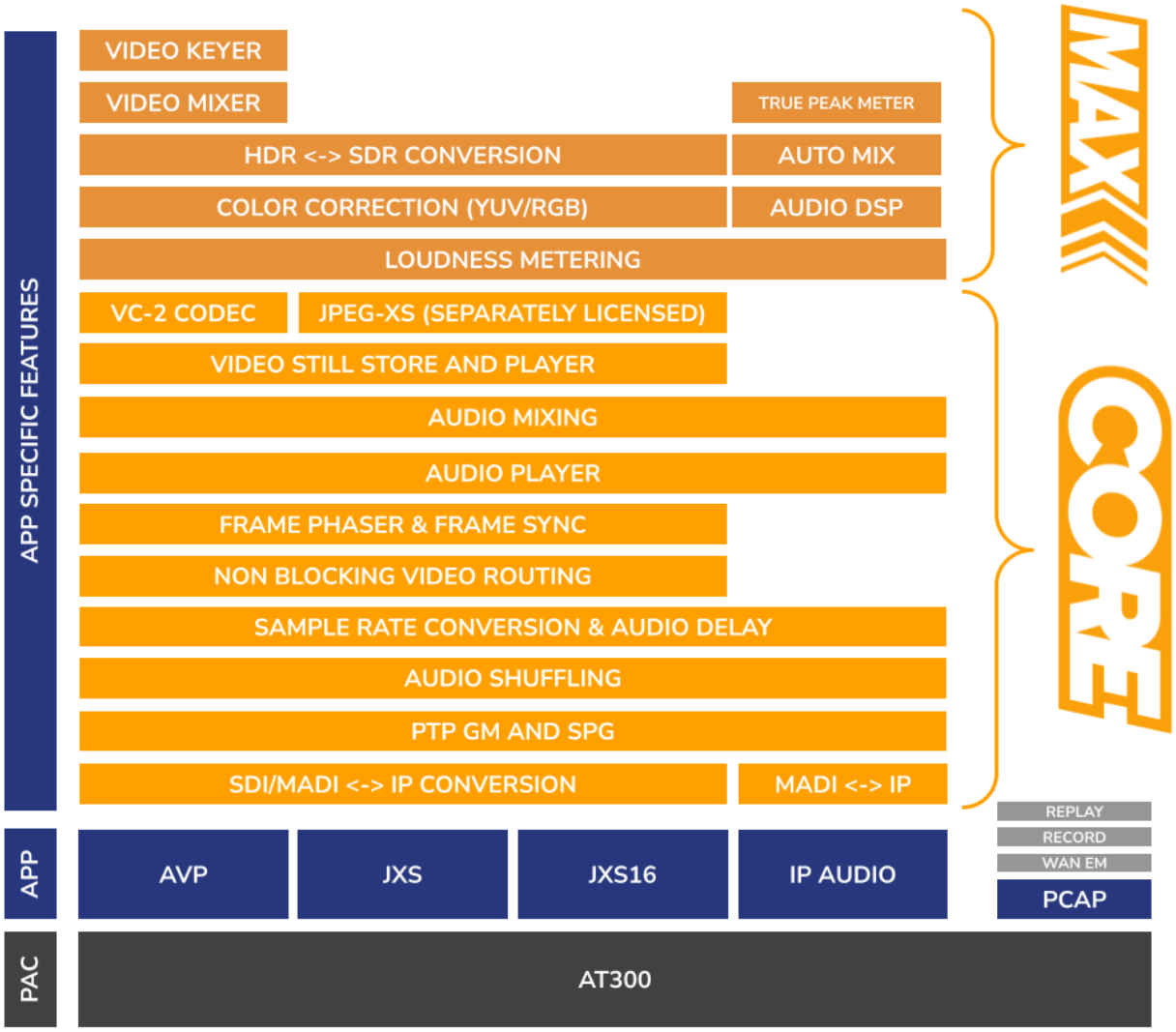
BLADE//runner SOFTWARE

BLADE//runner is a software defined ecosystem that offers five different APPs that are each tailored for different functionality. The BLADE//runner **CORE** license includes access to all five APPs and includes extensive APP-specific functionality.

The block diagram below shows the five available APPs and outlines functionality that is unique to one or more APPs. Some functionality is separately licensed under the **MAX** option. The AT300 Programmable Acceleration Card (PAC) can run one APP at a time but another APP can be loaded by selecting it and rebooting the PAC.



BLADE//runner architecture showing the five APPs available for the AT300 in blue and APP specific features in Orange (licensed) & Gray (free)

BLADE//runner is built upon a framework consisting of I/O, Routing, Processing, Delay and Sync features that are common across all APPs. The BLADE//runner **CORE** license provides access to all APPs for one AT300 PAC (node-locked).

BLADE//runner APPs

AUDIO VIDEO PROCESSOR (AVP) APP

AVP is a software APP for the AT300 PAC that provides a comprehensive audio, video and metadata framework for encapsulation/de-encapsulation, routing and delay/sync of IP and SDI. In addition to the AT300's native dual 100GE IP network interfaces, SDI and MADI I/O are available when using one of the micro-BNC rear-modules thereby providing direct access to legacy baseband infrastructures. AVP also features test-signal and LTC insertion functionality.

