropriate hardware.

Video frame resizing is applied automatically as required. Multiple resize algorithms are available depending on hardware resources. Enhanced resize operations are available by default, including advanced conversions between HD 1080i (interlaced) and HD 720p (progressive) formats that preserve temporal distinctions between interlaced fields.

The system is able to play back files in virtually any video frame size from legacy very-low-resolution footage through to files well beyond HD (subject to adequate resources) effectively.

2.4   AUDIO PROCESSING

Internal audio processing is PCM, either 32 bits-per-sample integer or 32/64 bits-per-sample floating point as required. Automatic conversion between formats is provided.

By default AMS operates at 48 Khz sample rate throughout. Automatic sample rate conversion (resampling) is provided for both playback and capture allowing use of clips with different sample rates.

SDI connections support up to 8 channels of embedded audio (16 on 3G-SDI connections). Optional alternative hardware allows an almost unlimited number of channels. AMS internally has no defined limit.

2.5   ANC/VBI

AMS has full internal support for ANC (Ancillary Data) and VBI processing, including interchange between ANC-encapsulated and native closed caption formats (see below). ANC processing is built around the specification in SMPTE S291m.

All SDI inputs can capture a full range of ANC packets from any valid VANC line. All SDI outputs can emit ANC packets to any standardised VANC area. Note that ANC stored in the HANC area of SDI is not currently supported.

ANC storage in files is limited by the capabilities of the containers. See the container formats for details.

At playback, AMS can replace ANC packets back onto the original source signal lines, or can reconstruct the lines automatically with packet fitting, allowing for e.g. automatic adjustment of ANC packet layout when playing HD-1080 material on an HD-720 output.

2.6   CLOSED CAPTIONS

AMS currently supports CEA-608 (SD) and CEA-708 (HD) closed caption formats.

CEA-608 captions can be captured from SD-SDI VANC, SD-SDI digitised VBI, and analog VBI (on systems with analog inputs). CEA-608 captions can be output to the same three locations. All VBI output is to line 21.

CEA-708 captions can be captured and output only to/from HD-SDI VANC.

Automatic frame rate conversion of CEA-708 captions is supported (e.g. to allow 1080i material to be played on a 720p output port).

Conversion between CEA-608 and CEA-708 captions is not currently supported. In particular, playout of SD material with CEA-608 captions on an HD output port will not emit a closed caption signal.

WTS captions are not currently natively supported. However, WTS captions stored in ANC tracks will be transparently processed correctly (and will work).

2.7   TIMECODE

AMS supports timecode tracks on appropriate files and can be configured to output embedded timecode (VITC, D-VITC, RP188 depending on output) where supported by the hardware.

Input timecode can be recorded onto files where supported by the container formats, and can also (optionally) be used to control the start and stop of recordings, including to synchronise multiple record ports (where the ganged recording option is purchased).

LTC associated with each input channel is not directly supported, however embedding of LTC into SDI streams as RP-188 or D-VITC can be done using external embedders where required.

Use of LTC to provide house timecode is no longer supported, instead the AMS should be time-locked via NTP – modern house master clocks normally provide NTP support.

2.8   ANC/CAPTION CONVERSIONS

The system can automatically extract CEA-608 and CEA-708 data packets from ancillary-data streams, allowing (for example) use of files that can only store opaque ANC packets as a source of closed caption material.

3   PLAYBACK FORMATS

Container (file) formats fall into two categories: full-function, and end-to-end-only. Those with full-function status support the full range of capability including shuttle/seek (even in long-gop files), marks, looping, etc.

On the other hand, files with end-to-end-only function can only be played from end to end without any marks or seeking. Support for these file formats does however allow their use in sequences and as a source for transcoding or re-wrapping into a full-function format.

3.1   CONTAINER (FILE) FORMATS – FULL FUNCTION

Please note that due to limitations in the container definitions, most container formats have limitations on the specific encodings that they are able to carry. When determining what encodings a container can carry, also check for encoding-specific notes in the corresponding encoding support sections of this document.

3.1.1   AVI

Extensions: .avi / .avix / .avx / .divx / .xvid

AVI files support only video and audio. Virtually all supported video and audio encodings are recognised. Uncompressed RGB video is supported subject to hardware capability.

