



RAVENNA 2020 Webinar Series

OEM solutions for RAVENNA, AES67 and ST2110

Tue, May 26, 2020
15:00 h (CEST)

Andreas Hildebrand, ALC NetworX

Arie van den Broek, Archwave

Claude Cellier, Merging

Claudio Becker-Foss, DirectOut

Bill Rounopoulos, Ross Video

Agenda:

	<u>Topic</u>
15 min.	Panel Introduction
	AES67 & SMPTE ST 2110 – current status
60 min.	How to implement AES67 & SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A

Agenda:

Panelists:

	<u>Topic</u>	
15 min.	Panel Introduction	
	AES67 & SMPTE ST 2110 current status	
60 min.	How to implement SMPTE ST 2110: Different approaches & available building blocks	
15 min.	Panel discussion Q&A	

<u>Name</u>	<u>Affiliation</u>
Claudio Becker-Foss	DirectOut – Germany CTO

Agenda:

Panelists:

	<u>Topic</u>	
15 min.	Panel Introduction	
	AES67 & SMPTE ST current status	
60 min.	How to implement SMPTE ST 2110: Different approaches & available building blocks	
15 min.	Panel discussion Q&A	

<u>Name</u>	<u>Affiliation</u>
Claudio Becker-Foss	DirectOut – Germany CTO
Claude Cellier	Merging Technologies – Switzerland CEO

Agenda:

Panelists:

	<u>Topic</u>
15 min.	Panel Introduction
	AES67 & SMPTE ST 2110 current status
60 min.	How to implement SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A



<u>Name</u>	<u>Affiliation</u>
Claudio Becker-Foss	DirectOut – Germany CTO
Claude Cellier	Merging Technologies – Switzerland CEO
Bill Rounopoulos	Ross Video – Canada Business Development Manager OEM

Agenda:

Panelists:

	Topic
15 min.	Panel Introduction
	AES67 & SMPTE ST 2110 current status
60 min.	How to implement SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A



Name	Affiliation
Claudio Becker-Foss	DirectOut – Germany CTO
Claude Cellier	Merging Technologies – Switzerland CEO
Bill Rounopoulos	Ross Video – Canada Business Development Manager OEM
Arie van den Broek	Archwave Technologies – Switzerland CEO

Agenda:

Panelists:

	<u>Topic</u>
15 min.	Panel Introduction AES67 & SMPTE ST 2110 current status
60 min.	How to implement SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A



<u>Name</u>	<u>Affiliation</u>
Claudio Becker-Foss	DirectOut – Germany CTO
Claude Cellier	Merging Technologies – Switzerland CEO
Bill Rounopoulos	Ross Video – Canada Business Development Manager OEM
Arie van den Broek	Archwave Technologies – Switzerland CEO
Andreas Hildebrand	ALC NetworX – Germany RAVENNA Evangelist

Agenda:

	<u>Topic</u>
15 min.	Panel Introduction
	AES67 & SMPTE ST 2110 – current status
60 min.	How to implement AES67 & SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A



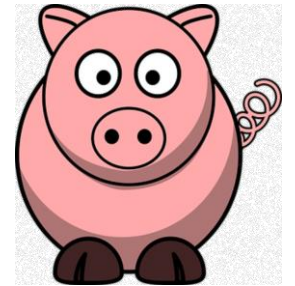
AES67

**AES67-~~2013~~²⁰¹⁸ Standard for
Audio Applications of Networks:
*High-performance Streaming Audio-
over-IP Interoperability***

published on September, 11th, 2013

AES67-2018 – what has changed?

- Clarifications and minor corrections
 - sender keep-alive recommendation
 - MTU requirements in the presence of (optional) RTP header
 - SDP examples corrected (alignment with changed RFC7273)
 - PTP domain number range corrected
- PICS (Protocol Implementation Conformance Statement) added
 - tool to insure proper compliance of AES67 implementations
 - states which capabilities and options of the protocol have been implemented
 - useful for implementers and system planners / buyers



AES67-2018 – what has changed?

G.3.4 Transport

G.3.4.1 Network layer

Requirement level	Requirement language
1	Shall (requirement)
2	Should (strong suggestion)
3	May (permission)
0	Informative

Statement Number	Feature	Requirement level	Notes	Supported
6.1-1	Media packets shall be transported using IP version 4 as defined in RFC 791.	1	Mark as supported if media packets are transported using IP version 4 as defined in RFC 791	Yes [] No []
6.1-2	A receiver that does not support reassembly shall ignore IP packet fragments.	1	Application does not support IP packet reassembly Receiver can safely ignore IP packet fragments	Yes [] No [] n/a []
6.1-3	Senders may set the Don't Fragment flag (DF) bit in the header of outgoing media packets.		Sender sets the Don't Fragment flag (DF) bit in the header of outgoing media packets.	Yes [] No []
6.1-4	Senders should terminate transmission in response to receipt of an ICMP "Too Big" message.		Sender terminates transmission if the sender terminates transmission of the offending packet in response to receipt of an ICMP "Too Big" message.	Yes [] No []
6.1-5	Multicast messaging shall be accomplished using IP multicasting as described in RFC 1112.	1	Mark as supported if multicast messaging is accomplished using IP multicasting as described in RFC 1112.	Yes [] No []
6.1-6	All devices shall support IGMPv2 as defined in RFC 2236	1	Mark as supported if the device supports IGMPv2 as defined in RFC 2236.	Yes [] No []
6.1-7	Devices may support IGMPv3 as defined in RFC 3376.	3	Mark as supported if the device supports IGMPv3 as defined in RFC 3376	Yes [] No []
6.1-8	Devices shall use IGMP to request reception of any multicasts required.	1	Mark as supported if the device uses IGMP to request reception of any multicasts required.	Yes [] No []
6.1-9	Senders shall use IGMP to request receipt of any multicast media packets they are going to send, before starting to send such packets.	1	Mark as supported if the sender uses IGMP to request receipt of any multicast media packets it is going to send, before starting to send such packets.	Yes [] No []

28 (!) pages

AES67-2018 – what has changed?

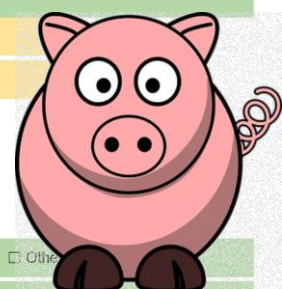
- Clarifications and minor corrections
 - sender keep-alive recommendation
 - MTU requirements in the presence of (optional) RTP header
 - SDP examples corrected (alignment with changed RFC7273)
 - PTP domain number range corrected
- PICS (Protocol Implementation Conformance Statement) added
 - tool to insure proper compliance of AES67 implementation
 - states which capabilities and options of the protocol have been implemented
 - useful for implementers and system planners / buyers
 - PICS summaries at: http://www.aes.org/standards/PICS_Repository/

AES-R19-2019

Vendor	ALC NetworkX		Date	2020/01/14	
Model	COMi.MX RAVENNA SoM		Version	946/41-60 & -70	

AES67-2018 PICS Summary

Transport	☒ Multicast	☒ Unicast			
QoS configuration	☒ Configurable markings with standard defaults ☐ Fixed standard markings ☐ Configurable, other defaults ☐ Other markings, not configurable				
Sample rates	☒ 48 kHz	☒ 44.1 kHz	☒ 96 kHz		
Packet times	☒ 1 ms	☒ 125 µs	☒ 250 µs	☒ 333 µs	☒ 4 ms
PTP profiles	☒ IEEE1588 Default ☒ AES67 PTP Media ☐ IEEE 802.1AS (AVB)				
SDP transport	☒ Manually ☒ SAP ☐ SIP ☒ Other (specify)				
Description	RAVENNA method (RTSP)				
Discovery	☒ SAP ☒ mDNS ☐ NMOS IS-04 ☐ Other (specify)				
Description	RAVENNA method (advertising RTSP uri and other services)				
Packet spacing (Transmitter)	☒ strict ☐ loose				
Jitter buffer (Receiver)	☐ small ☒ large				
SIP support	☐				
Other interoperability disclosures					
SMPTE ST 2110-30 support	☒				
Other PTP profiles	☒ SMPTE ST 2059-2 ☐ Other				
Description					



AES TG SC-02-12-M: AES67 Development

- Improving the standard specification where necessary
 - ST2059 / ST2110-30 harmonization
 - Multicasting addressing
 - SDP/SIP improvements
 - WAN and redundancy recommendations
- Planning and organizing plug-fests, in cooperation with SMPTE/VSF
- TG participants:
 - anyone implementing AES67
 - parties / individuals with strong interest in AES67 interoperability

SMPTE ST 2110 – Professional Media over Managed IP Networks



The SMPTE ST 2110 standards suite specifies

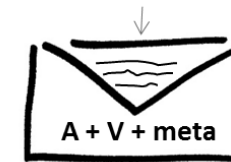
- the transport, synchronization and description of
 - separate elementary essence streams (video, audio, ancillary data)
 - over managed IP networks (at any speed, from 1GbE to 100 GbE and beyond)
 - for real-time production, playout and other professional media applications

Two fundamental approaches to IP-based transport:

- **Bundled** (Audio, Video, Metadata together)
 - Audio/Video/Metadata/Sync travel *coherently*
 - Requires extra work to “unpack” separate essences
- **Essence-based** (Audio, Video, Metadata separate)
 - Ideal for *Studio/Production* workflows
 - Individual essence kept in sync using PTP timing

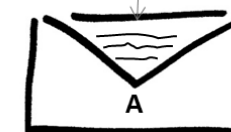


Destination IP Address

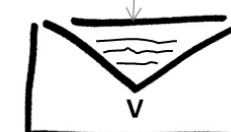


One IP address

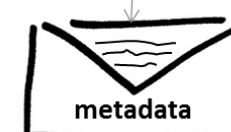
IP Address #1



IP Address #2

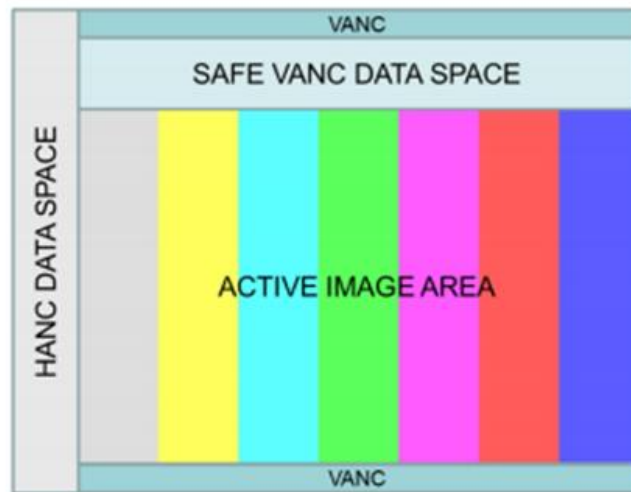


IP Address #3



Separate IP addresses

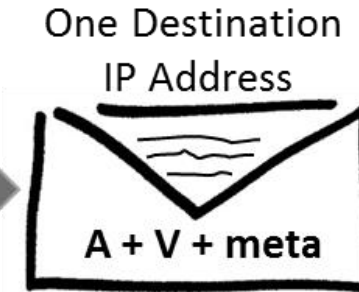
SMPTE ST 2022-6 - The bundled approach:



SDI Raster

IP Packetization of SDI Raster
Method: **SMPTE ST 2022-6**

- Audio (from HANC)
- Video (from active area)
- Metadata (from VANC)
- Sync/Timing (from frame)



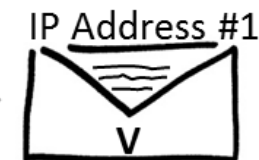
Published beginning in 2012

SMPTE ST 2110 - The Essence-based approach:



Active Video

IP Packetization of Active Video
Method: SMPTE ST 2110-20



Audio

IP Packetization of Audio Channels
Method: SMPTE ST 2110-30



Metadata

IP Packetization of ANC Data
Method: SMPTE ST 2110-40



Published in 2017

SMPTE ST 2110 - Professional Media over Managed IP Networks



Document structure (published):

- 2110-10: System Timing & Definitions
 - defines transport layer and synchronization (SMPTE2059, clocks, RTP, SDP etc.)
- 2110-20: Uncompressed Active Video
 - defines payload format for raw video (RFC4175, RTP, SDP, constraints)
- 2110-21: Traffic Shaping and Delivery Timing for Uncompressed Active Video
 - defines timing model for senders and receivers (traffic shaping requirements)
- 2110-22: Compressed Active Video
 - defines payload format for CBR-compressed video (no codec definition!)

