AOIP-HYDRA2 INTERFACING USER GUIDE V1.0

AoIP-Hydra2 Interface Unit

CALREC

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AoIP–HYDRA2 Interfacing

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AoIP–HYDRA2 Interfacing

INFORMATION

CALREC

INFORMATION

Should you require any technical assistance with your Calrec product please contact your regional Calrec distributor. Customers within the UK or Ireland should contact Calrec directly.

For a complete list of worldwide distributors by region, go to www.calrec.com or contact us for more information.

Our UK customer support team works closely with our global distributor network to provide the highest level of after sales support. Your distributor should be your first point of contact and will often be able to provide an instant solution, be it technical advice, spares or a site visit by an engineer.

Product Warranty

A full list of our conditions and warranties relating to goods services is contained in Calrec's standard terms and conditions. A copy of this is available on request.

Repairs

If you need to return goods to Calrec for whatever reason, please contact your regional distributor, or Calrec customer support beforehand for guidance, as well as to log the details of the problem and receive a reference number.

Telephone: (9:00am-5.30pm)	+44 (0) 1422 842159
Email - Technical:	support@calrec.com
Email - General:	enquiries@calrec.com
Postal Address:	Calrec Audio Ltd. Nutclough Mill, Hebden Bridge, West Yorkshire, HX7 8EZ, UK
Fax:	+44 (0) 1422 842159
Website:	www.calrec.com

For customers outside the UK and Ireland, shipping via the distributor saves customers from dealing with exportation paperwork. If there is a need to send direct to Calrec, contact us beforehand to log the incoming repair and for assistance with exportation documents.

Standard of Service

Ensuring the highest standards is a priority, if you have any comments on the level of service, product quality or documentation offered to you by Calrec, please contact the Calrec Customer Support team in the UK who will endeavour to address your issues. Calrec welcomes all customer feedback.

For feedback specific to this document, please contact enquiries@calrec.com.

Whenever you contact Calrec Customer Support please have the following information to hand:

- Name.
- Company.
- Email Address.
- Full details of enquiry (e.g. fault report).
- Serial number of faulty hardware (if applicable).

Once this information has been provided, a service ticket will be created to log your enquiry. The service ticket reference number will be given via email.

Serial Numbers

All units produced by Calrec are given a serial number and are booked into a central record system at the time of manufacture. These records are updated whenever a piece of hardware is dispatched to or received from a customer.

When contacting Calrec Customer Support with a hardware inquiry it is important that the correct Calrec serial number is provided to enable the customer support team to provide a high level of service. AoIP serial numbers can be found on the label on the lid of the chassis as shown below.

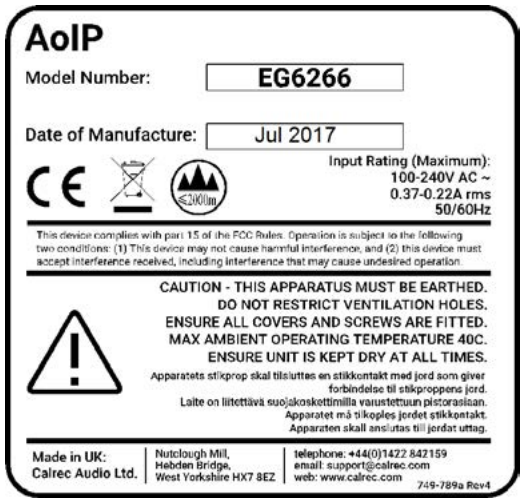
After Sales Modifications

Please be aware that any modifications other than those made or approved by Calrec Audio Limited or their agents, may invalidate the console's warranty. This includes changes to cabling provided by Calrec and variations to the recommended installation as detailed in Calrec documentation.

Modifications to this equipment by any party other than Calrec Audio Limited may invalidate EMC and safety features designed into the equipment. Calrec Audio Limited can not be liable for any legal proceedings or problems that may arise relating to such modifications.

If in doubt, please contact Calrec Audio Limited for guidance prior to commencing any modification work.

EXAMPLE OF LABEL ON LID OF CHASSIS SHOWING MODEL NUMBER



Installation
In many installations the AC power connectors will not be readily accessible, effectively making the equipment permanently connected. The installation should be carried out in accordance with all applicable installation rules and regulations.

Service Personnel
The AC power disconnect devices are the 2 x IEC (IEC60320-1 C13/C14) couplers located at the rear of each unit. WARNING: The apparatus has a dual power system. It is essential that BOTH AC power IEC couplers are disconnected to prevent exposure to hazardous voltage within the unit.