DV-in-AVI is supported for both Type 1 and Type 2 files.

Standardised descriptive metadata fields (from RIFF INFO chunks) are processed by default.

3.1.2   DV-DIF (ISO/IEC 61834 STREAM)

Extensions: .dv, / .dif

All standardised DV video-frame formats are supported in these files.

Audio embedded in the frames must be 16-bit stereo PCM. 12-bit DV audio is not supported.

This container format has no provision for descriptive metadata.

3.1.3   FLAC

Extensions: .flac

This container only supports FLAC audio. Any valid FLAC audio configuration (including multi-channel, high-sample-rate audio) is supported.

Descriptive metadata is not currently processed.

3.1.4   FLASH VIDEO

Extension: .flv

These files are supported for video and audio (one of each) only. All known video and audio encodings for the format are supported.

A limited amount of descriptive metadata is retrieved for these files.

3.1.5   LXF (NEXIO NATIVE FORMAT)

Extension: .lxf

This format supports a single video track and a single (typically multi-channel) audio track. In addition, for HD LXF files with NTSC-type origin (e.g. 30000/1001 frame rate) the system will decode and process CEA-708 closed captions that may be embedded in the LXF VBI area.

Supported video encodings are Motion JPEG, MPEG-1, MPEG-2, and DV.

Audio must be PCM, any valid number of channels. LXF files only support audio at 48 Khz. Sample sizes of 16, 24, and 32 bits are supported. Note that at this time, 20-bits-per-sample audio will be rejected.

All known descriptive metadata is automatically retrieved from these files.

3.1.6   MP3 (MPEG-1 LAYER 3 STREAM)

Extension: .mp3

All standardised MP3 files containing MPEG-1 audio are supported. ID3v1 and ID3v2 tags are read for descriptive metadata.

3.1.7   MXF (MEDIA EXCHANGE FORMAT)

Extension: .mxf

Support is provided for Operational Patterns OP-1a and Op-Atom files in accordance with the relevant SMPTE standards documents. The file reader is also tolerant of many of the encoding errors that are found in files in common use (such as missing mandatory fields in certain packs, or incorrect video height information on interlaced files).

For Op-Atom, the files must contain the necessary file linkage information per SMPTE standard, and all of the files that make up the complete package must be present (e.g. if an Op-Atom set consists of one video and four audio files, all five files must be present for the clip to be readable). Op-Atom files must be placed in the same folder.

MXF clips may contain one video track, any number of (possibly multi-channel) audio tracks, and zero or more ANC/VBI tracks per SMPTE S436m. All material should be frame wrapped for best operation – clip-wrapping is mostly supported but not guaranteed.

Video track supported encodings include DV-Video, MPEG-2 Intra and long-GOP (including IMX and XDCAM specialisations), MPEG-1, JPEG-2000, DNxHD, Motion JPEG, h.264/AVC (including AVC-Intra) and MPEG Elemental Stream (ES).

Audio must be uncompressed PCM, any sample rate, any number of channels. Sample sizes of 8, 16, 24, and 32 bits per sample are supported.

ANC/VBI data must be encapsulated in accordance with SMPTE S436m. At this time there is limited support for VBI processing, however encapsulated ANC is fully supported.

Closed captions stored within S436m ANC tracks are automatically extracted and are fully supported for output.

3.1.8   QUICKTIME

Extension: .mov / .qt

Quicktime is the preferred default format for most AMS installations.

Quicktime files support a video track, any number of audio tracks, zero or more closed caption tracks, one optional timecode track, and zero or more ANC (ancillary data) tracks.

Video tracks can be virtually any supported encoding, as can audio tracks.

Timecode tracks must be native Quicktime "tmcd" tracks.

Closed caption tracks can be either of two types:

– CEA-608 standard closed caption encoding (defined by Apple). This is the same "c608" format used by Quicktime Player.

– CEA-708 captions use a custom encoding based on the above format due to lack of any standard encoding. The track is identified as "c708" format. Details of the exact encoding are available on request.

Ancillary data tracks also use a custom encoding due to lack of any standard. There are two encodings currently supported:

– "van2" encoding. This stores groups of ANC packet in 8-bit pure data format.
Details of the exact encoding are available on request.