SMPTE ST 2110 - Professional Media over Managed IP Networks



Document structure (published):

- 2110-30: PCM Digital Audio
 - defines payload format for linear audio (AES67, constraints)
- 2110-31: AES3 Transparent Transport
 - defines payload format for non-linear audio (RAVENNA AM824)
- 2110-40: Transport of SMPTE Ancillary Data
 - defines RTP payload format for SDI ancillary data (new IETF draft)

SMPTE ST 2110 - Professional Media over Managed IP Networks



Document structure (in development):

- 2110-23: Single Video Essence Transport over Multiple 2110-20 Streams
 - defines how to split high-bandwidth signals into several lower-bandwidth ST2110-20 tributary streams (constraints, grouping, addressing, RTP timestamps, SDP ...)
- 2110-24: Transport of SD Signals
 - defines how to transport SD-formatted signals into ST2110 streams (packetization, RTP timestamps, SDP ...)
- 2110-41: Extensible Fast Metadata Transport
 - defines how to transport extensible, dynamic meta data in ST2110 context (including synchronization)



Further Work in SMPTE DGs

ST 2110

- 1-year review of: -10 / -20 / -21 / -40
- New work: -24 (SDO Definitions)
- PICS (analog to AES67-2018)

ST 2059

- 1-year review of: -1 & -2
- ST 2059 Security
- PTP Monitoring

Related:

VSF

- ST 2110-over-WAN, ST 2110 format enumeration

IEEE1588-2020 (PTPv2.1)

- Improvements and extensions, fully backwards-compatible

Agenda:

	Topic
15 min.	Panel Introduction AES67 & SMPTE ST 2110 current status
60 min.	How to implement SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A



Name	Affiliation
Claudio Becker-Foss	DirectOut – Germany CTO
Claude Cellier	Merging Technologies – Switzerland CEO
Bill Rounopoulos	Ross Video – Canada Business Development Manager OEM
Arie van den Broek	Archwave Technologies – Switzerland CEO
Andreas Hildebrand	ALC NetworX – Germany RAVENNA Evangelist



RAVENNA 2020 Webinar Series

DirectOut solutions for RAVENNA, AES67 and ST2110

Claudio Becker-Foss, CEO/CTO of DirectOut

MONTONE.42 – RAVENNA / AES67 / ST 2110-30/31



DirectOut PRODIGY series

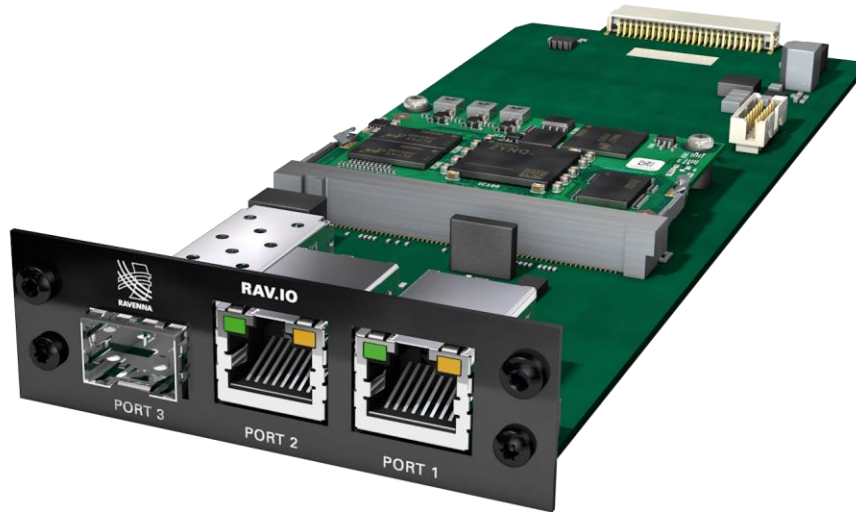


PRODIGY.MC



PRODIGY.MP

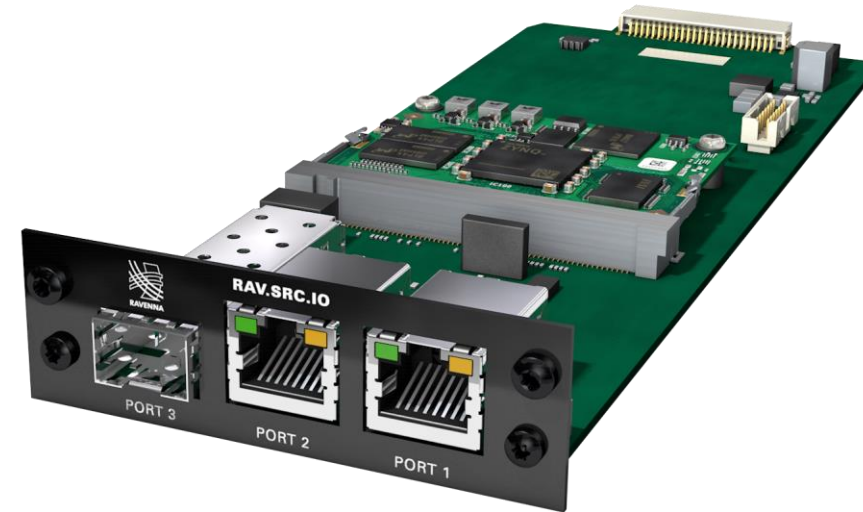
DirectOut RAVENNA network modules



RAV.IO

128 channels

RAVENNA / AES67 / ST 2110-30/31

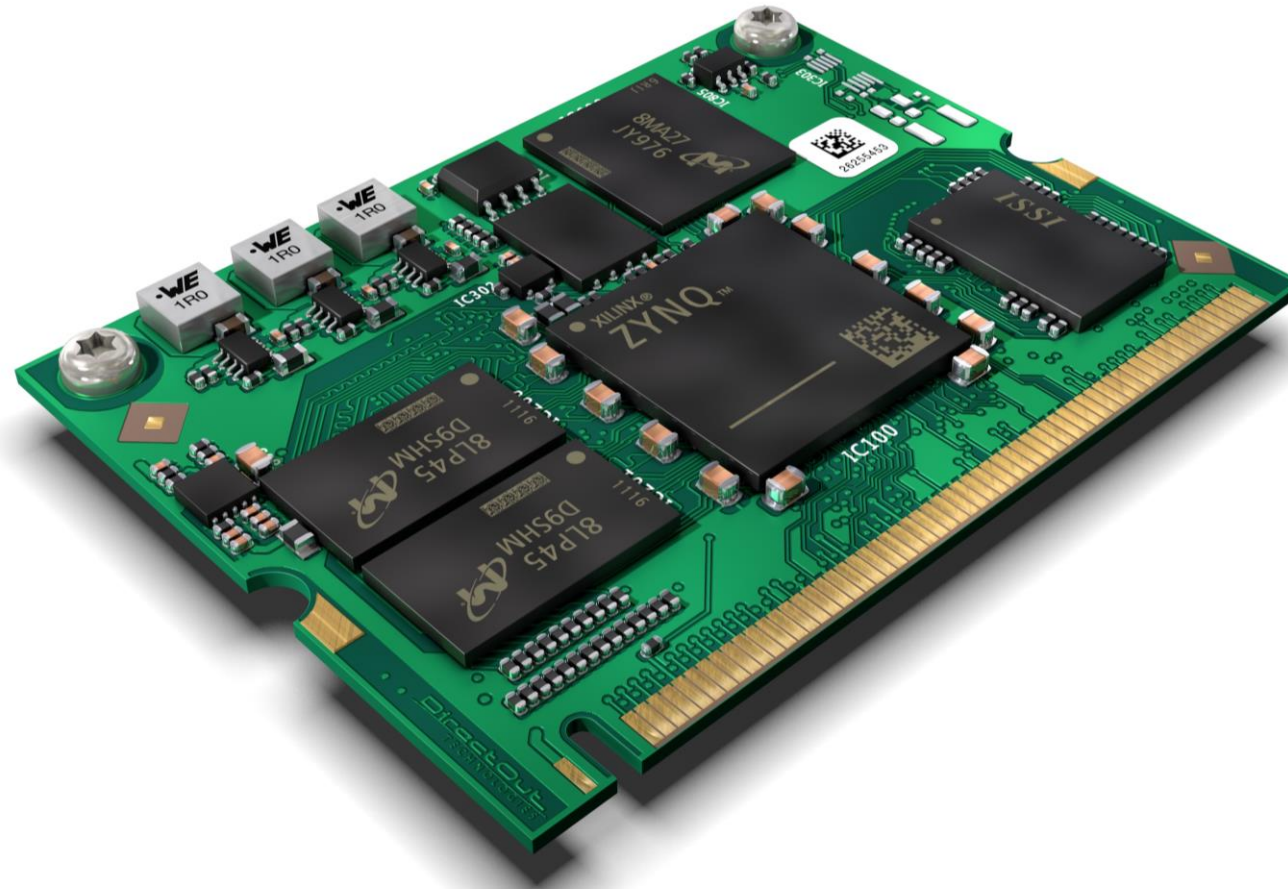


RAV.SRC.IO

128 channels + SRC

RAVENNA / AES67 / ST 2110-30/31

RAV2 Module – RAVENNA / AES67 / ST 2110-30/31



RAV2 Module – Features

RAVENNA implementation with full AES67, ST2110-30/31 support in a compact Mini-PCI form factor

Audio

- 128 x 128 audio channels
- Up to 32 multicast or unicast streams
- Up to 192kHz sample rate

Network

- Lowest latency support: down to 1 sample/packet!
- Buffer for WAN with up to 500ms latency
- ST2022-7 and unicast redundancy support

PTP

- Built-in PTP grandmaster capability
- Multicast, hybrid and unicast Mode
- Adaptive PTP filters
- Jitter Measurement

Remote Control

- Configurable via web interface (HTML5 / Javascript) and/or internally by the host device
- NMOS available (IS-04, IS-05)
- Management / Streaming ports independently assignable



For more information:

oem@directout.eu

www.directout.eu

Agenda:

	<u>Topic</u>
15 min.	Panel Introduction
	AES67 & SMPTE ST current status
60 min.	How to implement SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A



<u>Name</u>	<u>Affiliation</u>
Claudio Becker-Foss	DirectOut – Germany CTO
Claude Cellier	Merging Technologies – Switzerland CEO
Bill Rounopoulos	Ross Video – Canada Business Development Manager OEM
Arie van den Broek	Archwave Technologies – Switzerland CEO
Andreas Hildebrand	ALC NetworX – Germany RAVENNA Evangelist



- The company that has a passion for RAVENNA for 10 years and it shows!
- We are not shy to share that love with all of you!
- By designing, sharing and maintaining a large collection of core components
- Let us first review some of those essential pieces that comprises the open RAVENNA/AES67 ecosystem
- Starting with a unique suite of Virtual Audio Device drivers for Linux, Windows and MacOS

MAC OS Virtual Audio Device



- The Merging Technologies RAVENNA/AES67 STANDARD Virtual Audio Device edition is **free of charge** and intended for owners of **any RAVENNA and/or AES67 multi-cast device**
- Merging OEM customers get access to the additional features of the PREMIUM version
- Support for NMOS planned to be released this summer as an additional option

MAC Virtual Audio Device

Driver	RAVENNA/AES67 ¹ Virtual Audio Device	
	STANDARD Edition	PREMIUM Edition
Requirements	Any AES67 compatible device	Requires at least one Merging Network Interface connected over the network (e.g. Horus, Hapi or Anubis)
Operating System macOS	Yosemite* 10.10.X - ElCapitan* 10.11.X - Sierra* 10.12.X - High Sierra** 10.13.X - Mojave 10.14.X*** - Catalina 10.15.1/10.15.2***	
Latency	48 (AES67) samples only	16 - 32 - 48 (AES67) - 64 - 128 - 192 - 288 - 480 samples
Sampling rate supported	44.1/48kHz	44.1/48kHz, 88.2/96kHz, 352.8/384kHz, DSD64, DSD128, DSD256
I/O @ 44.1/48kHz	64 Inputs and Outputs ²	128 Inputs and Outputs ²
I/O @ 88.2/96kHz	Not Available	128 Inputs and Outputs ²
I/O @ 176.4/192kHz	Not Available	128 Inputs and Outputs ²
I/O @ 352.8/384kHz/DSD	Not Available	128 Inputs and Outputs ²
MIDI Pre Amps	Not Available	MIDI Pre Amps & Din support
Bundled application	MT Discovery	MT Discovery
¹ SAP implemented in device so no need for a RAVENNA-2-SAP (SIP is not supported)		
² The I/O performance will vary with the system configuration.		
* Yosemite, ElCapitan and Sierra are LEGACY. Not supported anymore by Apple nor Merging. Works as is. Older VAD do not support MERGING+ANUBIS		
** High Sierra has been certified under VAD version 2.0.37039.dmg and higher. Merging now recommends version 2.1.41930 and higher		
*** Mojave 10.14.5/10.14.6 and Catalina 10.15.1/10.15.2 supported. VAD 2.1.41930 and higher recommended. Catalina 10.15.3 not yet supported.		
MERGING+ANUBIS is supported as of VAD version 2.0.37039.dmg and higher		
ANEMAN comes as a separate installer and should be installed along the VAD. Download www.aneman.net/#download MERGING+ANUBIS users must use ANEMAN v1.1.8 and higher		

Merging RAVENNA/AES67 Settings

Show All

Visit <http://www.merging.com/products/networked-audio> to find out how much more you can do with a Merging Networked Audio Interface. More options, more channels, higher sampling rates, full RAVENNA functionality and award winning performance at an affordable price.