Third Party Equipment
Integrating third party equipment into a Calrec system may compromise the product's ability to comply with the radiated emission limits set in the latest EMC (Electro Magnetic Compatibility) standard.

Calrec Audio Limited can not be responsible for any nonconformance due to use of third party equipment. If in doubt, please contact Calrec Audio Limited for guidance prior to integrating any third party equipment.

ESD (Static) Handling Procedures
In its completed form, this equipment has been designed to have a high level of immunity to static discharges. However, when handling individual boards and modules, many highly static sensitive parts are exposed. In order to protect these devices from damage and to protect your warranty, please observe static handling procedures, for example, use an appropriately grounded anti-static wrist band.

All modules and cards should be returned to Calrec Audio Limited in anti-static wrapping. Calrec Audio Limited can supply anti-static wrapping upon request.

This applies particularly to digital products due to the types of devices and very small geometries used in their fabrication, analogue parts can, however, still be affected.

RoHS Legislation
In order to comply with European RoHS (Reduction of Hazardous Substances) legislation, Calrec PCB and cable assemblies are produced with lead-free (tin/copper/silver) solder instead of tin/lead solder.

In the unlikely event of a customer having to carry out any re-soldering on any Apollo, Artemis, Summa, Brio 36, RP1 or Hydra2 hardware, it is imperative that lead-free solder is used; contaminating lead-free solder with leaded solder is likely to have an adverse effect on the long-term reliability of the product. Circuit boards assembled with lead-free solder can be identified (in accordance with IPC/JEDEC standards) by a small oval logo (see below) on the top-side of the circuit board near the PCB reference number (8xx-xxx). The same logo is used on the connector hoods of soldered cable assemblies.

If in doubt, please check with a Calrec customer support engineer before carrying out any form of re-soldering.

ISO 9001 and RAB Registered
Calrec Audio Ltd has been issued the ISO9001: 2008 standard by the Governing Board of ISOQAR.

The award, for both UKAS and RAB registration (see below), is the most comprehensive of the ISO9000 international standards. Granted in recognition of excellence across design, development, manufacture and after-sales support, the certification follows a rigorous and thorough review of Calrec's internal and external communication and business procedures.

UKAS AND ANAB REGISTRATION

LEAD FREE

LEAD FREE STICKER

HEALTH AND SAFETY

Important Safety Instructions:

- Read these instructions.
- Keep these instructions.
- Heed all warnings.
- Follow all instructions.
- Do not use this apparatus near water.
- Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
- Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
- Protect the power cord from being walked on or pinched particularly at the plugs, convenience receptacles, and the point where they exit from the apparatus.
- Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/ apparatus combination to avoid injury from tip-over.
- Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operator normally, or has been dropped.
- Warning: To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.
- Not intended for outdoor use.
- This equipment must be EARTHED.
- Before starting any servicing operation, equipment must be isolated from the AC power supply. The disconnect devices are the 2 x IEC connectors (IEC 60320-1 C13/C14 couplers).
- Do not allow ventilation slots to be blocked.
- Do not leave the equipment powered up with the dust cover fitted.

Cleaning

For cleaning the front panel of the equipment we recommend using a soft anti-static cloth, lightly dampened with water if required.

Explanation of Warning Symbols

Triangular warning symbols contain a black symbol on a yellow background, surrounded by a black border.

The lightning flash with arrow head symbol within an equilateral triangle, as shown on this page, is intended to alert the user to the presence of dangerous voltages and energy levels within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock or injury.

The exclamation mark within an equilateral triangle, as shown on this page, is intended to prompt the user to refer to important operating or maintenance instructions in the documentation supplied with the product.

Earthing

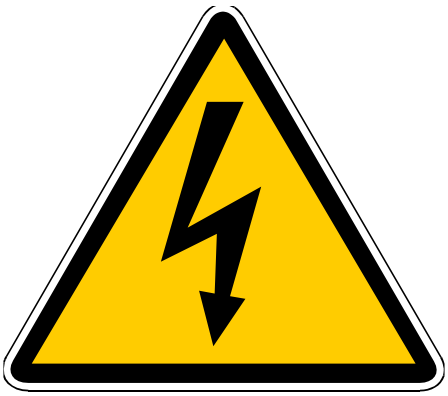
This is a Class I product. An Earth connection MUST be provided in each AC power cord.

Caution: Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type. Batteries must not be exposed to excessive heat such as sunshine, fire or the like

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

DANGEROUS VOLTAGES



IMPORTANT INSTRUCTIONS

Other Symbols in Use

For apparatus intended to be used at altitude not exceeding 2000m, a warning label containing the following symbol shown below shall fixed to the equipment at readily visible place.