JPEG-XS ENCODE / DECODE (JXS & JXS16) APPs

JXS and JXS16 are software APPs for the AT300 PAC that in addition to uncompressed encapsulation/de-encapsulation provide additional instances of ST2110-22 JPEG-XS encoding and decoding.

Key Features:

- Configurations:
  - JXS APP: Can be configured as either 8 encode OR 8 decode.
  - JXS16 APP: Can be configured as 16 encode OR 16 decode OR 8 encode + 8 decode.
  - Each JPEG-XS codec instance supports one UHD/FHD/HD signal, allowing for a maximum of 16 x UHD signals.
  - Configuration changes take effect upon reboot.
- Uncompressed Gateway Capabilities: Both JXS and JXS16 APPs provide:
  - 2110-20, -30/31, and -40 encapsulation and de-encapsulation.
  - Routing and shuffling.
  - Delay and synchronization capabilities.[1]
  - Test-signal generation.
  - LTC insertion functionality.

Licensing: Separate JPEG-XS licenses are required for JPEG-XS encoding/decoding.

[1] The JXS16 APP when operating in 16 x Encode mode does not have delay instances.

IP AUDIO (IPA) APP

IPA is a software application for the AT300 PAC, functioning as a dedicated engine for audio mixing, DSP, and routing. It offers significant mono routing capacity, accommodating up to 16,384 inputs and 12,288 outputs. When combined with a compatible rear-module, IPA also provides coax MADI I/O and/or WordClock reference outputs.

PACKET CAPTURE (PCAP) APP

PCAP is a special software application for the AT300 PAC that permits PTP-timestamped packet capturing at wire speed (with a total capacity of 4GiB per 100G port), packet retransmission with configurable delay, jitter and packet loss, and timed replay of nanosecond-precision pcap files. PCAP is ideal for troubleshooting purposes and requires no license.

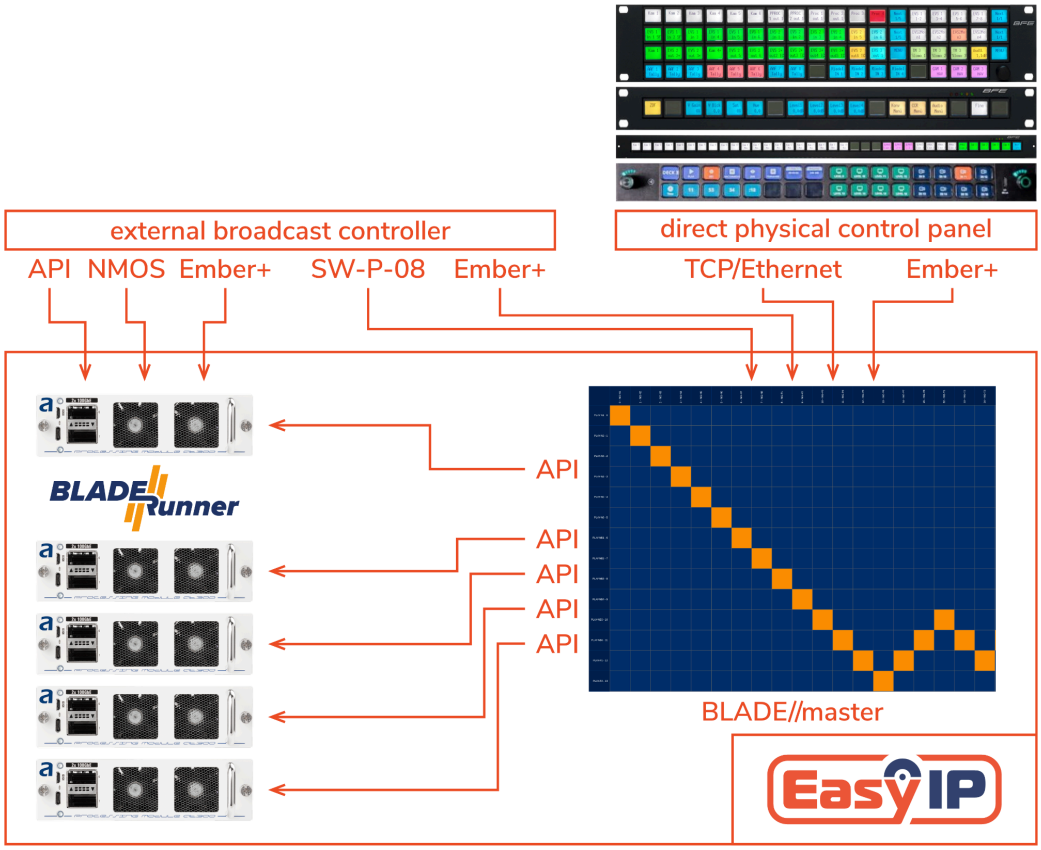
CONTROL:

All BLADE//runner APPs are controlled by a modern and extensive JSON based API with which all parameters can be controlled and monitored. The API can be natively accessed with both WebSocket and REST. In addition all APPs support NMOS IS-04 and IS-05 for discovery and connection management.