– "vanc" encoding. This is supported for legacy files and uses a different, less efficient format.

Descriptive metadata in the Qucktime structure is automatically processed and imported.

3.1.9   ISO MEDIA FORMAT (MP4)

Extension: .mp4 / .m4p / .m4a / .m4v

Files using this container format, which is based on QuickTime, can in principle contain anything that a QuickTime file can handle. However, typically they contain MPEG-4 / h.264 / AVC video in conjunction with AAC or uncompressed audio.

3.1.10   FRAME SEQUENCE

Extension: .seq

AMS supports playback of video tracks that are stored on disk as individual frame files (i.e. one image file per video frame) using an XML-based "sequence definition" file with the .seq extension. Details of the format for this file is available on request.

The frame files themselves can be in any of several formats, including Bitmap, SGI-Image, PNG, JPEG/JFIF, and raw YUV frame.

3.1.11   WAVE

Extension: .wav, .wave

These files support a single audio track which must be PCM. Any number of channels is allowed within the container definition. Any sample rate is allowable.

RIFF INFO chunks are processed for descriptive metadata.

3.1.12   Y4M UNCOMPRESSED VIDEO

Extension: .y4m

Files in this format contain a single uncompressed video track and are fully supported. However, high-resolution files in this format are very high bit rates and may not be usable on all hardware configurations.

3.1.13   COMPOSITE CLIP FORMAT

Extension: .clip

This is an XML-based format that allows definition of arbitrary clips made up from multiple separate files. For example, this could be used to combine a Y4M uncompressed video track with a WAVE file containing the associated audio track.

For further details of the format for this file (which includes descriptive metadata capability) please contact us.

3.2   STILL IMAGE FORMATS

There are a number of image file formats that are recognised by AMS and can be treated, for the most part, as one-frame-long video clips. The supported formats include:

- JPEG/JFIF files (.jpg, .jpeg)
- Bitmap files containing uncompressed RGB (.bmp)
- Portable Network Graphics (PNG) files
- Silicon Graphics Image (SGI) files.

3.3   CONTAINER (FILE) FORMATS – END-TO-END FUNCTION

The following file formats are only available for end-to-end-playback function at this time. While rare, it is not unknown to come across particular files in these formats that do not work properly (or at all).

3.3.1   AIFF AUDIO

Extension: .aiff / .aif

3.3.2   ASF (MICROSOFT ADVANCED STREAMING FORMAT)

Extension: .asf / .wmv / .wma

Any ASF file containing DRM cannot be played. Not all possible formats are supported due to limitations in ASF. It is recommended that particular combinations are carefully tested before relying on them being playable.

3.3.3   GENERAL EXCHANGE FORMAT (GXF)

Extension: .gxf

All known encodings are supported. These files are mostly encountered in legacy archives of Grass Valley Profile clips.

3.3.4   MPEG STREAM

Extension: .mpeg / .mpg / .m2p / .m2v / .mts / .m4v / .ts / .vob / .m2ts

Most program, transport, and elemental stream (PS, TS, ES) files can be processed. Transport streams may only contain a single package.

While only MPEG-1 and MPEG-2 video with MPEG-1 audio are officially supported in these files, many other encodings are known to function.

3.3.5   MATROSKA

Extension: .mkv

Limited descriptive metadata is available from these files.

3.4   VIDEO ENCODINGS

For the best possible function of the server, it is recommended that Intra (also known as I-frame-only or key-frame-only) encodings are used. However, the server does provide extensive support for temporally-coded material. It is recommended that when using temporal encodings, closed-GOP variants are used whenever possible. Open-GOP encodings will play correctly but are considerably less efficient in some circumstances.

The following video encodings are formally supported for playback:

DV-Video	DVSD, DVCPro 25/50, DVCPro HD 100.
MPEG-1	Any GOP length including Intra. SD up to 25 Mbits/sec supported. HD video and higher bit rates will usually work but are not guaranteed.
MPEG-2	Any GOP length including Intra. SD or HD, up to 200 Mbits/sec. 4:2:0 or 4:2:2. Higher resolutions up to UHD and 4K and higher bit rates are supported on appropriate hardware. IMX and XDCAM encoding variants are supported. NOTE: When using long GOP, closed GOP's are recommended.
MPEG-4 part 2	Any GOP length including Intra. SD or HD up to 200 Mbits/sec. Higher resolutions and bit rates available on appropriate hardware.