ALTITUDE WARNING SYMBOL

PACKAGE CONTENTS

There are a number of options when ordering an AoIP Unit: Connectivity type and I/O options.
Every system includes the 1U unit which contains the processing core. Small format pluggable transceivers (SFPs) are required for Hydra2 I/O box connections with the built-in Hydra 2 interface and for the AoIP connections to the IP network. The unit can be supplied with either 1 or 2 Coveloz IP interface devices. The following table shows the AoIP unit options:

	1U AoIP unit
AoIP Unit EG6266	Power, Router & Control Processor are all self contained within the unit which has 2 x IEC connectors to provide PSU redundancy. The unit currently operates at 48kHz and supports: Up to 512 Hydra2 Audio Inputs and 512 Hydra2 Audio Outputs with Primary and Secondary Connections for audio redundancy.
Cabling	One Y-Split IEC cable for supplying power to the unit.
	I/O packs
I/O Devices US6297	The AoIP unit can be supplied with either one or two Coveloz IP interface BACH-AES67 devices. A single Coveloz interface BACH-AES67 device supports: Up to 32 Streams of 8 channels in either direction (256 channels) using the AES67 format to allow bi-directional audio streaming over an IP network. This is converted into Hydra2 data format for use with the Calrec Console Range, where the user can interface the AoIP streams to any of the Hydra2 inputs and outputs, via a stream manger Web Application. When 2 Coveloz devices are fitted, the unit provides 512 channels of audio over two sets of IP connections. These provide Primary and Secondary IP connections for network redundancy, if required.
	SFP Packs
SFPs	One of the following options may be selected: LX SFP Pack; SX SFP Pack; Bi-Directional SFP Pack; Copper SFP Pack. Note that the SFP's for the IP side should be matched to the Network Switch it is to be connected to.
LX SFP Pack	4 x Single Mode SFPs
SX SFP Pack	4 x Multimode SFPs
Bi-Directional SFP Pack	2 x Bi-Directional SFPs (type A) and two Bi-Directional SFPs (type B)
Copper SFP Pack	4 x copper SFPs

ABOUT THIS GUIDE

The purpose of this guide is to walk through the two processes of:-

1. Patching console or other Hydra2 outputs into the unit, converting them into AES67 format IP streams for transmission to an IP service.

2. Receiving AES67 format IP streams into the unit from an IP service and converting them back into Hydra2 signals ready to be patched as inputs to the Calrec Console Range .

The guide is arranged in a number of sections:-

Introduction
This section is effectively an introduction to AoIP / AES67.

Installation
This section is an installation guide showing how the AoIP unit is to be connected up and the function of each of its connectors.

Hydra2 patching
This section is a configuration guide showing how the unit is patched to/from the Hydra2 Network. Using I/O Patching on the various consoles.

Setting Up Stream Management
This section covers how to connect into the AoIP unit from a PC.

Stream Management
This section covers how the Hydra2 inputs and outputs are connected to the IP source and destination streams and cover the use of the Coveloz Web UI for managing the streams in detail.

Glossary of Terminology
This section covers the various acronyms and terminology used in the AES67 / IP environments.

AoIP–HYDRA2 Interfacing

INTRODUCTION

CALREC

AOIP / AES67

An Overview of IP
IP technology is changing the broadcast industry in a revolutionary way, sweeping aside 80-year-old cable-based connections in favour of packet-switched workflows. It is transforming how audio, video and control data is encoded, transported and managed. The impact on the design of broadcast equipment is profound.

In the short term, broadcasters will need to replace existing analogue, AES3, MADI and SDI ports, with a new class of interface that enable them to connect to standard IT switch infrastructure, and adopt new control mechanisms for connection management and device discovery.

As this happens, the traditional distinction between audio, video and data transports will disappear, being replaced with a single agnostic, scalable network.

Gradually, old video and audio cabling will be replaced by fibres carrying IP traffic, and conventional audio and video routing equipment will be replaced by standard IT switches.

In the medium term, broadcasters' ambitions will extend beyond merely replicating existing working practices, as confidence and competence grows, and workflows will evolve to take advantage of the greater flexibility and geographical freedom now available to them.

In the longer term, the broadcast industry will further borrow from the IT industry by shifting away from bespoke hardware towards software processing running on commodity computing platforms. While not all broadcast processes will fit this model, many will, and in doing so, offer benefits in scalability and economy.

As the shift to IP infrastructure continues we will be encouraged to drop our conventional signal-based approach in favour of a services model, where content, both live and stored, may be discovered and accessed by anyone in possession of access rights and an appropriate IP connection, regardless of location.