EASY-IP

EASY-IP is arkona's solution for direct control of BLADE//runner systems through hardware and software panels as well as using 3rd party external control systems using standard control protocols.

Underpinning EASY-IP is the BLADE//master software which is included for free with all BLADE//runner systems. This software can be hosted on an external COTS server or directly on the AT300 PAC itself and allows for the exposure of any of the BLADE//runner APP features as an Ember+ controllable parameter tree. In addition, BLADE//master exposes an SWP-08 controllable routing matrix which most broadcast controllers support natively.

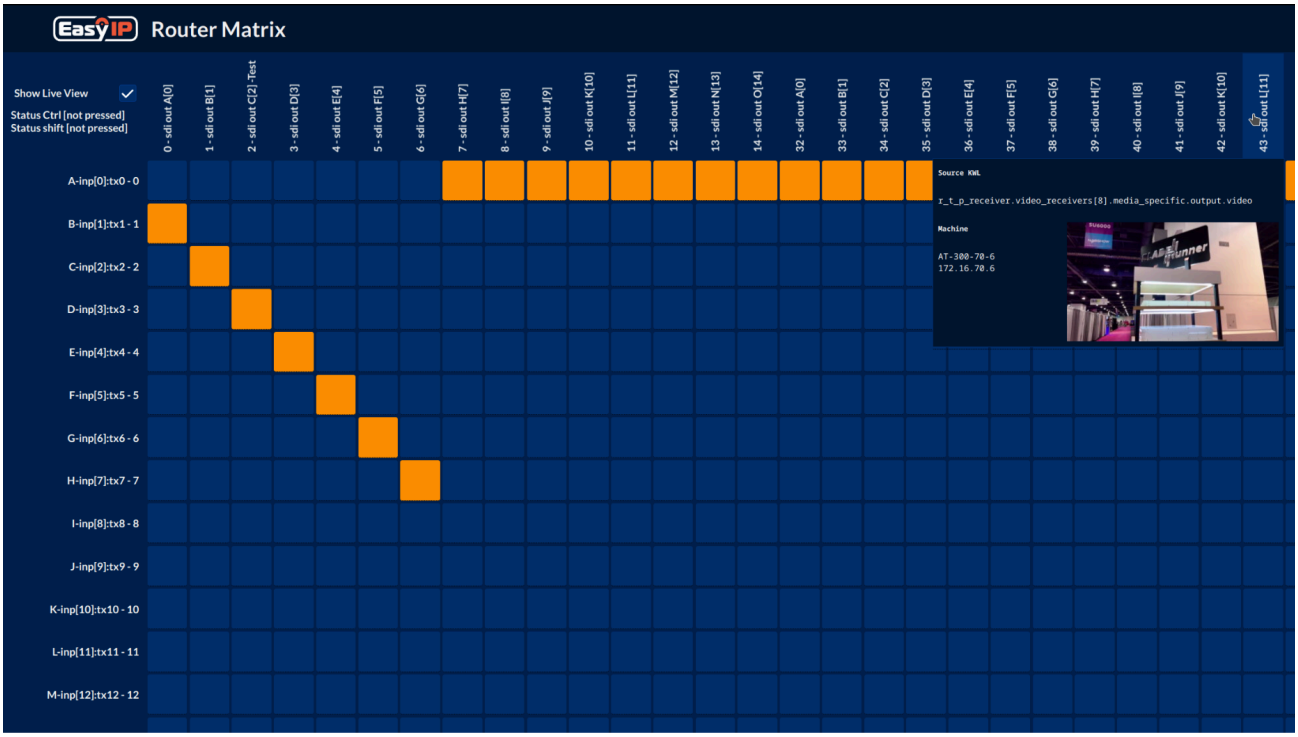


The BLADE//master software is used to translate between the native BLADE//runner API and SWP-08 & Ember+, either centrally or for each individual AT300

BLADE//master offers flexible control over AT300 units, allowing configuration as a single instance for either a standalone AT300 or a cluster of them. This enables functionalities such as creating a unified, homogenous video router capable of clean and quiet switching.

For enhanced reliability, multiple BLADE//master instances can operate simultaneously, providing redundancy.

BLADE//master also comes with the EASY-IP GUI to easily route audio and video and includes a live view function to quickly inspect video streams.



The EASY-IP routing GUI

CORE: I/O

BLADE//runner provides encapsulation and de-encapsulation functionality with instantiable ST2110 and ST2022 transmitters and receivers as well as interfacing to SDI and MADI through modular rear-modules. All IP senders and receivers support ST2022-7 seamless protection switching with at least class C (150ms)[2] path differential.

IP I/O:

VIDEO

ST-2110-20 (HD and UHD), ST2022-6 (SD and HD with embedded audio and ANC)
Encap/Decap latency: Less than 1 line

JPEG-XS

ST2110-22 (HD and UHD).
Available with the JXS and JXS16 APPs.
Compression configurable between 5:1 and 40:1.
Total Encoding-Decoding latency: Approximately 2 ms[3].

VC-2 (-LD)

ST2042 (HD and UHD)
Available with the AVP and JXS APPs
Compression configurable between 2:1 and 8:1
Total Encoding-Decoding latency: Less than 20 lines[4].