DNxHD	8-bit or 10-bit, up to full HD, any defined bit-rate profile up to 440 Mbits/sec. Note that the high bit rates possible with DNxHD may affect performance in some configurations, please check with support before using files with very high bit rates on multiple ports.
h.264 / AVC / MPEG-4 part 10	Any GOP length including Intra. SD or HD, up to 200 Mbits/sec. 4:2:0 or 4:2:2. Higher resolutions up to UHD/4K and higher bit rates supported on appropriate hardware. When using long GOP, it is recommended that a full I-frame (sync point) be encoded at sensible intervals.
Motion JPEG	SD or HD up to 200 Mbits/sec. Higher resolution / bit-rate available on appropriate hardware.
ProRes	All defined SD or HD profiles. 4:2:2 on all platforms. 4:2:2:4 (alpha-carrying) is supported on appropriate hardware.
Dirac	Up to HD resolution. Higher resolutions on appropriate hardware.
HEVC / h.265	Up to HD resolution. Higher resolutions on appropriate hardware.
Uncompressed RGB/YUV	Various different forms and colour samplings are supported, along with a number of lossless encodings such as QT-RLE. Note that uncompressed video generally means very high bit rates, which not all system configurations can support. Contact Support to discuss specific requirements.
JPEG-2000	Due to resource requirements, JPEG-2000 is supported only on certain hardware configurations. Contact Support to discuss your requirements.

There are dozens of other formats that are not formally supported, but will generally work. This includes h.261, h.263, Flash Video, several On2 codec variants, Apple Intermediate Codec (used in Final Cut Pro), Windows Media Video, and many others.

3.5   AUDIO ENCODINGS

Virtually any uncompressed (PCM) audio format can be processed by the server, and for most uses, PCM audio is recommended, but the server has extensive audio decoder support.

The following audio encodings are formally supported for playback:

MPEG-1 Audio	Layers 1, 2, 3 are all fully supported.
AAC (Advanced Audio Coding)	Including multi-channel audio data
FLAC (Free Lossless Audio Codec)	Including full range of multi-channel options

Many other audio formats, while not formally supported, are available and will generally work. This includes AC-3 and Apple Lossless, among others.

4   RECORDING (CAPTURE) FORMATS

Please note that recording, and in particular video encoding, is resource intensive and therefore not all hardware configurations can handle all encodings.

A successful recording requires a supported container format in conjunction with video/audio/etc encodings that the container is capable of correctly storing.

4.1   CONTAINER FORMATS

These formats are available for recording and storing material. The recommended format in most cases is QuickTime, unless you have a workflow requirement to use something else. Note that reference is made to "listed" encodings, that means encodings listed later in this document as supported encoding formats.

4.1.1   QUICKTIME

Quicktime files can store one video track, any number of (possibly multi-channel) audio tracks, one optional closed caption track, and one optional ANC data track. At this time, Quicktime is the only format that allows recording of closed captions and ANC successfully.

All listed video and audio capture encodings are supported in QuickTime files. CEA-608 and CEA-708 captions are natively supported. ANC packets are supported.

4.1.2   AVI

AVI files support one video track and one or more uncompressed audio tracks. All listed video encodings are supported, but some of them will not be recognised by certain other software packages. Closed captions and ANC cannot be stored in AVI files.

This container format should normally only be used if you have a specific workflow requirement for AVI files.

4.1.3   DV-DIF

DV-DIF files are an excellent choice for SD capture using DV encodings. They support only a single video track encoded with any of the SD DV-Video encoding configurations, plus a single audio track which must be uncompressed, 2 channels, 16 bits per sample, 48 KHz sample rate.

4.1.4   ISO MEDIA FORMAT (MP4)

ISOM (MP4) format supports one video track and one or more audio tracks. The video track may be MPEG-4 part 2, or h.264/AVC. The audio tracks must be AAC (including multichannel configurations). For best interoperability, it is recommended that only a single audio track is used.