Central to the use of off-the-shelf IT components is conformance to a set of standards which, together, define IP networking. This includes protocols such as RTP, IGMP and PTP, all of which are used in audio and video over IP streaming, but would be familiar to IT specialists outside the broadcast industry.

Equally important are the open standards, specific to broadcasters, which define precisely how media are encoded and packetised, in order to stream in real-time. These open standards ensure different vendor's equipment interoperate reliably.

Equipment Requirements
To meet a broad range of needs, manufacturers have to create interfaces that conform to a variety of open standards (AES67, Ravenna, TR03, TR04, SMPTE2022, and maybe more), and provide elegant solutions for controlling and managing services, flows, sync, control data, monitoring, troubleshooting, SDN (Software-Defined Networking for over-riding the default packet-forwarding behaviour of an IP switch), based on another set of open standards.

There are huge opportunities for forward-thinking broadcasters and technology manufacturers alike, who are prepared to embrace and engage with the changes in equipment requirements.

Calrec provides a variety of networking interfaces, including this AoIP unit which is an AES67 based interface, and a modular I/O Dante card that also has AES67 compatibility.

AES67
Development of AES67 began in 2010 and it was published in 2013. AES67 does not describe a full protocol, rather it defines a set of 'ground rules' that make interoperation between equipment from third parties possible.

It is based on the common ground between a number of established IP-based audio networking systems including Ravenna, Livewire, Q-Lan and Wheatnet It is the closest thing the broadcast industry has to a common networking solution, and led to the formation in 2014 of the Media Networking Alliance (MNA).

The MNA consists of a host of like-minded technology companies – including Calrec to promote AES67 as the common interchange of digital media between different IP networking platforms.

The AES67-2015 standard defines an interoperability mode for transport of high-performance audio over networks based on the Internet Protocol. For the purposes of the standard, high-performance audio refers to audio with full bandwidth and low noise. These requirements imply linear PCM coding with a sampling frequency of 44.1 kHz and higher and resolution of 16 bits and higher. The Calrec AoIP unit described in this guide is based on a 48kHz and 24bit system using the AES67-L24 data format codec.

The words 'High performance' in the standard also implies a low-latency capability compatible with live sound applications and as such the standard considers low latency to be 10ms or less.

One of the most important aspects of AoIP is the ability for network participants to share an accurate common clock, which distinguishes high-performance media streaming from its lower-performance brethren such as Internet radio and IP telephony.

Using a common clock, receivers placed anywhere on the network can synchronize their playback with one another.

A common clock allows for a fixed and determinable latency between sender and receiver. A common clock also assures that all streams are sampled and presented at exactly the same rate. Streams running at the same rate may be readily combined in receivers.

This property is critical for efficient implementation of networked audio devices such as digital mixing consoles.

For further information on AES67 the reader should look at the AES67-2015 standard available from the AES.

AES67 continues to evolve - the Video Services Forum's set of technical recommendations (TR-03 and TR-04) covering the transport of media content in elementary essence flows, specifies AES67 as the transport protocol for elementary audio streams.

Controlling Media Streams

While there has been some industry success in agreeing a common transport mechanism for IP audio, there has been less success in agreeing how IP streams can be managed.

To fully realise the benefits of IP it must be possible for a device (or end point) to join a network, and discover for itself all the streams (or services) available on the network. It must do this in order to allow a human operator to see the available streams and to make choices about which to connect.

Firstly, this process requires that devices participate in an agreed 'discovery' scheme.

Secondly, as the list of connected devices changes, the discovery mechanism must allow for dynamic tracking of available streams.

Thirdly, once a stream has been discovered, detailed information must be provided by the transmitting device giving details of exactly how to listen to, and decode, that particular stream. These details are known as a session description, and include sample rate, encoding mechanism, sample depth, number of channels and multicast IP.

A popular service discovery mechanism, originally developed by Apple Corp, is Bonjour, with other mechanisms including SAP and SIP.

For a network of devices to work together it is necessary for them all to support a common discovery mechanism.

Unfortunately, the AES67 standard does not mandate the use of a particular discovery mechanism. This is because each have their own strengths and weaknesses, and the authors of AES67 felt that manufacturers ought to have the freedom to choose a mechanism that best matches particular application. While this position is supportable, its unfortunate consequence is that products with non-matching discovery mechanisms will not be able to inter-operate. In other words, they will remain unaware of each other's presence on the network.

Other Notable Interface standards

RAVENNA: officially launched in 2010 by ALC Networx it is very similar to AES67, but while the fundamental mechanisms and protocols for sync, transport and payload formats of AES67 are identical to RAVENNA's operating principles, AES67 calls for SIP connection management for Unicast stream operation. SIP is not specified for RAVENNA as RAVENNA uses RTSP/SDP for connection management.