AUDIO

ST2110-30/31 Level CX (64 channel max per stream), ST2022-6 (with embedded video and ANC), AES67, RAVENNA (80 channel max per stream)
Payload: L16, L24, AM824
Encap/Decap latency: Synchronous operation < 2msec; bypass option

METADATA

ST2110-40, ST2022-6 (with embedded video and audio)

[2] Based on the receiver being configured to handle 3G sources.
[3] Measured as a sum total of one encode plus one decode latency, not including path delay.
[4] Measured as one encode OR one decode. E.g. end-to-end latency is less than 40 lines not including path delay.

The following table shows the amount of IP senders and receivers per APP:

TX/RX INSTANCES PER APP	AVP	JXS (8 x Encode Mode)	JXS (8 x Decode Mode)	JXS16 (16 x Encode Mode)	JXS16 (16 x Decode Mode)	JXS16 (8+8 mode)	IPA
2110-20/2022-6 - Uncompressed (UHD uses 2 instances)	36/32	30/32	30/32	16/32	30/32	24/32	0/0
2110-22 - JPEG-XS Encoders (UHD)	0	8	0	16	0	8	0
2110-22 - JPEG-XS Decoders (UHD)	0	0	8	0	16	8	0
2042 - VC2 (UHD uses 4 instances)	20/32	0/32	0/16	0/0	0/0	0/0	0/0
2110-30/31 - Audio	511/256	511/256	511/256	511/256	511/256	511/256	1022/1024
2110-40 - Metadata (UHD uses 2 instances)	32/32	30/32	30/32	16/32	30/32	24/32	0/0

Note:

An active 2110-22 encoder instance replaces one uncompressed 2110-20 TX instance.

An active 2110-22 decoder instance replaces one uncompressed 2110-20 RX instance, two if decoding JPEG-XS UHD streams.

SDI I/O:

16 x UHD inputs, 16 x UHD outputs. Limit dependent on rear-module configuration.

16/32 audio channels de-embedded from each input.

16/32 audio channels selectively embedded to each output from the audio matrix.

ATC (LTC, VITC1, VITC2), Binary group data, AFD, Audio Meta Data, Closed-Caption, VBI data services /DTV descr., DVB/SCTE VBI data, ANSI/SCTE104, OP47, OBS source-id

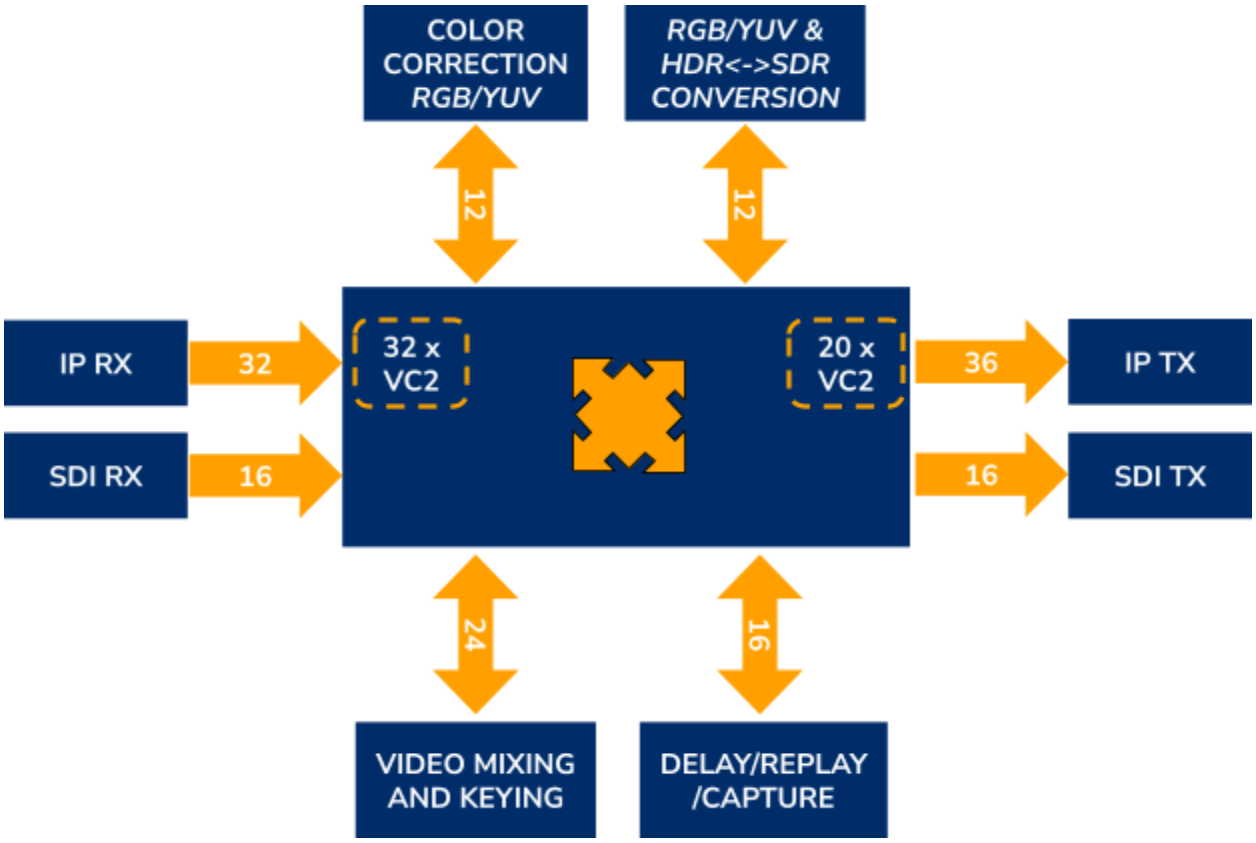
MADI I/O:

16 x inputs, 16 x outputs. Limit dependent on rear-module configuration.

CORE: VIDEO ROUTING & PROCESSING

Video routing & processing is an inherent functionality of all BLADE//runner APPs (except for the audio specific IPA APP) and provides non-blocking any-to-any routing of Video and Metadata between SDI and IP I/O and the various processing functions, such as color correction, delay and video mixing.

All routing is “clean and quiet” with make-before-break (MBB) or break-before-make (BBM) configurable per video receiver.



Any-to-any Video Routing of the AVP APP

VIDEO DELAY & SYNC

Delay and Sync is included in all BLADE//runner APPs and provide Video and Metadata delay through routable instances using a shared memory pool. SDI frame sync and UHD single-link to quad-link conversion is available on all input interfaces when outfitted with an appropriate rear-module.

- Configurable audio and video delay instances using a shared memory pool with multiple outputs (readers) per delay instance allowing for playout at different times from the buffer. (*Example: A single delay instance with a 2 second total delay buffer utilizes 4 readers to play out the same content at a delay of 2s, 1.8s, 0.75s and 0.2s.)*
- Auto-alignment feature using ST2110 RTP information for audio/video/metadata alignment.
- Frame Sync for up to 16x SDI inputs when an optional rear-module is attached.
- UHD Single-link/Quad-link splitter (2SI) and merger (2SI/SQD) with automatic re-ordering based on identifiers.

VIDEO DELAY

16 instances of video delay using an 8GB shared memory pool (upgradeable to 16GB). Total delay is dependent on format/bitrate. Each video delay instance provides up to 10 outputs (readers) allowing for playout at different times.

Example max delay with the standard 8GB memory:
At 3G 1080p50 = 32 sec.
At 3G 1080p60 = 27 sec.
12G UHD would use 4 x the memory of 3G, while HD and SD use less.

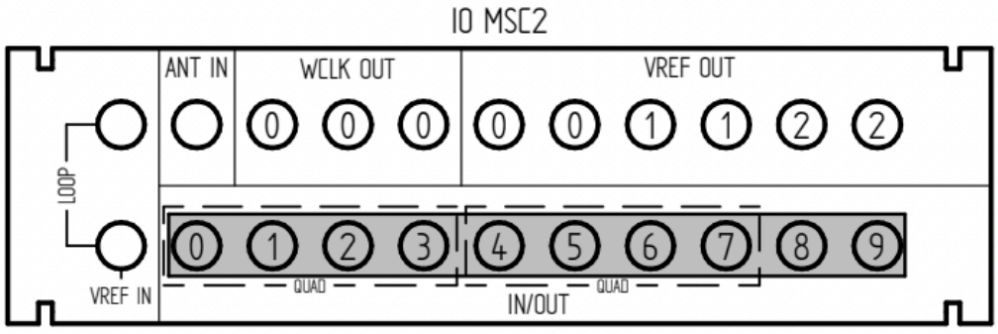
DELAY AND SYNC FEATURES PER APP	AVP	JXS	JXS16 16 x Encode	JXS16 8+8 & 16 Decode	IPA
Video delay instances	16	16	0	16	0
Video delay memory pool. Standard (Optional)	8GB (16GB)	8GB (16GB)	8GB (16GB)	8GB (16GB)	N/A
Video delay readers per instance	10	10	0	10	0

PTP GRANDMASTER CLOCK & SYNC PULSE GENERATOR

PTP GM and SPG is a feature available in all APPs and provides IEEE1588 PTPv2 GrandMaster functionality with support for the SMPTE 2059-2 and AES67 profiles allowing it to be the PTP GM for ST2110 networks.

Synchronization can either be derived from internal clock, GPS input, or external video reference (BB or Tri-Level). GMC supports up to 256 simultaneous PTP agents.

With the optional IO_MSC2 rear-module it also adds support for GPS/GLONASS antenna input as well as legacy reference outputs for Word Clock (3 outputs) and Black and Burst and Tri-Level video reference outputs (6 outputs in total which can have up to three different timing domains). In addition the IO_MSC2 provides 10 BNC connectors for UHD/3G/HD/SD or MADI which are configurable as IN or OUT.



The IO_MSC2 rear-module

VIDEO STILL STORE PLAYER/GRABBER AND CLIP PLAYER

The BLADE//runner AVP, JXS and JXS16 (16 x Decode and 8 Encode + 8 Decode) APPs provide the ability to do frame grabbing, still store playing and clip playing. In total there are 16 video writers and 24 video readers using a shared memory pool of 8GB (upgradeable to 16GB).