4.1.5   MXF D-10

The system supports writing MXF files compliant with the D-10 subset of OP-1a wrapping.

These files may only contain SD MPEG-2 video encoded using one of the IMX encoding profiles, in conjunction with a single PCM audio track containing up to 8 channels of audio. The audio must be 48 KHz, 16 or 24 bits per sample. Conversion to AES-3 encapsulation is automatic.

4.1.6   MXF OP-1A

The system will write MXF OP-1a compliant files. All files will have a single video track, and zero or more audio tracks (possibly multi-channel). Closed captions and ANC are not currently supported.

The following video encodings are supported:

- DV Video (SD or HD)

- MPEG-2 video, intra-only. IMX and XDCAM-Intra presets are supported, along with generic intra-only.

- DNxHD, any valid profile. Note that this is the recommended format for HD MXF interoperability.

- Motion JPEG.

All audio must be uncompressed, 48 KHz, 16 or 24 bits per sample. Experience shows that packing more than 8 channels into a single track can cause interoperability problems with some third party software.

4.1.7   MXF OP-ATOM

The system will write compliant MXF OpAtom files. Only video and audio files can be written. The system will create one file for each track.

The same encoding restrictions detailed for MXF OP-1a apply here.

4.2   VIDEO ENCODERS

The following video encoders are supported in AMS. However, note that due to the varying resource requirements, the encoders that can be used on a particular system depend on the hardware platform and the specific configuration in use (in particular how many simultaneous encodings are required).

4.2.1   APPLE PRORES

Encoding is supported up to HD, 4:2:2, at Standard, HQ, LT and Proxy levels.

NOTE: ProRes encoding is exceptionally resource intensive. If you plan to record multiple ProRes streams simultaneously, please check with Support

4.2.2   DNXHD

DNxHD encoding is HD only. Support is provided for both 8 and 10-bit encoding at data rates up to 440 Mbits/sec (for 1080p/59.94 in 10 bit).

Note that the very high bit rates possible with DNxHD may impact some configurations. Please check with Support about what your particular configuration can be expected to achieve.

4.2.3   DV VIDEO

All systems support SD DV video encoding using the standard DVSD, DVCPro-25 and DVCPro-50 profiles.

DVCProHD-100 encoding is available as an optional extra for HD encoding.

4.2.4   MOTION JPEG

Supported for SD and HD (UHD/4K on appropriate hardware). Bit rate and quality are controlled by options and have no specific limits. Note that at maximum-quality settings, bit rates can get pretty high if not restricted by configuration.

4.2.5   MPEG-2

Intra (I-frame only) encoding is available as standard, including IMX presets for SD encoding. Encoding is supported in both 4:2:0 and 4:2:2 colourspaces. Several Intra-coding presets are provided, or the various parameters for bit-rate and quality can be manually configured.

Long GOP encoding is available as an option. Currently all long-GOP encoding is closed-GOP.

4.2.6   MPEG-4 PART 2

Intra (I-frame only) encoding is available as standard.   Several Intra-coding presets are provided, or the various parameters for bit-rate and quality can be manually configured.

Long GOP encoding is available as an option

4.2.7   ADDITIONAL ENCODINGS

H.264 encoding can be made available as an extra-cost option if required.

4.3   AUDIO ENCODERS

For most purposes, audio is best stored uncompressed. However, if there is a specific requirement for compressed audio, the following encodings are supported:

4.3.1   AAC (ADVANCED AUDIO CODEC)

Multi-channel and single-channel configurations are supported. Any AAC-legal bit rate can be used (but in most cases 48 KHz should be used). Any AAC-legal bit rate can be used. Compression level can be

4.3.2   MPEG LAYER 2

Only mono and stereo are possible with this encoder. Any sample rate defined by the MPEG standard can be used but 48 KHz should be used in most cases. Bit rates up to 320 Kbits/sec are possible.

4.3.3   FLAC (FREE LOSSLESS AUDIO CODEC)

Any FLAC-legal number of audio channels is allowed. Any FLAC-legal sample rate is allowed, although 48 KHz should be used in most cases.

5   SUMMARY

5.1   PROCESSING

Supports standard video modes up to 1080i/p 25/29.97/30. SDI by default, other connection options available. 3G-SDI modes (1080p @ 50/59.94/60 fps) available by option.