Dante: developed in 2006 by Audinate and is the most established of these protocols. The biggest difference between Dante and both AES67 and Ravenna is that Dante is proprietary, rather than an open standard. Despite this, many technology companies – including Calrec – work with Audinate to provide compatible equipment.

AVB: different to AES67, Ravenna and Dante, using etherframes rather than IP packets to transport data, which means that AVB is not an AoIP protocol. Unlike AoIP protocols, AVB networks cannot extend across routers or bridges. In other words, they are geographically limited to LAN segments. A further limitation is that AVB networks require AVB-enabled switches and hubs.

Elemental Streaming-The Future

As the broadcast industry continues to embrace IP we can expect single network infrastructures to be used to convey video, audio, sync and control data, as well as providing conventional network services such as file transfers, telephony, email and internet access.

It will no longer be necessary to combine media streams into a single transport as with SDI. It will be more convenient to stream the elements of a programme individually, removing an encoding and decoding stage entirely. The video, audio and data components of a programme may be logically linked, at a control level, while remaining separate at a transport level. This means that a device that is only interested in the audio portion of a programme need only receive the audio stream, and can ignore the video portion of the programme.

This approach is called elemental streaming.

There are several approaches to elemental streaming, including IP Live (devised by Sony), ASPEN (based on MPEG-TS), and TR03 and TR04, from the Video Services Forum (VSF). Of these, TR03 looks likely to become the most widespread.

The broadcast industry has learned its lesson from the chaotic development of audio networking, where multiple proprietary technologies hindered the development of a standards-based approach. Its approach to the development of elemental streaming is far more structured. A joint taskforce, JT-NM, was set up to research broadcast industry requirements of IP networking.

JT-NM developed a reference architecture which offered a technology-agnostic model to meet these requirements, identify candidate technologies and encourage industry organisations to codify the standards on which the next generation of products will be built.

AoIP–HYDRA2 Interfacing

INSTALLATION

CALREC

CONNECTIONS & INDICATORS

The Calrec Audio over IP unit provides a Hydra2 - AoIP interface carrying up to 512 x 512 channels using AES67/Ravenna and or AVB devices.

The unit can accommodate two devices AoIP 1 & AoIP 2 and may be fitted with 256 x 256 channel AES67/Ravenna or AVB devices, or 1 of each as required.

In addition to the standard Hydra2 redundancy each device also has both a primary and secondary 1Gbps IP connection, supporting hitless switching for redundancy. IP Stream management is achieved through a WEB UI.

Enclosure
The AoIP interface unit is 440mm wide x 225mm deep x 44mm (<1U) high.

Cooling
The unit has a single low noise fan. Air is drawn in from the right and extracted from the rear left, please allow at least 25mm (1') clearance at the right and rear of the unit for operation up to 40 deg C (104 deg F) ambient temperature.

Power
The AoIP unit contains dual AC mains PSUs for redundancy that can be fed 100-240V AC via rear mounted IEC connectors. The IEC connectors have a retaining clip that can hold some types of IEC cables in place. The cable supplied with the unit should be clipped in place.

Hydra2 network connections
A pair of rear mounted SFP slots provide primary and secondary connections back to routers in a Hydra2 network.

IP network connections
Primary and secondary SFP slots are also provided for the 2 x AoIP ports and indicators are provided on the rear to show which devices have been fitted to the unit. See "Small Form-Factor Pluggable (SFP) Overview" on page 20

The AoIP unit which is classed as a fixed format I/O must be given a Hydra2 I/O Box ID which is unique on the network, before being connected. The ID is a value from 1 to 256, set as a binary representation using DIP switches accessible from the rear. See "Hydra2 I/O Box IDs" on page 18

Other connections
The AES sync O/P on the rear of the unit provides a PTP clock reference derived from the Internet stream. *Note: this sync O/P is not yet enabled as of 01/08/17.* **Synchronisation can be taken from the output of the PTP clock from the Grandmaster clock source.**

The System OK LED strobes every second to indicate that the system is actively talking to the AoIP devices and the Hydra 2 interface, or every 100ms if the Hydra 2 interface is not active. The AES67 or AVB indicators next to each AoIP port on the rear illuminate to show the presence and type of device fitted.

Config Port
A Cat 5e connector on the front of the unit is used for setup via a WEB UI.

Front Panel Reset & Status LEDs
A recessed reset button allows the user to reset the system. A red Fan Fail led illuminates if the fan stops spinning. Next to this are the 2 PSU leds which illuminate green to show they are ON.