NOTE - Currently the JXS16 APP when configured in 16 x Encode mode does not have video player/grabber functionality.

A frame grabber instance requires 1 writer and 1 reader while a still store or clip player requires 1 reader. The frame grabber can have up to 10 outputs with different delays.

It is possible to mix and match players and grabbers.

FEATURE	WRITERS	READERS
Video clip/still store player requirement per instance	0	1 (UHD needs 2)
Video frame grabber requirement per instance	1 ((UHD needs 2)	1 (UHD needs 2)
Total amount available per app	16	24

TEST SIGNAL GENERATOR & LTC GENERATION

The BLADE//runner AVP, JXS and JXS16 APPs include 2 instances of test signal generators routable to any I/O as well as LTC time code generation.

OUTPUTS

Video: 100% color bar, counters, RP198.
Audio: Silence/1kHz/440Hz/400Hz (-6dB, -18dB,-20dB)
Time code generator/inserter: Free run, SDI, PTP, LTC (dig. Audio) output.

SUPPORTED SDI VIDEO STANDARDS

UHD FORMATS

2160p 50;59.94;60Hz SMPTE ST-2082
2160p 30;29.97;25;24;23.98Hz SMPTE ST-2081

HD FORMATS

1080p 60Hz SMPTE-424M, 425M Level A
1080p 59.94Hz SMPTE-424M,425M Level A
1080p 50Hz SMPTE-424M, 425M Level A
1080i 60Hz SMPTE-274M(4),-292M(D)
1080i 59.94Hz SMPTE-274M(5),-292M(E)
1080i 50Hz SMPTE-274M(6),-292M(F)
1080p 30Hz SMPTE-274M(7)-292M(G)
1080p 29.97Hz SMPTE-274M(8)-292M(H)
1080p 25Hz SMPTE-274M(9)-292M(I)
1080p 24Hz SMPTE-274M(10)-292M(J)
1080p 23.98Hz SMPTE-274M(11)-292M(K)
720p 60Hz SMPTE-296M(1),-292M(L)
720p 59.94Hz SMPTE-296M(2),-292M(M)
720p 50Hz SMPTE-296M(2),-292M(M)
720p 30Hz;29.97Hz;25Hz SMPTE-296M(2), -292M(M)

SD FORMATS

576i 16:9 and 4:3 SMPTE-259M(C)
480i 16:9 and 4:3 SMPTE-259M(C)

DCI FORMATS

2048x1080 DCI p24 and sF25

COLORSPACE

REC 601, REC 709, REC 2020 / 2100

CORE: AUDIO ROUTING & PROCESSING

All BLADE//runner APPs provide mono routing and audio processing such as mixing, gain and sample rate conversion. The functionality differs between the IP AUDIO and the AVP/JXS APPs as per below.

Audio routing and shuffling within the audio router is always done with crossfade while V-fade is used when an audio IP receiver changes source.

AUDIO DELAY

256 instances of 16-channel audio delay each using up to 256MB from a 1GB shared memory pool. Each audio delay instance provides up to 16 outputs (readers) allowing for playout at different times.
Dolby-E alignment functionality is available for every audio delay instance.

Example max delay@ 48kHz for one instance = 42 sec, max 8 instances with max delay.

DELAY AND SYNC FEATURES PER APP	AVP	JXS	JXS16 16 x Encode	JXS16 8+8 & 16 Decode	IPA
Audio delay instances	256	256	256	256	256
Audio delay memory pool	1GB	1GB	1GB	1GB	1GB
Audio delay readers per instance	16	16	16	16	16
Automatic A/V/M alignment based on RTP timestamps	YES	YES	YES	YES	N/A
DolbyE alignment	YES	YES	YES	YES	NO
SDI frame syncs	16	16	0	0	N/A