AES67 now!


Interface: Ethernet (en0: 169.254.7.166) ☒ Auto
Latency: 48 smpl (AES67)
Frequency: 48000 Hz

Number of Channels
Inputs: 64
Outputs: 64

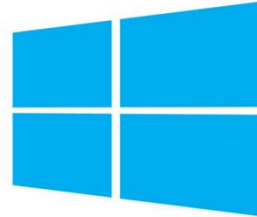
Status
Driver: Running
PTP: Locked

Online RAVENNA Devices:
 
Ravennamodul Mac Book Pro

Advanced Settings...

2.0.29137

Windows Virtual Audio Device



Windows 10

- Bundled free for owners of a Merging Network Interface (Horus, Hapi, Anubis)
- Merging OEM customers get also access to the ASIO driver
- Major current upgrade to functionality by adding aggregation offered by multi-ASIO and WDM support
- Optional ST2022-7 support currently under validation by major Broadcaster including in VM deployments
- Support for NMOS planned to be released this summer as an additional option

Windows Virtual Audio Device

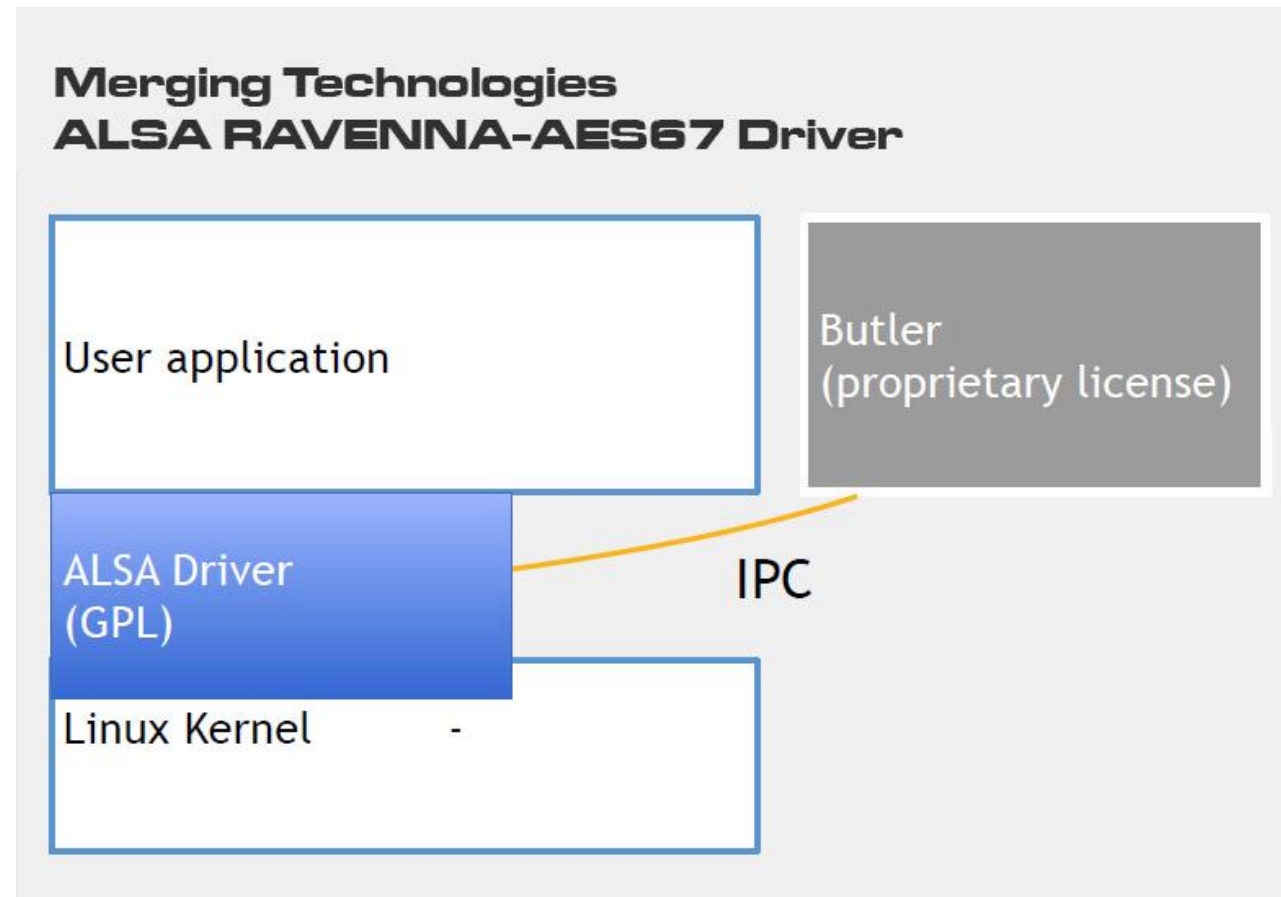
Driver	RAVENNA ASIO Driver v12
Requirements	At least one Merging Network interface hardware (Horus, Hapi or Anubis*)
Operating System	Windows 7 (64bit) Windows 10 (64bit)
Buffer sizes	48 - 64 - 128 - 512 - 1024 samples
Latency Frame modes supported	6* - 12* - 16 - 32 - 48 - 64
Sampling Rate Supported	44.1/48kHz, 88.2/96kHz, 176.4/192kHz, 352.8/384kHz, DSD64, DSD128, DSD256
I/O @ 44.1/48kHz	128 Inputs and Outputs ²
I/O @ 88.2/96kHz	64 Inputs and Outputs ²
I/O @ 176.4/192kHz	32 Inputs and Outputs ²
I/O @ 352.8/384kHz & DSD	16 Inputs and Outputs ²
MIDI Pre Amps	Available with Pyramix and some third party applications supporting the Avid PRE protocol
Bundled applications	MT Discovery & ANEMAN
¹ Legacy ASIO Driver version 9 supports Windows 7 -32 bit and does not support ANEMAN nor firmware Horus and Hapi v3.9.4 and above	
² The I/O performance will vary with the system configuration	
* Supported as of the RAVENNA ASIO driver v12.0 and requires ANEMAN v1.1.8 and above	
Horus and Hapi Firmware 3.9.4 requires the RAVENNA ASIO driver v12.0.2 and above (and vise-versa)	
ANEMAN comes as a separate installer, we recommend to install ANEMAN from https://www.aneman.net/#download	

Linux Virtual Audio Device



- Merging Technologies is proud to deliver to the community an ALSA Linux driver designed to provide high performance RAVENNA/AES67 support for the Linux ecosystems
- The driver is available in two flavors, a public build for non-commercial applications available to anybody interested in AES67/RAVENNA, and an OEM build for commercial products integration
- Up to 64 I/O @ 1fs for OEM build. Public build is limited to 8 I/O

Linux Virtual Audio Device Architecture



ANEMAN (Audio Network Manager) for RAVENNA, AES67 and ST2110

- Allows you to see devices status (hardware or stream errors) with history (logs)
- Gives extensive info when a connection error arrives, helping you in fixing the problem
- Automatic or manual discover, save and load connections
- Open specification
- Free - it is to AoIP what Linux is to OSs
- Integrates automatically every ZMAN based device
- A wide variety of devices supported (Merging, LAWO, Archwave, DirectOut, Ross Video and more...)
- A customisable (Enterprise grade) version of ANEMAN is also available for larger scale projects

ANEMAN

Action View Settings Debug Help

Rearrange Zoom All ☐ Auto Zoom New Logic Zone New Sample Rate Zone

Matrix View

8430A Scoop_Test

INPUT
Scoop_Test
I2S I/O PGM
48000 Hz

OUTPUT
8430A-00-50-D5
Audio IO INPUT A
48000 Hz

STREAM
Scoop_Test_I2S I/O-1
Channel: #1 of 2
Codec: L24 / FrameSize: 48
Addr: 239.1.1.164 / Port: 5004
Addr: 239.1.20.13 / Port: 5004
Status: Streaming/Connected

CONNECTIONS TO >>>

CONNECTIONS FROM >>>

Physical Inputs
I2S I/O
PGM
COORD
MIC1
MIC2
MIC3
MIC4
AUX1
AUX2

Physical Outputs
I2S I/O
Inter Sound
English
CUE
IFB 1
IFB 2
I2S I/O - 6
I2S I/O - 7
I2S I/O - 8

Devices

Name	Type	IPv4	Version	Company	Product	Serial
8430A-00-50-D5		192.168.1.141	0	GENELEC	8430A	00:07:f3:00:50:d5
ASIO (on OCT00317)		192.168.1.142		Merging Techn...	ASIO	123719795576523
Anubis_600039		192.168.1.133	1.1.5b42863	Merging Techn...	MERGING+AN...	A600039
zoem_110341		192.168.1.159	1.1.2b42350	Merging Techn...	MT ZOEM	110341
Horus_80131		192.168.1.155	3.9.9b41529	Merging Techn...	Horus	80131
Horus_80858		192.168.1.135	3.9.9b42703	Merging Techn...	Horus	80858
CoreAudio (on garm)		192.168.1.198		Merging Techn...	CoreAudio	305419896
ASIO (on DESKTOP-49AH25I)		10.0.0.91		Merging Techn...	ASIO	123719798600812
ASIO (on PoutineW10)		10.0.0.44		Merging Techn...	ASIO	53350628357543
CoreAudio (on build-macosx)		10.0.0.94		Merging Techn...	CoreAudio	115444275210115

Ready for next operation

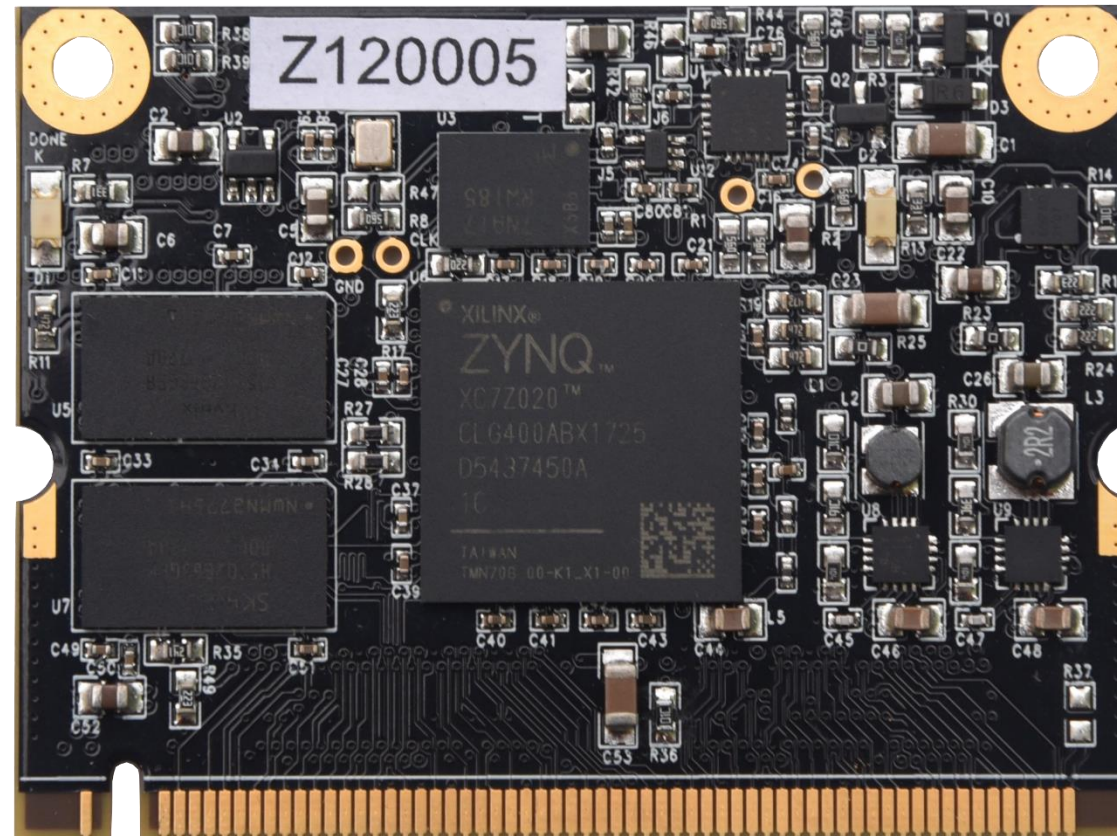
ANEMAN, Audio Network Manager for RAVENNA, AES67 and ST2110

For more detailed information on ANEMAN, and for those who missed the very recent Webinar “Controlling RAVENNA / AES67 Networks with ANEMAN” hosted by Nicolas Sturmel from Merging, the recording of the session is available here:

https://drive.google.com/drive/folders/1MUKqvTII4cHqnJx7Z1TYD7ZfBiTYd9_Y?usp=sharing

Feel free to share the link with any interested colleague. If you have a technical / commercial question regarding ANEMAN, please contact Nicolas directly.