The Hydra2, AoIP 1 & AoIP 2 primary and secondary interface LEDs illuminate to show they are connected.

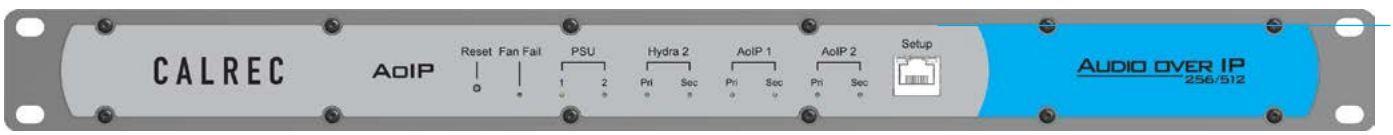
STATUS LEDS

AES67/AVB	Lights to show devices are installed.
System OK	Flashes heartbeat every second when connected and running. Fast flashing indicates no comms with Hydra 2.
Fan Fail	Lights Red to show fan not spinning.
PSU 1 & 2	Light solid green when PSU working.
Hydra2 Pri & Sec	Light solid green when valid connections made to Hydra2 SFP ports.
AoIP 1 & 2 Pri & Sec	Lights solid green when valid connections made to AoIP1 & 2 SFP ports.

SPECIFICATION

Height	< 1U - 44mm (1.73')
Width	19" Rackmount (483mm)
Depth	225mm (8.9') inc BNC
Weight	3.13kg (6.9lbs)
AC input power	100-240V AC, 50/60Hz, 0.35-0.18A RMS, Supply current - 0.18A @ 240V, 0.30A @ 115V, 0.35A @ 100V
Power Dissipation (Heat)	26.0W @ 100-240V AC
Operating ambient air temperature	0-40 C

AOIP FRONT VIEW



AOIP REAR VIEW

CONNECTING AOIP TO THE OUTSIDE WORLD

There are 2 stages to connect up the AoIP Hydra Interface unit:-
1. Connection to Hydra2.
2. Connection to the IP Network

The image to the right shows the AoIP unit connections (primary connections only being shown for simplicity).

In order for the AoIP unit to send and receive audio data to the Hydra2 network it needs to be connected into a router card, a Hydra2 HUB or a Hydra2 module. This connection is managed using the normal patching screens of H2O and the console PC.

The IP network side of the unit, needs to be connected, typically into a managed network switch with PTPv2 capabilities or two switches for redundancy.

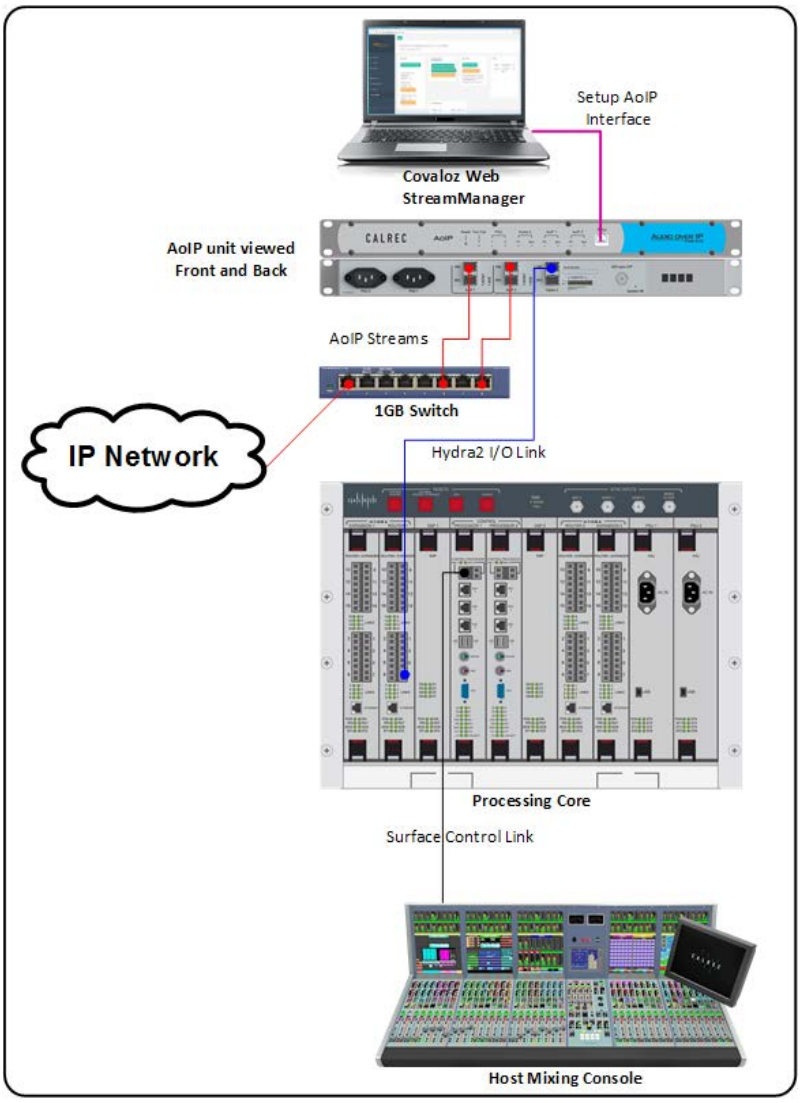
The configuration and connection of the patched Hydra2 ports to and from IP data streams is managed using the Coveloz web user interface which is detailed later on in this guide. See "AoIP Stream Manager" on page 38