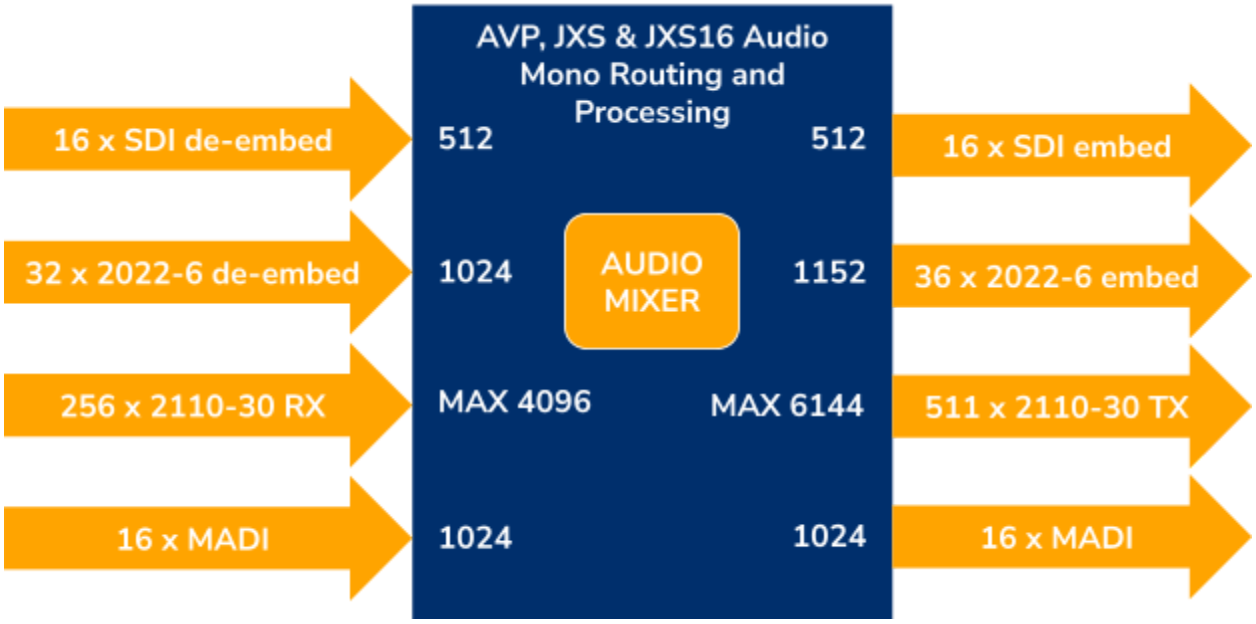
SAMPLE RATE CONVERTERS:

All BLADE//runner APPs provide routable instances of audio sample-rate converters. Each instance processes up to 16 mono channels of audio.

SRC INSTANCES PER APP	AVP	JXS	JSX16	IPA
Sample-rate converters (16 channel)	72	48	48	240

AUDIO ROUTING AND PROCESSING FOR AVP, JXS AND JXS16 APPs

The AVP, JXS and JXS16 APPs provide a non-blocking audio router of 6,656 x 8,832 mono channels, all individually routable.



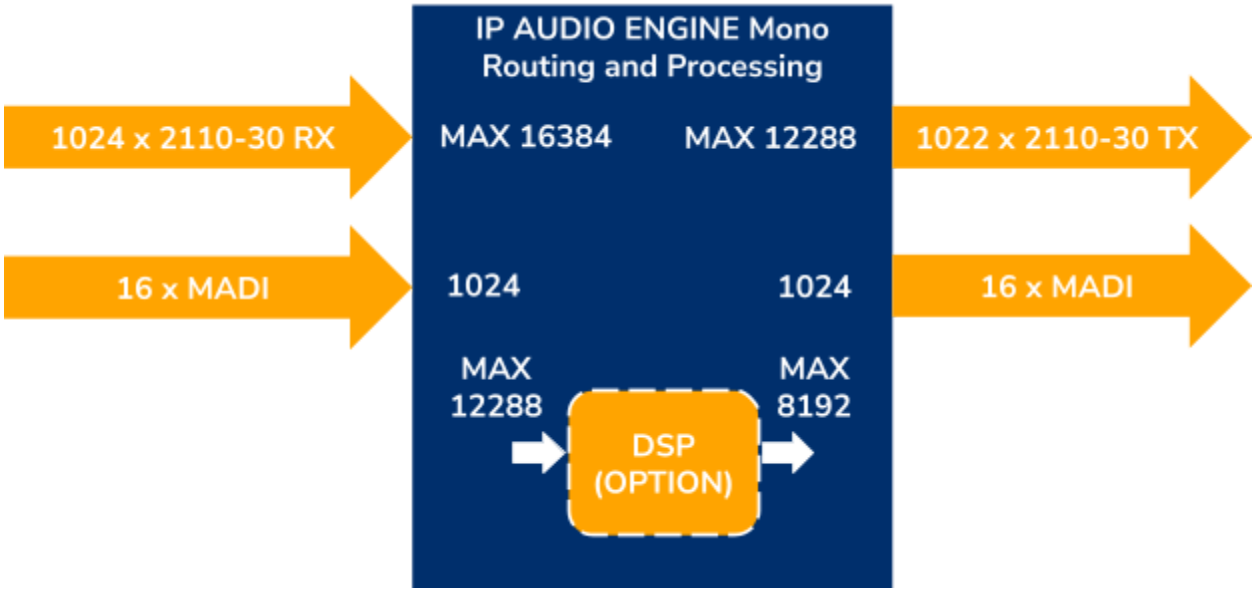
Mono routing capacity of the AVP and JXS APPs

AUDIO ROUTING AND PROCESSING FOR THE IPA APP

The dedicated IP AUDIO (IPA) APP provides a massive 16,384 x 12,288 router with 12,288 channels of audio mixing and DSP functionality. IPA provides mono, stereo and mix-minus (N-1) mixing instances. In combination with the optional DSP software license it also provides dynamic compressors, equalizers and true peak and loudness metering.

All mixing and DSP instances can be cascaded/combined in any order without adding delay. Max delay from input to output is no more than 2 samples.

When combined with one of the optional micro-BNC rear-modules the IPA APP also supports MADI I/O.