ZMAN - AUDIO NETWORK MODULE FOR RAVENNA / AES67 ECOSYSTEMS



ZMAN - AUDIO NETWORK MODULE FOR RAVENNA / AES67 ECOSYSTEMS

AUDIO SPECIFICATIONS

- Sample Rate 44.1kHz/48kHz, 88.2kHz/96kHz, 176.4kHz/192kHz
- Optional high-resolution support for DXD, 384kHz, DSD64, DSD128 and DSD256
- Word lengths 16, 24, or 32 bits per sample
- I2S/TDM Audio format
- Network input audio buffer up to 16k samples
- Up to 32 RAVENNA/AES67 I/O streams, up to 256 network audio channels
- Word clock IO for synchronization

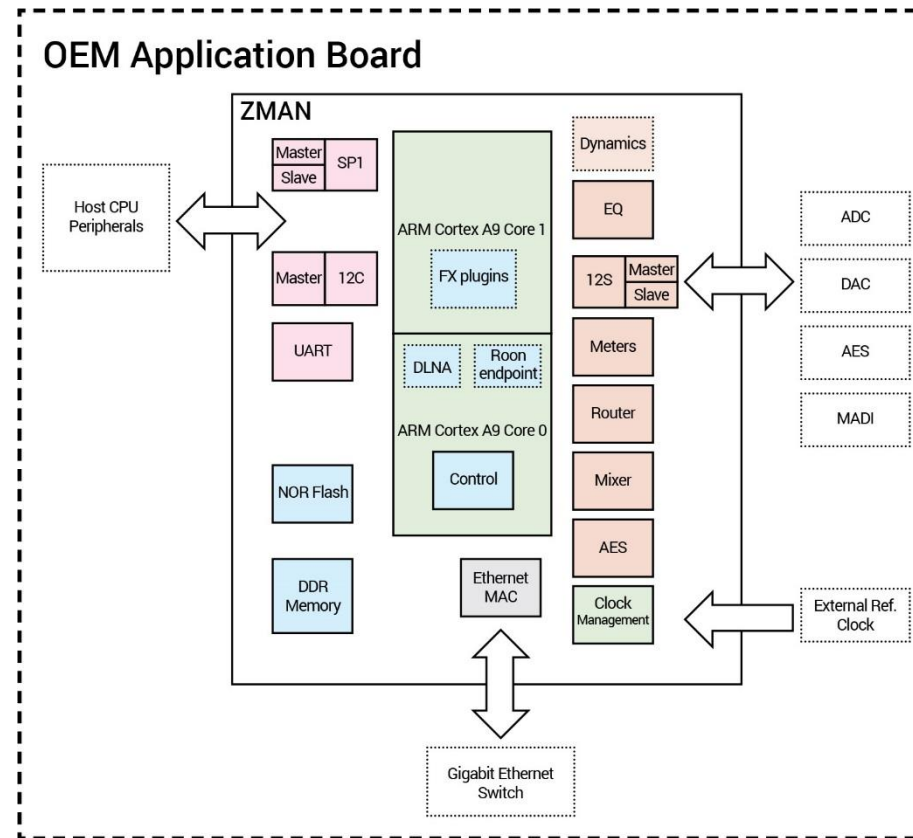
HARDWARE SPECIFICATIONS

- Single Power supply 3.3V, under 5W
- Xilinx SoC Zynq based design
- Dual core ARM Cortex A9 processors, ARMv7-A architecture
- DDR3 Memory (512 MB)
- NOR Flash (128 MB)
- Standardized RGMII interface for Gigabit Ethernet switches or PHY, IEEE Std 802.3
- Mezzanine connectors (3 x 80 pins)
- Pin compatible to Dante Brooklyn II (Mini-PCI)

ZMAN - AUDIO NETWORK MODULE FOR RAVENNA / AES67 ECOSYSTEMS

- Small form factor Module (59.6 x 44.5 mm)
- Channel based routing matrix with over 500 channels capacity
- Ultra Low Phase Noise built-in Master Oscillator plus option for externally supplied clock signal (ie. OCXO, Atomic clock or GPS disciplined oscillator)
- Full RAVENNA/AES67 IP stack including PTP with master/ slave capability for low wander/jitter multi-devices synchronization
- Real-Time Signal Processing, ARM & FPGA-based (128x32 Mixer, 28 Bands of EQ, etc.)

ZMAN - AUDIO NETWORK MODULE FOR RAVENNA / AES67 ECOSYSTEMS



ZMAN - AUDIO NETWORK MODULE FOR RAVENNA / AES67 ECOSYSTEMS

- 2 Versions
- ZMAN-010 (offering a cost-effective entry-point for low to moderate channel count, max 64x64 @ 1FS) and high performance ZMAN-020 (for higher channel count, max 256x256 @ 1FS or higher processing requirements)

ZMAN-010

Up to 64x64 @ 1FS

ZMAN-020

up to 256x256 @ 1FS

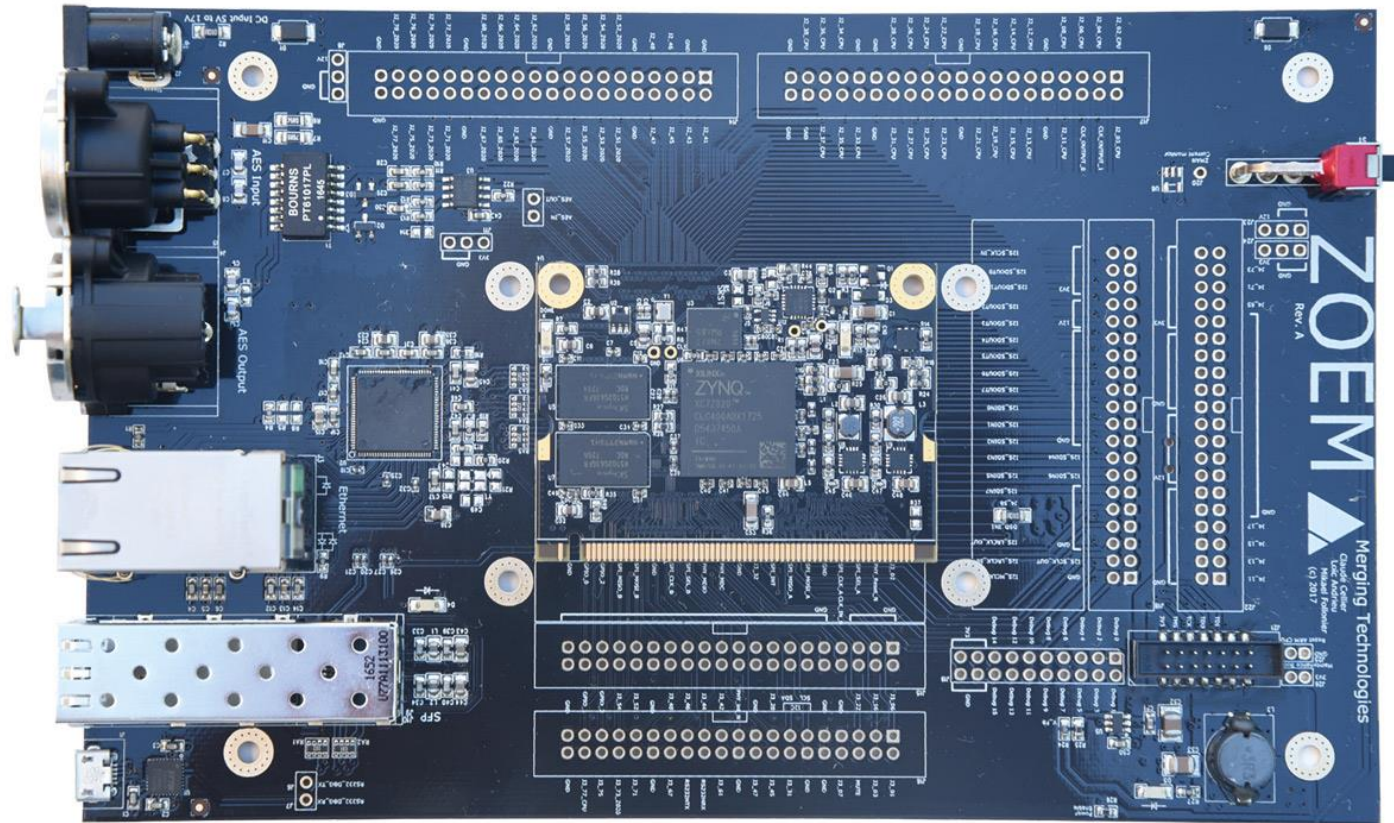
ZMAN - AUDIO NETWORK MODULE FOR RAVENNA / AES67 ECOSYSTEMS



- NMOS support successfully self-tested in March 2020 and currently under validation by several of our OEM Broadcast customers
- ST2022-7 support currently under validation by major Broadcaster

ZMAN + ZOEM

Audio Networking and Processing development kit.



Agenda:

	<u>Topic</u>
15 min.	Panel Introduction
	AES67 & SMPTE ST current status
60 min.	How to implement SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A



<u>Name</u>	<u>Affiliation</u>
Claudio Becker-Foss	DirectOut – Germany CTO
Claude Cellier	Merging Technologies – Switzerland CEO
Bill Rounopoulos	Ross Video – Canada Business Development Manager OEM
Arie van den Broek	Archwave Technologies – Switzerland CEO
Andreas Hildebrand	ALC NetworX – Germany RAVENNA Evangelist



BACH AUDIO NETWORKING MODULES, CHIPS & SOFTWARE

BACH liberates you to outperform your competition with open control and a broad portfolio of ST2110 & AES67 solutions

Features/ Benefits

- Better satisfy your user's experience with open control
- Your brand front and center, not ours
- Grow your revenue by innovating across markets



Multi-Protocol Support





**HIGH IMPACT
EFFICIENCY**

INNOVATE WITH LIBERTY ACROSS MARKETS
A COMPREHENSIVE PORTFOLIO OF TECHNOLOGIES

AUDIO NETWORKING MODULES, CHIPS & SOFTWARE

HIGHLIGHTS

≤ 512 CHANNELS
≤ 128 STREAMS
3 x GigE



BACH openModule
Ultimate Capacity Module
Many performance options

64 CHANNELS
NO H/W CHANGES



BACH Liberty Module
Pin-compatible DANTE BROOKLYN II alternative
Quickly plug into full standards compliance today!