IP Addresses of the AoIP Unit
The IP network side of the unit has a number of IP addresses associated with it. By default these IP addresses are as shown below.

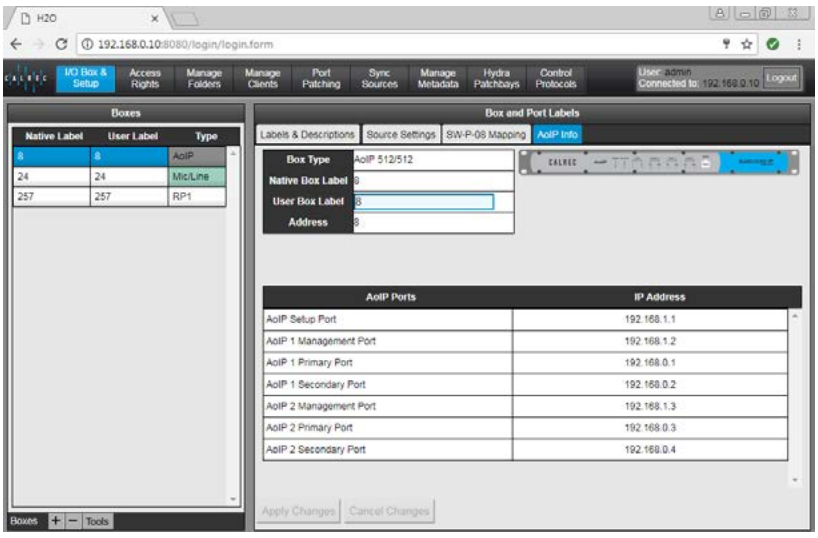
AoIP Setup Port (On Front)	192.168.1.1
AoIP 1 Management Port	192.168.1.2
AoIP 1 Primary AoIP Port	192.168.0.1
AoIP 1 Secondary AoIP Port	192.168.0.2
AoIP 2 Management Port	192.168.1.3
AoIP 2 Primary AoIP Port	192.168.0.3
AoIP 2 Secondary AoIP Port	192.168.0.4

Note that providing the AoIP unit is added to H2O, its current IP addresses are shown in H2O on the I/O Box & Setup tab. The user selects the AoIP box from the left hand side 'Boxes' area and selects the AoIP Info tab which appears in the right hand 'Box and Port Labels' area. See the image to the right for details.

AOIP UNIT CONNECTIONS TO HYDRA AND THE IP NETWORK (PRIMARY PATHS)



AOIP UNIT IP ADDRESS INFORMATION SHOWN IN H2O



HYDRA2 I/O BOX IDs

Hydra2 I/O boxes with valid Hydra IDs (HIDs), are automatically detected and added to the Hydra database when first plugged in to the network. This database entry will remain until it is manually deleted via the network management organiser, H2O. This removes it from H2O, and prevents system status errors on the master router. From a core point of view, you just need to remove it from the required I/O list.

It is important that careful consideration is given to HID settings prior to connecting any I/O boxes to the network, especially if future networking of standalone systems is a possibility.

As an example, consider two Calrec systems, each with several I/O boxes with HIDs starting at '1' and set in ascending numerical order. If you later decide to network these two systems together you will have multiple I/O boxes with the same HIDs on the network.

In this scenario when a show or memory containing patches is loaded, there is no way of controlling which patches will be made to which I/O box. Instead we recommend using a separate numbering range for each standalone system so no conflicts can arise in the future.

ID configurations
For RP1's and Brio 36's expansion slots, these appear in the I/O box list with a RP1 or Brio core icon and its I/O box ID is set automatically based on the System ID to ensure it will not conflict with other I/O on the network. This expansion I/O appears like a Modular I/O box as described in the previous section and its 'box'/port labels can be edited from H2O.