Mono routing and processing capacity of the IPA APP

AUDIO MIXING FOR FOR AVP, JXS AND JXS16 APPs

Included in the **CORE** license, the AVP, JXS and JXS16 APPs provide high quality floating point mono and stereo mixing as well as mix minus (N-1) functionality.

The Audio Mixing functionality supports up to 4,096 inputs, 1,024 outputs and 4,096 faders. Any amount of mixers can be cascaded together in any order without incurring additional delay.

FUNCTIONALITY	INSTANCES	MAX INPUTS PER INSTANCE	FEATURE SET
Mix Minus (N-1)	16	256 mono	Gain, Phase Invert, Mute, Solo
Mono Mix	64	64 mono	Gain, Phase Invert, Mute, Solo, Optional output Master Fader
Stereo Mix	64	64 stereo/mono	Gain, Phase invert (left/right output separate), Mute, Solo Pan/Balance with different laws selectable per fader, Optional output Master Fader
Loudness Monitoring	256	16 mono	Configurable amount of front/surround channels Momentary (400ms), short term (3s) and gated loudness measurement (with active enable & reset button) K-weighting can't be disabled.

AUDIO MIXING FOR FOR THE IPA APP

The following table describes the features and functionality of the IPA **CORE** APP. Additional features are available by adding the **MAX** license (see section below).

IP AUDIO APP FUNCTIONALITY	MAX INSTANCES	MAX INPUTS	FEATURE SET
Mix Minus (N-1)	32	256	Gain, Phase Invert, Mute, Solo, Post fader peak meters
Mono Mix	512	64	Gain, Phase Invert, Mute, Solo, Optional output Master Fader, Post fader peak meters
Stereo Mix	512	64 (mono or stereo)	Gain Phase invert (left/right output separate), Mute, Solo Pan/Balance with different laws selectable per fader, Optional output Master Fader Post fader peak meters
Input Trim	512	16	A/B select with gain and phase adjustment
Faders	1024	16	Level adjustment for individual channels with selectable transition curve / speed
Down Mix	512	12	Surround sound to stereo downmix with adjustable coefficients

The following section describes the features unlocked with the BLADE//runner MAX license. Not all features are available for all APPs. See the infographic at the top of this datasheet.

VIDEO MIXER & KEYER

The MAX license enables 24 routable instances of Mixer/Keyer functionality for the AVP APP.

MIXER & KEYER

A/B mix or Luminance Key/Fill with configurable transitions. UHD uses 2 instances.

COLOR CORRECTION & HDR<->SDR CONVERSION

Color correction and color space conversion is a feature available in the AVP and JXS APPs that provide additional routable instances of RGB/YUV color correction and SDR-HDR color space conversion. This feature is enabled as part of the MAX license.

COLOR CORRECTION

RGB color and ProcAmp (YUV) controls. UHD uses 2 instances.
Processing latency: < 100 pixels.

COLORSPACE CONVERSION SDR<->HDR

Broadcast quality colorspace conversion: SDR (BT609/709) to/from HDR (BT2020/2100) using tetrahedral interpolation with user loadable 3D LUTs.

The amount and type of instances depends on the APP. The AVP application provides 12 x Color Correction and 12 x Color Correction + Colorspace instances while the JXS (encode & decode mode) and JXS16 (8 encode/8decode + 16 x decode modes) applications provide 8 x Color Correction + Colorspace instances. Color correction and colorspace conversion is not available when running the JXS16 application in 16 x Encode mode.

FEATURE AND INSTANCES	AVP	JXS & JXS16 (except 16 x encode)	JXS16 (16 x Encode)
Color correction (Proc Amp)	12	0	0
Color and Colorspace conversion (Proc Amp + HDR<->SDR)	12	8	0

DIGITAL SIGNAL PROCESSING (DSP)

A MAX license enables DSP in the IPA app which adds dynamic compressors, equalizers and true peak and loudness metering as per the table below.

IP AUDIO APP FUNCTIONALITY	MAX INSTANCES	MAX INPUTS	FEATURE SET
FEATURES UNLOCKED WITH THE MAX LICENSE			
Dynamic Compression	1024	16	Side chain support for control from either true peak or Loudness (RMS) meters. Optional output gain adjust Attack/Release with hold option in either samples or time based Presets (soft knee, hard knee, ducking, gate or auto gain)
Effect Delay	512	16	128K sample delay (2.7s @ 48KHz) per mono channel (up to 4096 mono channels) Each instance can have up to 16 delay taps each with their own delay, alternatively each channel can be controlled independently. The depth can be doubled by using the SmoothTransitionExtended mode for 256K sample delay (5.4s @ 48KHz) - this uses twice as much hardware resources (up to 2048 mono channels if used for all delay instances).
Multi-band Equalizer	2048	16	1 - 31 bands Total of 8192 IIR (biquad) stages (e.g. a 4-stage EQ needs 4)
True Peak Meter	512	16	Can be used as control input for compressor
Loudness Meter	1024	16	Configurable amount of front/surround channels Momentary (400ms), short term (3s) and gated loudness measurement (with active enable & reset button) Can be used as control input for a compressor. Option to disable K-weighting
Reverb	32	16	Multi channel reverb generator