16 CHANNELS
8 STREAMS



BACH Minuet
System-on-Chip

AUDIO ON LINUX
64 CHANNELS
8 STREAMS

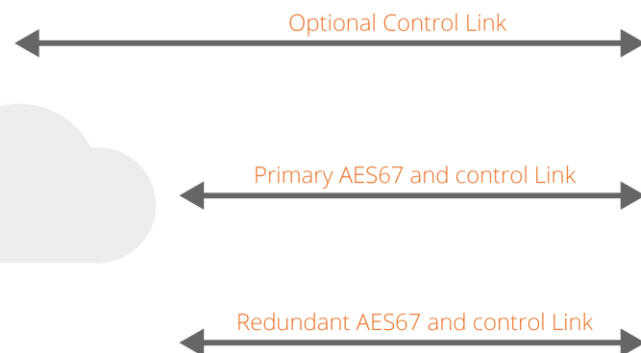
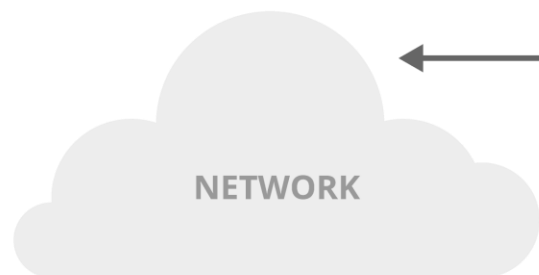


BACH Virtual Sound Card Development Platform
BACH in software on a server

CONTROL
SOFTWARE

**DashBoard
ANEMAN**

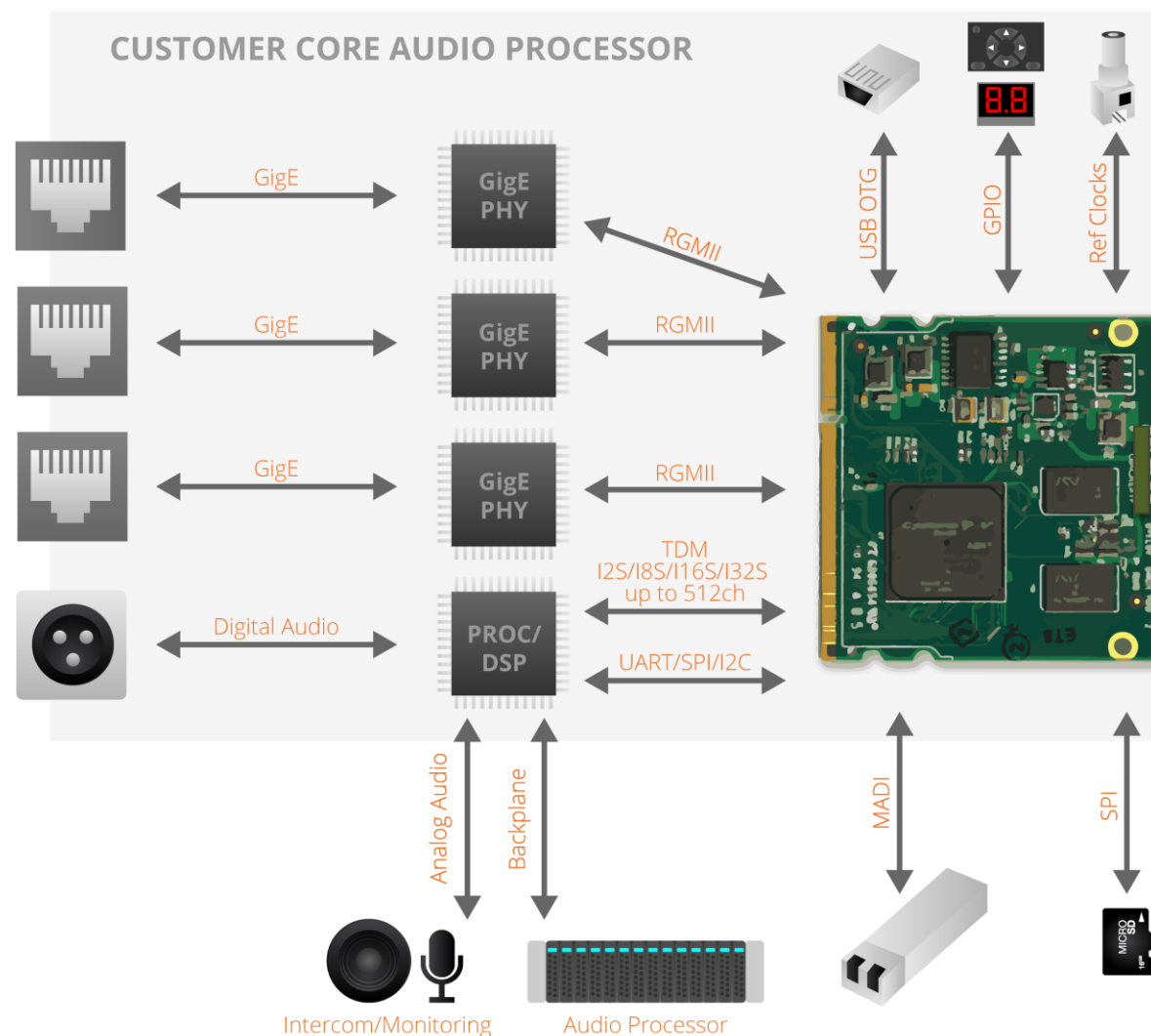
Ross DashBoard & ANEMAN
Easily manage your network your way



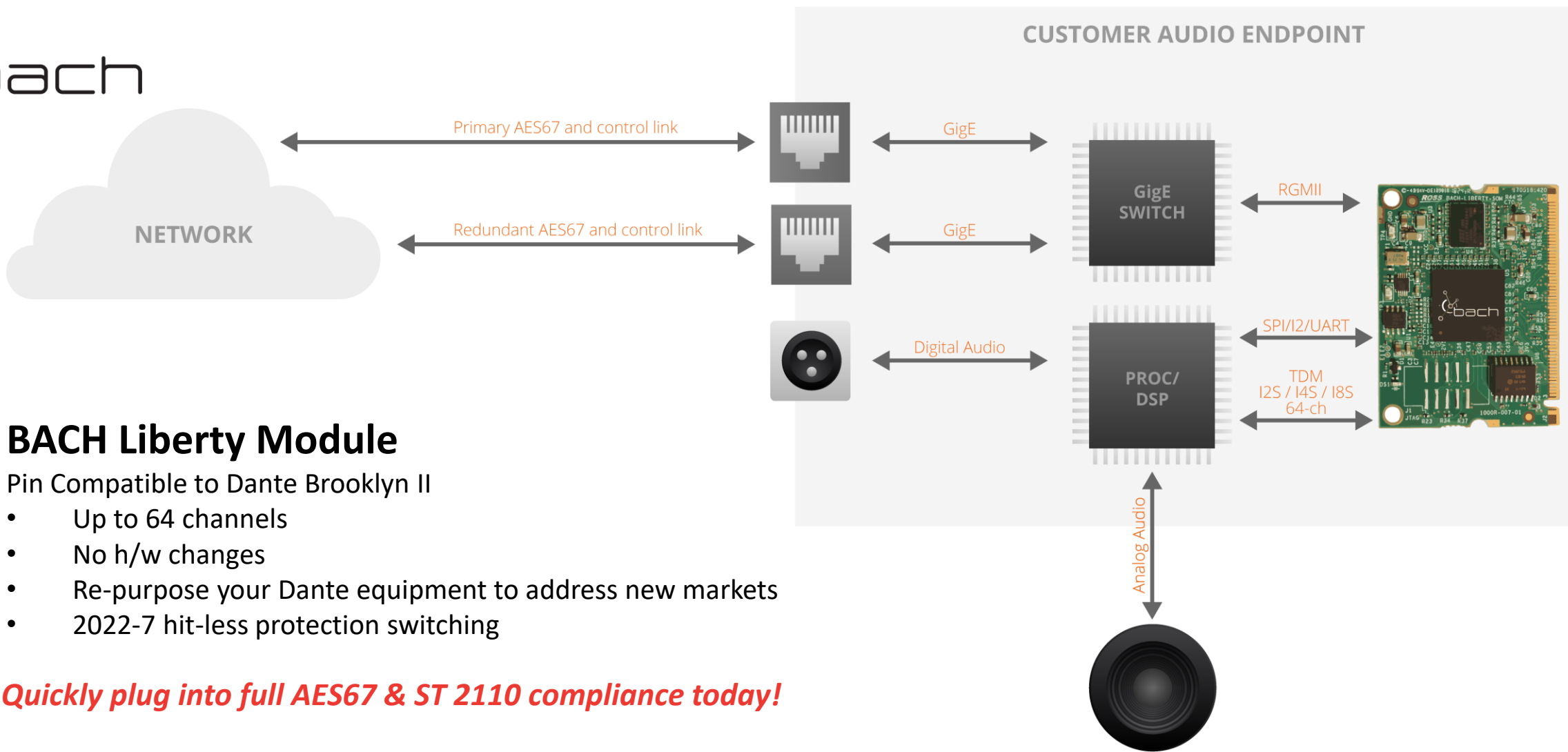
BACH openModule

Unsurpassed performance and flexibility

- Up to 512 channels and 128 audio streams
- 1 to 80 channels, configurable per audio stream
- Network latency/ jitter compensation of up to 500 msec!
- Full AES67 and ST 2110-30 conformance level: A, B & C
- 2022-7 hit-less protection switching, physical & control port redundancy



BACH openModule Ordering Codes	Description	Max Audio Channels	Max Audio Streams	Network Redundancy	Audio I/O
COV-BACH-OM-512	Highest Capacity	512	128+128	Stream & Port (Dual GE PHY) 2022-7	16+16 x I32S
COV-BACH-OM-256	High Performance	256	32+32	Stream & Port (Dual GE PHY) 2022-7	8+8 x I32S
COV-BACH-OM-128	Lowest System Cost	128	32+32	Stream & Port (Dual GE PHY) 2022-7	8+8 x I16S
COV-BACH-OM-MADI	Duplex MADI	64	32+32	Stream & Port (Dual GE PHY) 2022-7	MADI TX & RX with ASRC
COV-BACH-OM-PDK	Customizable openModule	64	8+8	Stream & Port (Dual GE PHY) 2022-7	8+8 x I8S

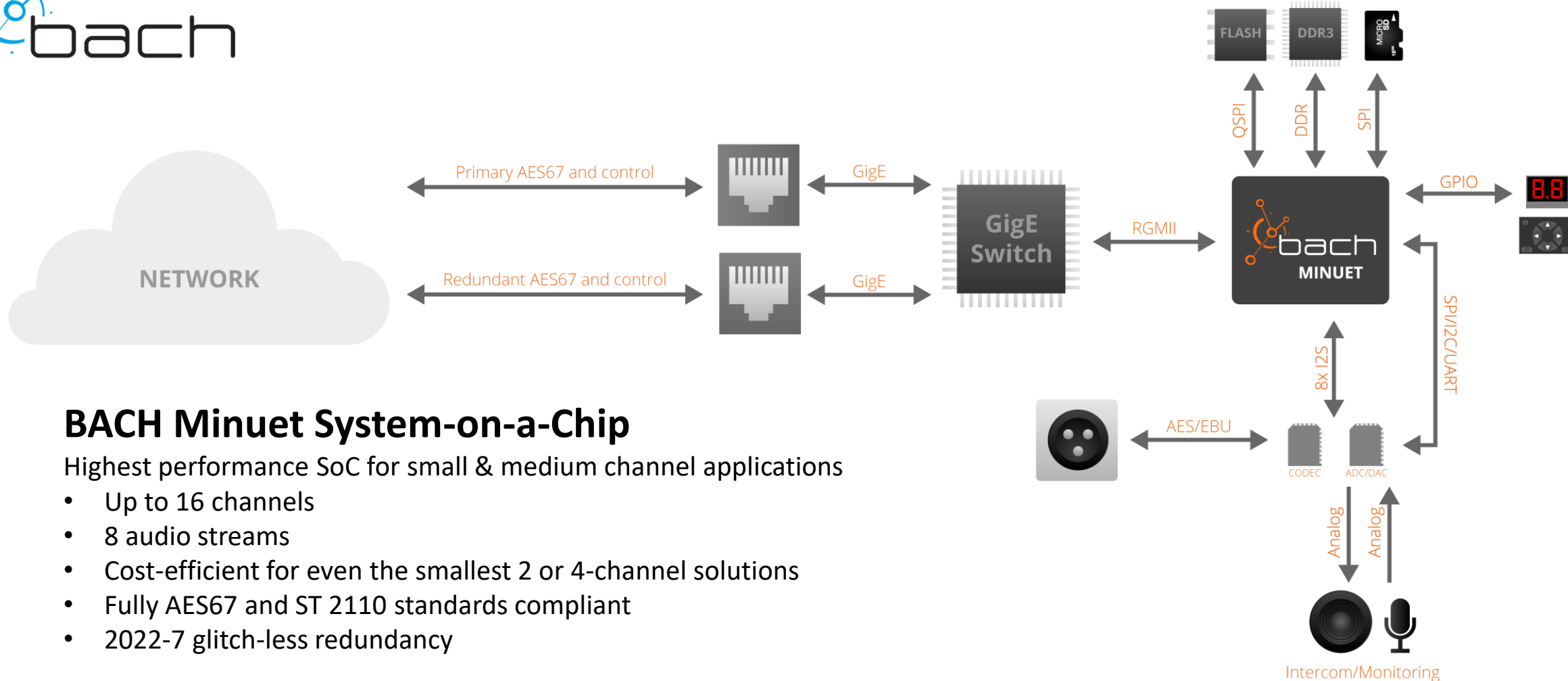


BACH Liberty Module

Pin Compatible to Dante Brooklyn II

- Up to 64 channels
- No h/w changes
- Re-purpose your Dante equipment to address new markets
- 2022-7 hit-less protection switching

Quickly plug into full AES67 & ST 2110 compliance today!