Extensive support for video resizing, frame rate conversion, colour space conversion. Full 10-bit 4:2:2 on standard SDI connections. Advanced up/down/cross conversion for standard HD and SD formats including field/frame temporal delta processing.

All internal processing in 4:4:4 RGB/YUV

Full support for alpha processing on appropriate hardware including 4:4:4:4 YUV/RGB

Supports up to 8 (16 on 3G-SDI) embedded audio channels in SDI. All internal audio processing is in 32 bits-per-sample integer, or 32/64 bits-per-sample floating point.

Extensive support for sample rate conversion, format conversion, channel multiplex/demultiplex.

Extensive support for ancillary data (VANC/VBI) and closed captions (CEA-608, CEA-708, SMPTE S436m)

5.2   PLAYBACK CONTAINER FORMATS

Full-function video and audio container formats:

> AVI (Audio Video Interleave)
> DV-DIF (DV video stream)
> FLAC (Free Lossless Audio Codec native stream)
> FLV (Flash Video)
> LXF (Nexio Native Format)
> MP3 (MPEG layer-3 audio)
> MXF (Media Exchange Format) – Accepts valid OP-1a and Op-Atom files.
> Quicktime
> ISO Media Format (mp4)
> Frame Sequence (.seq)
> Wave (.wav)
> Y4M uncompressed video
> XML Clip Description (.clip)

Still Image formats:

> JPEG/JFIF, Bitmap, PNG, SGI (Silicon Graphics Image)

End-to-end-playback-only video and audio container formats:

> AIFF, ASF, GXF, MPEG stream (PS, TS, ES), MKV (Matroska)

5.3   PLAYBACK VIDEO ENCODINGS

Supported formats: DV-Video, MPEG-1, MPEG-2, MPEG-4 pt.2, DNxHD, h.264/AVC/MPEG-4 pt.10, Motion JPEG, ProRes, Dirac, HEVC/h.265, JPEG-2000, Uncompressed RGB/YUV.

Many other formats are available and generally work, including h.261, h.263, Apple Intermediate Codec, various On2 codecs, Flash Video, and many others.

5.4   PLAYBACK AUDIO ENCODINGS

Virtually any PCM (uncompressed) format is supported and extensive conversion capability is built in.

Supported encoding formats: MPEG-1 audio (layer 1,2,3), AAC, FLAC.

Many other audio formats are available and generally work, including AC-3 and Apple Lossless.

5.5   RECORDING CONTAINER FORMATS

Recording is possible in the following container formats:

Quicktime (default), AVI, DV-DIF, ISO Media Format (MP4), MXF D-10, MXF OP-1a, MXF Op-Atom.

Some container formats are not capable of storing all video/audio encodings due to inherent limitations.

5.6   VIDEO ENCODERS

Note: Number of available simultaneous recordings depends on encoding and hardware capability.

Apple ProRes. SD or HD, 4:2:2, Standard / HQ / LT / Proxy profiles.

DNxHD. HD only, 4:2:2, 8 or 10 bit, up to 440 Mbits/sec.

DV Video. SD as standard, DVSD/DVCPro25/DVCPro50. DVCPro HD 100 available as an option.

Motion JPEG. SD or HD, supports both quality and bit-rate control.

MPEG-2. Intra (I-frame only) as standard, long-GOP optional. 4:2:0 and 4:2:2. Presets for several configurations including IMX (for SD). Can also be freely configured for special requirements.

MPEG-4 part 2. Intra (I-frame only) as standard, long-GOP optional.

Additional encodings are available as options:

h.264/AVC

5.7   AUDIO ENCODERS

Uncompressed (PCM) audio is recommended in most cases. 24-bit integer storage is typical, but many options are available up to 64-bit floating point. Audio is normally stored at 48 KHz (native SDI sample rate) but sample rate conversion is built in.

The following encoders are also available:

   AAC (Advanced Audio Codec). Single and multi-channel support, any AAC-legal bit rate.

   MPEG Layer 2. Mono and Stereo only. Bit rates up to 320 Kbits/sec supported.

   FLAC (Free Lossless Audio Codec). Supports multi-channel audio.