BACH Minuet System-on-a-Chip

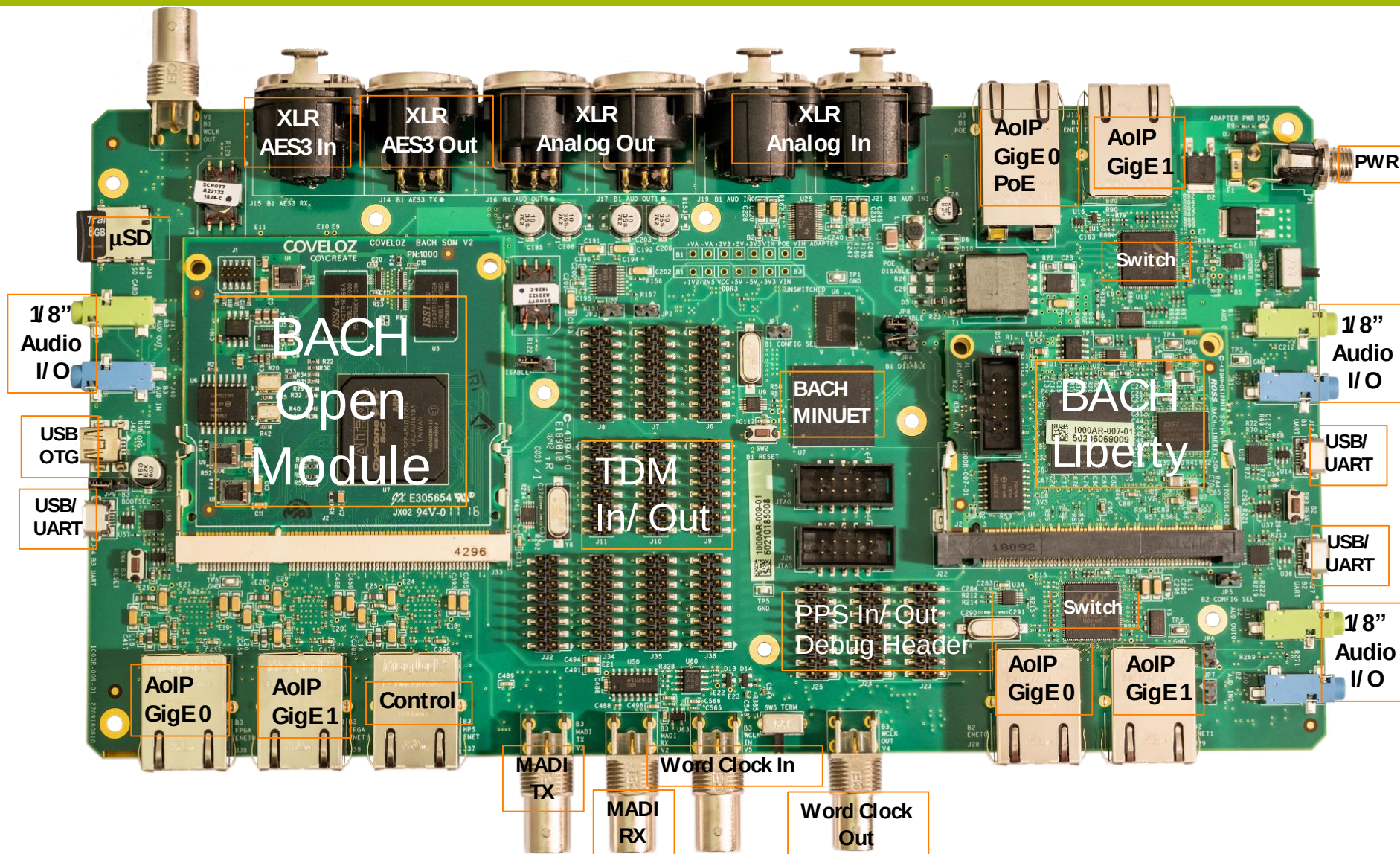
Highest performance SoC for small & medium channel applications

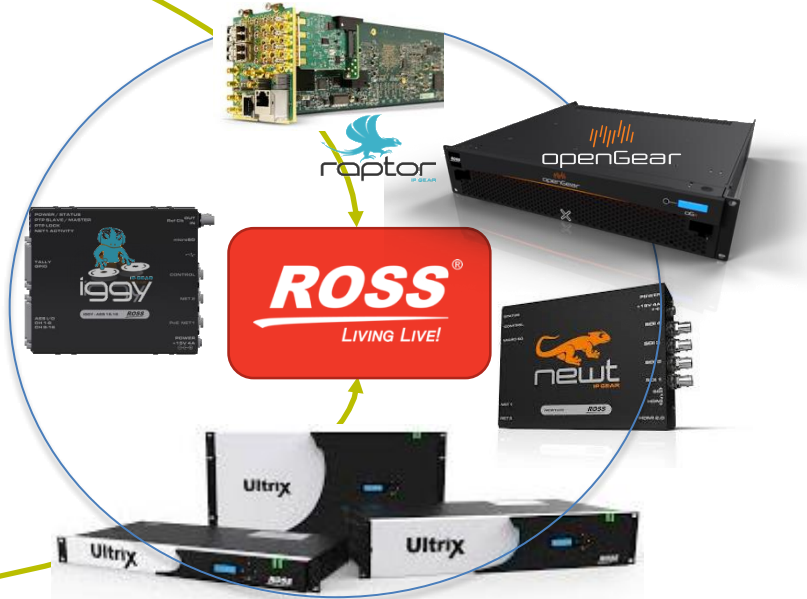
- Up to 16 channels
- 8 audio streams
- Cost-efficient for even the smallest 2 or 4-channel solutions
- Fully AES67 and ST 2110 standards compliant
- 2022-7 glitch-less redundancy



BACH Virtuoso PDK

- Quickly evaluate BACH technology
- Fully functional h/w reference design
- Universal PDK for BACH family
- Includes BACH openModule, Liberty and Minuet





Agenda:

	<u>Topic</u>
15 min.	Panel Introduction
	AES67 & SMPTE ST current status
60 min.	How to implement SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A



<u>Name</u>	<u>Affiliation</u>
Claudio Becker-Foss	DirectOut – Germany CTO
Claude Cellier	Merging Technologies – Switzerland CEO
Bill Rounopoulos	Ross Video – Canada Business Development Manager OEM
Arie van den Broek	Archwave Technologies – Switzerland CEO
Andreas Hildebrand	ALC NetworX – Germany RAVENNA Evangelist

Arie van den Broek

CEO Archwave

Who we are:

As one of the first RAVENNA partners

Committed to the visions of open technology and open standards

Since 2018 part of RIEDEL

Based in Switzerland

Our Approach:

Low-channel count, SOC based solutions

Focus on Ramp-on / Ramp-off products

Our Solutions:

Focus on ramp on, ramp off:

- 2 to 32 channel solutions
- Small unit size
- Realtime OS, no Linux, 'close to the metal'
- 100Mb connectivity
- Future proof

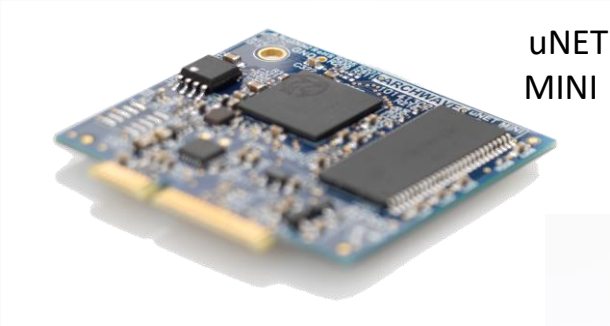
Key features:

- Fully RAVENNA compliant
- AES67 compliant
- Built in web server
- ST 2110-30 compliant*
- Simple NMOS implementation (NMOS IS-04 & IS-05)*
- ANEMAN compliant

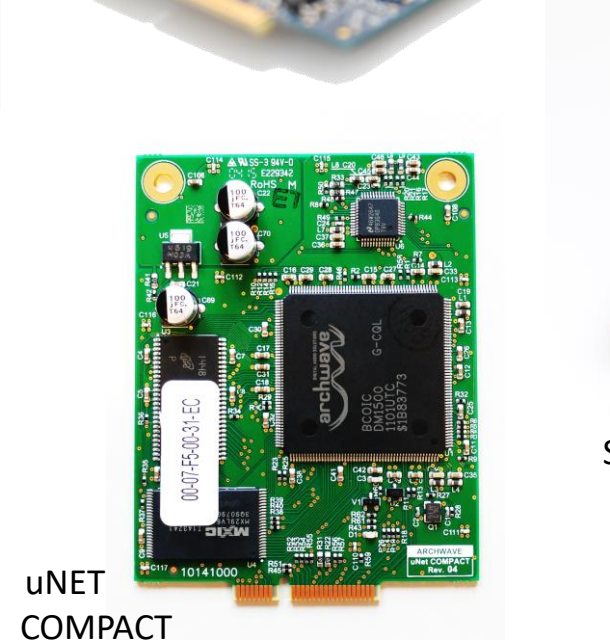
* Q4 2020

Our Solutions:

	uNET MINI	uNET COMPACT	uNET STANDARD
Channels	2 x 2 2 x 2 USB Streaming	Up to 16	Up to 32 32 x 32 USB Streaming
Audio Bridging (Network x USB x Local)	2 x 2 x 2		8 x 8 x 8
Supported Sample Rates (44.1kHz, 48kHz, 96kHz & more...)	•	•	•
RAVENNA	•	•	•
AES67	•	•	•
ST 2110-30	•	•	•
USB Host			•
Data Tunnelling	•	•	•
PCB Footprint	40mm x 44mm	60mm x 75mm	60mm x 78mm



uNET
MINI

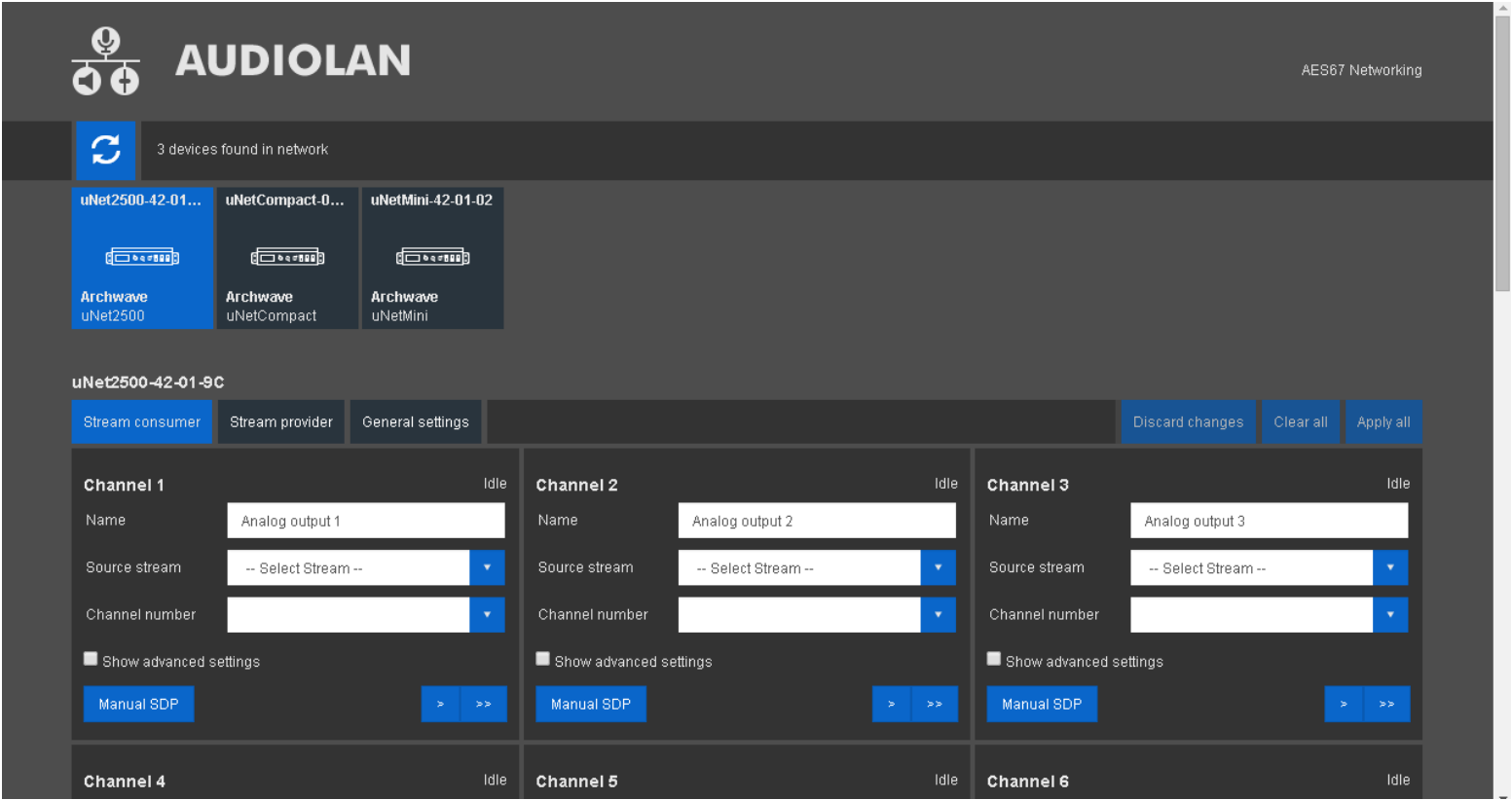


uNET
COMPACT



uNET
STANDARD

Web interface:



Typical use cases:

- Active loudspeakers
- Networked amplifiers
- Network audio interfaces
- Intercom applications
- Audio players and recorders

Support for manufactures:

- Fast implementation time
- ARC allows for fully remote setup and management
- Low cost development kits
- Low cost pre-paid support packages
- We are here to help!

Agenda:

	<u>Topic</u>
15 min.	Panel Introduction
	AES67 & SMPTE ST 2110 current status
60 min.	How to implement SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A



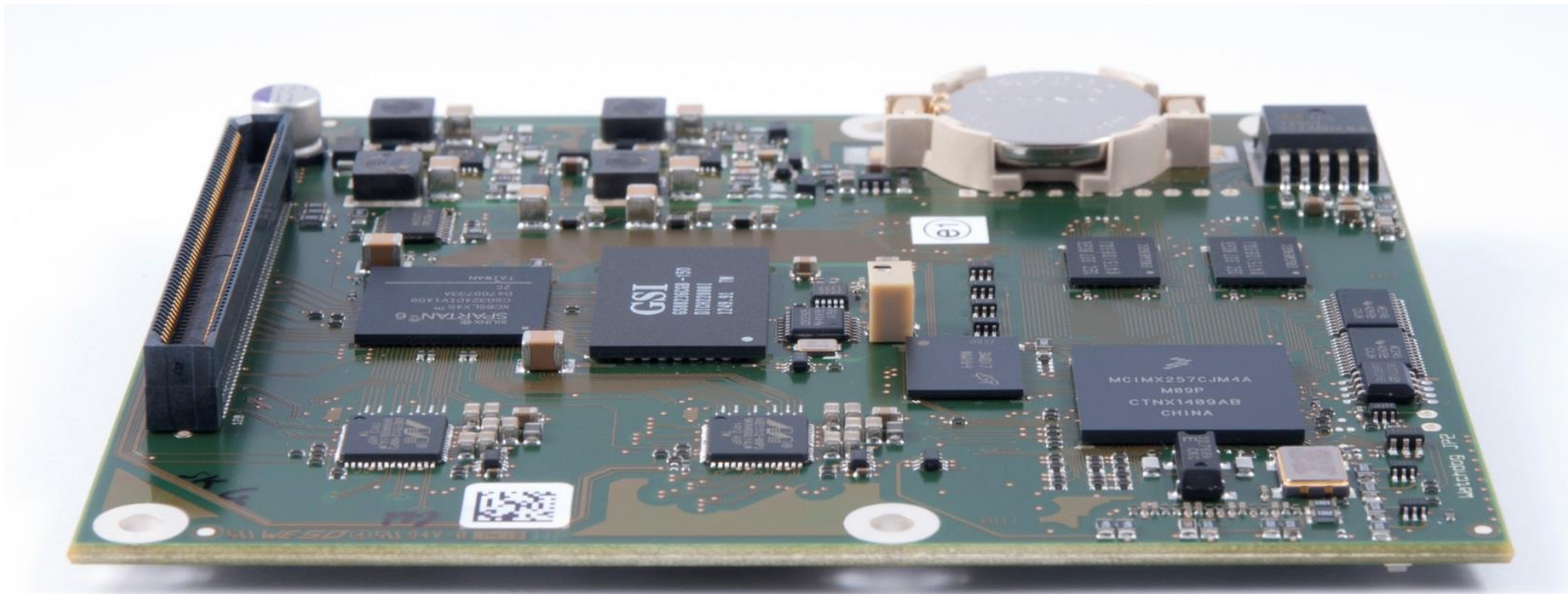
<u>Name</u>	<u>Affiliation</u>
Claudio Becker-Foss	DirectOut – Germany CTO
Claude Cellier	Merging Technologies – Switzerland CEO
Bill Rounopoulos	Ross Video – Canada Business Development Manager OEM
Arie van den Broek	Archwave Technologies – Switzerland CEO
Andreas Hildebrand	ALC NetworX – Germany RAVENNA Evangelist



RAVENNA / AES67 Building Blocks from ALC NetworkX

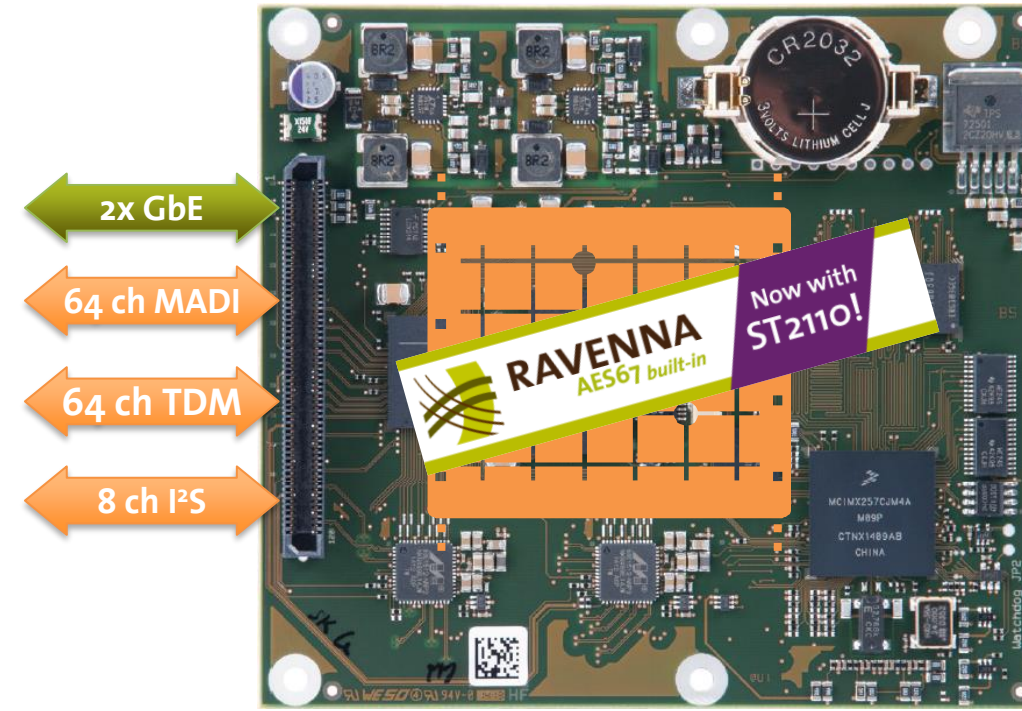
- (1) COMi.MX RAVENNA / AES67 SoM
- (2) COMi.MX Reference Design incl. full Source Code Package
- (3) C/C++ RAVENNA / AES67 Software Framework
- (4) RVSC for Windows
- (5) RAV2SAP discovery converter

COMi.MX – **RAVENNA / AES67** SoM *for quick & easy OEM integration*



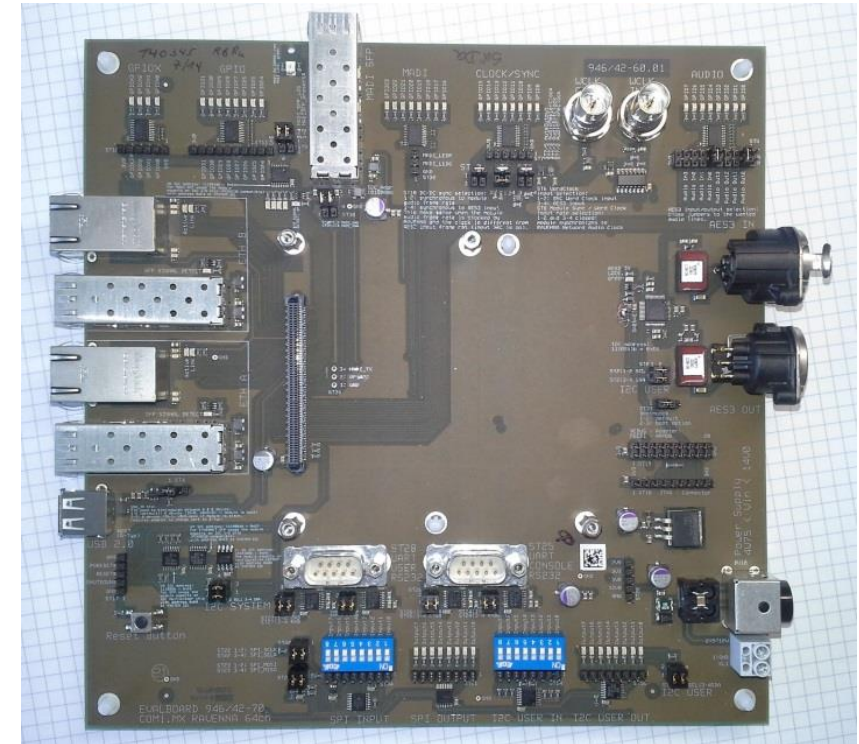
COMi.MX – RAVENNA / AES67 SoM

- Fully self-contained RAVENNA implementation
- 2x 64 channels in & out
- Up to 192 kHz sampling rate
- Full AES/EBU bit-transparent operation supported
- Lowest latency support: down to 1 sample/packet!
- Jitter / delay buffer up to 40 ms per channel
- Audio interfaces: I²S (8 ch) / TDM, MADI (64 ch)
- 2 GbE NICs w/ ST2022-7 redundancy or load balancing
- 4-tier 256 x 256 audio matrix
- Full AES67 & ST2110-30/-31 support



COMi.MX – Eval Board

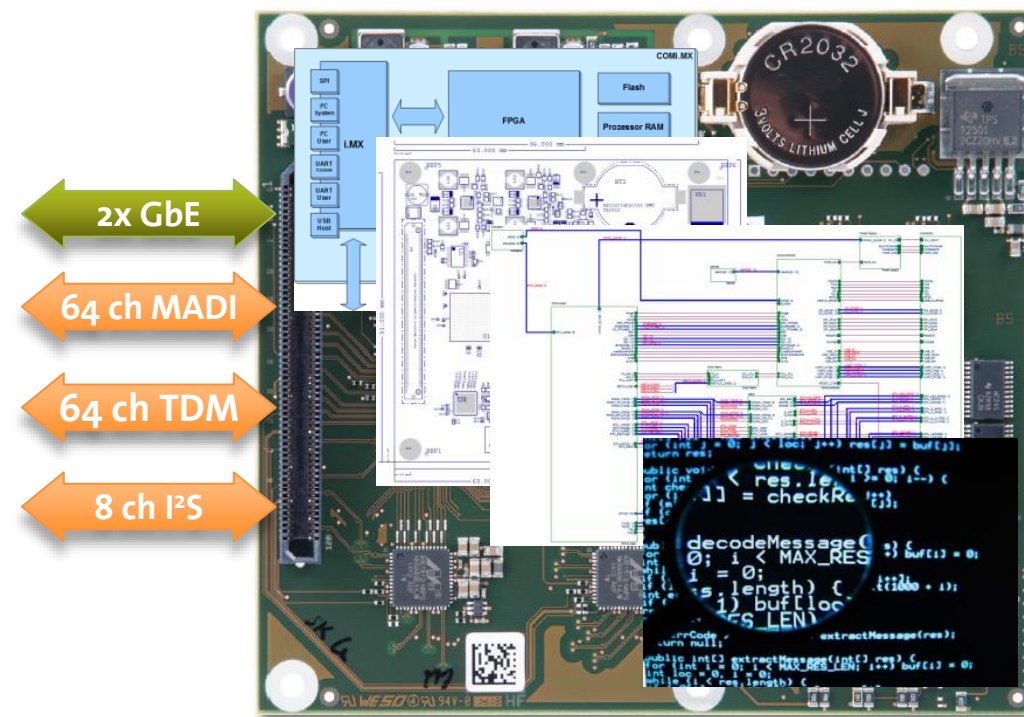
- Test and evaluation board for COMi.MX
- Single voltage power input (4.75 – 15 V DC)
- AES3 in / out (2 x XLR)
- 64 channel MADi in / out (1 x SFP)
- WCLCK in / out (2 x BNC)
- Dual GbE NICs (2 x RJ45 / 2 x SFP)
- 1 x UART system console (RS-232 SubD-9)
- JTAG Debug Port
- Access to: I²C (system + user), UART user, USB 2.0 (A/B), SPI, all GPIO lines



COMi.MX – Reference Design

SoM design & source code package:

- Functional VHDL project w/ full VHDL source code for Xilinx Spartan6 on COMi.MX
- Schematic diagrams of COMi.MX board
- RAVENNA/AES67 software framework
 - C/C++ source code
 - Complete Linux environment & development tool chain
- Technical documentation
- Basic technical support



RAVENNA/AES67 Software Framework

- C/C++ source code:
 - IEEE1588 clock protocol stack (based on ptp4L)
 - RAVENNA/AES67 streaming engine
 - Configuration & connection management
 - Advertising & discovery
 - Ember+ support
- Audio interface driver needs to be supplied by manufacturer (platform-specific)
- Technical documentation
- Complete Linux environment & development tool chain
- Reference platforms: COM8313 and Linux-PC

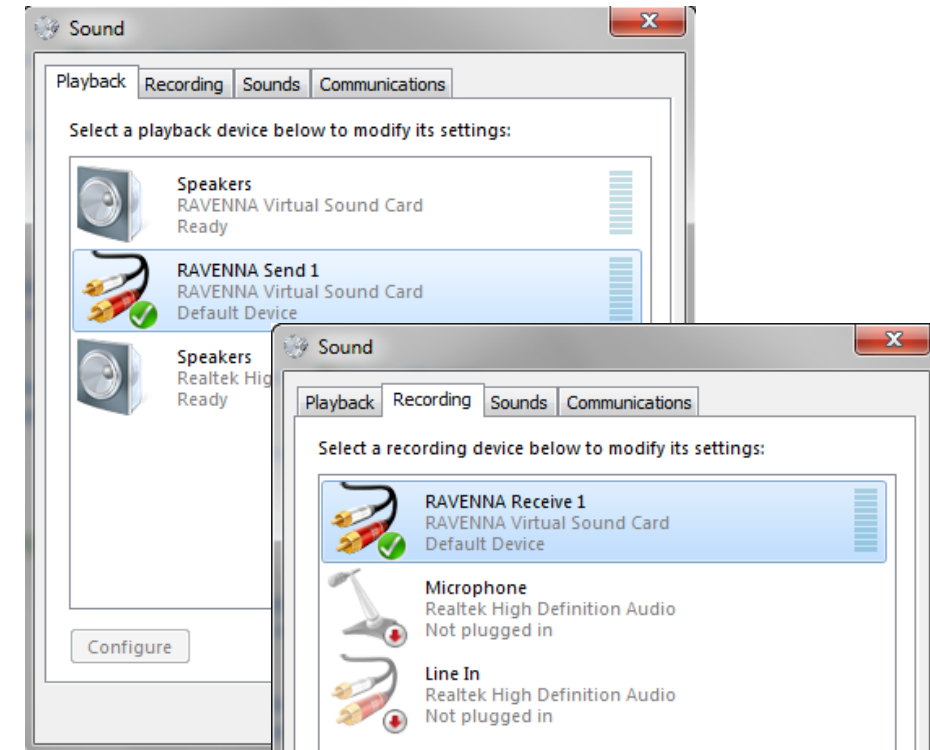


RVSC – RAVENNA Virtual Sound Card for Windows

- Operates under Windows 7 & 8 & 10
- Supports WDM driver model
- Typ. processing latency: ~ 10 ms
- PTP HW support, requires selected Intel NICs
- AES67 / ST 2110 support (multicast-only)
- Free version w/ 2 playback & 1 record WDM device

! No commercial support

- Up to 64 channels playback / record (available to RAVENNA partners for lab work / testing)



RAVENNA-to-SAP Converter

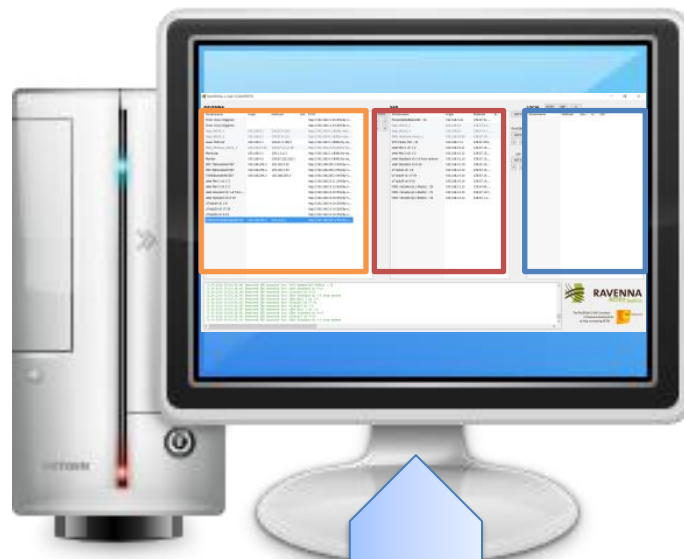
Problem: various methods to transfer SDP

- RAVENNA®: uses DNS-SD (mDNS), rtsp for SDP transfer
 - Works with multicast & unicast (side-by-side with SIP)
 - Method supported by virtually any media player and / or streaming application
- Dante™ (in AES67 mode): uses SAP
 - Experimental protocol for announcing multicast sessions
 - Periodically multicast transmission of full SDP data records
 - No manual read-out / entry of SDP data
- Solution: **RAVENNA-2-SAP Converter**
 - Converts selected or all RAVENNA announcements into SAP and vice versa
 - Provides full SDP read-out and manual entry through UI

RAVENNA-to-SAP Converter



Bonjour / RTSP

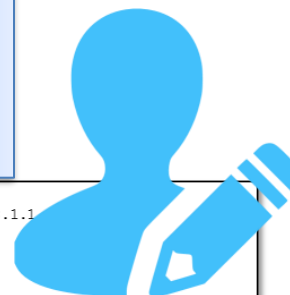


SAP



Dante™

SDP



```
v=0
o=- 1311738121 1311738121 IN IP4 192.168.1.1
s=Stage left I/O
c=IN IP4 239.0.0.1/32
t=0 0
m=audio 5004 RTP/AVP 96
i=Channels 1-8
a=rtpmap:96 L24/48000/8
a=recvonly
a=ptime:1
a=ts-refclk:ptp=IEEE1588-2008:39-A7-94-FF-FE-07-CB-D0:domain-rmbr=0
a=mediaclk:direct=963214424
```


RAVENNA-to-SAP Converter



Bonjour / RTSP



SAP



Dante™



AES67 Streams



RAVENNA-to-SAP Converter



Bonjour / RTSP



SAP



Dante™



AES67
Streams



AES67 Streams





RAVENNA-2-SAP CONVERTER

RAI

RAVENNA

Streamname ^	Origin	Multicast	SAP	RTSP
From CALL1 Digigram				rtsp://192.168.11.30:554/by-n...
From CALL2 Digigram				rtsp://192.168.11.34:554/by-n...
Hapi_90105_2	192.168.9.1	239.67.9.10/1		rtsp://192.168.9.1:80/by-nam...
Hapi_90105_3	192.168.9.1	239.67.9.11/1		rtsp://192.168.9.1:80/by-nam...
Lawo PGM out	192.168.2.1	239.67.2.100/1		rtsp://192.168.2.1:8081/by-na...
MNA_Montone_Demo_1	192.168.10.50	239.67.10.1/128		rtsp://192.168.10.50:80/by-na...
MoniLoop	192.168.2.1	239.1.2.1/1		rtsp://192.168.2.1:8081/by-na...
Monitor	192.168.4.2	239.67.222.222/1		rtsp://192.168.4.2:8081/by-na...
SRC 7@xnode401587	192.168.255.3	239.192.3.52		rtsp://192.168.255.3:554/by-n...
SRC 8@xnode401587	192.168.255.3	239.192.3.53		rtsp://192.168.255.3:554/by-n...
TONE@xnode401587	192.168.255.3	192.168.255.3		rtsp://192.168.255.3:554/by-n...
uNet Mini 1 ch 1-2				rtsp://192.168.15.11:554/by-n...
uNet Mini 2 ch 1-2				rtsp://192.168.15.12:554/by-n...
uNet Standard ch 1-8 from ...				rtsp://192.168.15.10:554/by-n...
uNet Standard ch 9-16				rtsp://192.168.15.10:554/by-n...
uTrack24 ch 1-8				rtsp://192.168.14.10:554/by-n...
uTrack24 ch 17-24				rtsp://192.168.14.10:554/by-n...
uTrack24 ch 9-16				rtsp://192.168.14.10:554/by-n...

SAP

Streamname ^	Origin	Multicast	R...
FocusriteRedNetA16R : 32	192.168.5.22	239.67.31...	
Hapi_90105_2	192.168.9.1	239.67.9.1...	
Hapi_90105_3	192.168.9.1	239.67.9.1...	
MNA_Montone_Demo_1	192.168.10.50	239.67.10...	
NTP-Penta-720 : 32	192.168.7.11	239.67.253...	
uNet Mini 1 ch 1-2	192.168.15.11	239.67.15...	
uNet Mini 2 ch 1-2	192.168.15.12	239.67.15...	
uNet Standard ch 1-8 from andrew	192.168.15.10	239.67.15...	
uNet Standard ch 9-16	192.168.15.10	239.67.15...	
uTrack24 ch 1-8	192.168.14.10	239.67.14...	
uTrack24 ch 17-24	192.168.14.10	239.67.14...	
uTrack24 ch 9-16	192.168.14.10	239.67.14...	
Y001-Yamaha-QL1-06e5cc : 29	192.168.12.12	239.67.64...	
Y001-Yamaha-QL1-06e5cc : 31	192.168.12.12	239.67.127...	
Y001-Yamaha-QL1-06e5cc : 32	192.168.12.12	239.67.1.1...	

LOCAL

Streamname ^	Multicast	Sou...	R...	SAP

```

13.09.2016 08:53:34,441 Received SAP announce for: Y001-Yamaha-QL1-06e5cc : 32
13.09.2016 08:53:34,501 Received SAP announce for: uNet Standard ch 9-16
13.09.2016 08:53:35,334 Received SAP announce for: uTrack24 ch 9-16
13.09.2016 08:53:36,502 Received SAP announce for: uNet Standard ch 1-8 from andrew
13.09.2016 08:53:37,842 Received SAP announce for: uNet Mini 2 ch 1-2
13.09.2016 08:53:38,333 Received SAP announce for: uTrack24 ch 17-24
13.09.2016 08:53:38,335 Received SAP announce for: uTrack24 ch 1-8
13.09.2016 08:53:38,367 Received SAP announce for: uNet Mini 1 ch 1-2
13.09.2016 08:53:38,501 Received SAP announce for: uNet Standard ch 9-16
13.09.2016 08:53:39,334 Received SAP announce for: uTrack24 ch 9-16
13.09.2016 08:53:40,501 Received SAP announce for: uNet Standard ch 1-8 from andrew
  
```


RAVENNA
 AES67 built-in

 The RAVENNA-2-SAP Converter
 is freeware developed by
 to help connecting AES67


Agenda:

	<u>Topic</u>
15 min.	Panel Introduction
	AES67 & SMPTE ST 2110 – current status
60 min.	How to implement AES67 & SMPTE ST 2110: Different approaches & available building blocks
15 min.	Panel discussion Q&A

Questions?



More answers...



RAVENNA / AES67 OEM Solutions:

<https://www.ravenna-network.com/adopting-ravenna/oem-solutions/>

RAVENNA / AES67 / SMPTE ST 2110 Resources:

www.ravenna-network.com/resources

You've made it!



Contact information:

Andreas Hildebrand
ALC NetworX GmbH

ravenna@alcnetworx.de



CELEBRATING 10 YEARS
RAVENNA
AES67 & ST 2110 built-in

www.ravenna-network.com