For Hydra2 boxes each I/O box in a system needs to be given a unique Hydra ID (HID), set using switches accessible from the rear of a fixed format box, or on the side of the controller card within a Modular I/O box.

I/O box IDs are pre-set to '0' at the Calrec factory to effectively set the boxes into an 'off' state to avoid issues in the event of multiple boxes being placed on the network with the same HID.

Before connecting each I/O box to the network ensure you set a unique HID by following the instructions on the following pages.

Note, some customers may find that their I/O boxes have been pre-configured with unique HIDs at the Calrec factory, prior to dispatch.

Changing an I/O Box's HID
If you have already connected and powered up an I/O box and then wish to change its HID you will need to follow these steps:

1. Power off the I/O box.
2. Change the HID to a new, unique value by following the instructions on the following pages.
3. Remove the I/O box from the core's required list.
4. Remove the I/O box from Hydra database in H2O on the I/O box and Port Labels tab.
5. Remove shows/memories/patches which reference the I/O box.
6. Once the reset has completed, power up the I/O box.

If you plan to reuse the original HID it is important that you follow these steps including removing patches (or entire show/memories) which patch to the original I/O box, otherwise these patches may be made to the 'new' I/O box next time the show/memory containing the patch is loaded.

Duplicate HIDs
What happens if you connect two I/O boxes with the same HID to a console?

Firstly, the system will be unpredictable in terms of its use of the ports across the two boxes. A patch to output port 1 could pick either box's output port to patch to, and each time the patch is made, either port may be chosen.

Secondly, there will be confusion between different I/O types. For example, in the scenario above one I/O box may be analogue and the other digital.

Spare/Replacement I/O Boxes
Replacement I/O boxes of equivalent type should be set with the same IDs as the units they are replacing to allow them to function as drop-in replacements with existing user memories, requiring no further configuration.

Care should be taken when setting HIDs to avoid accidentally duplicating the same HID on more than one box.

Do not add extra I/O to the system unless you are confident it will not cause a conflict on the network.

SETTING HYDRA2 IDs FOR FIXED FORMAT I/O

The 8-way switch on the rear of all fixed format I/O boxes is set as an 8-bit binary representation of the HID value with the left hand switch used for the most significant bit, and the right hand switch for the least significant bit. A switch in the down/off position represents a binary 0 and a switch set in the up/on position represents a binary 1.

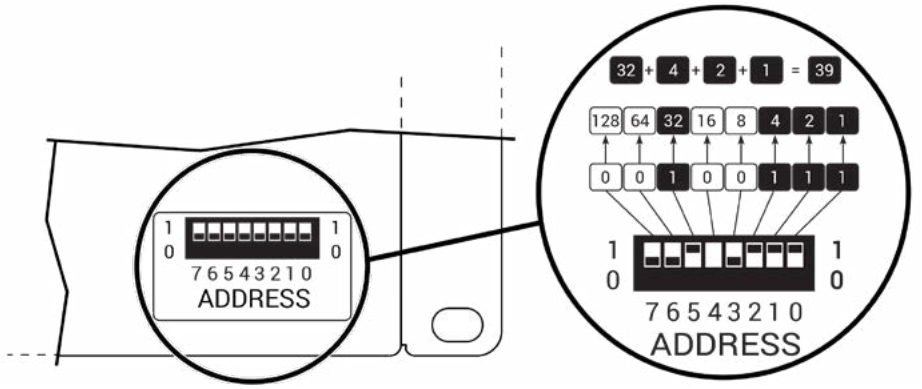
Each switch/binary-bit equates to a decimal value, starting at 1, for the least significant bit.

The remaining switches are double the value of their less significant neighbour, making the 8th/most significant bit equate to a decimal value of 128.

All fixed format I/O box ID switches are orientated the same way, though some boxes, such as MADI units, use a different style switch with more pronounced labelling.

Ignore any labels on the switch itself and always refer to the Calrec labelling on the surrounding panel which will show the most significant bit switch on the left and the binary 1 position as up.

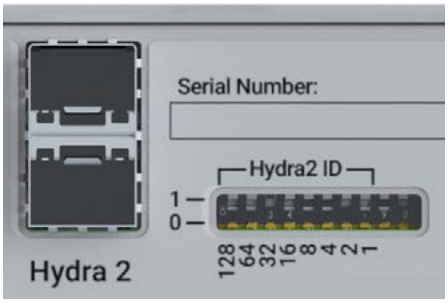
SETTING THE HID ON A FIXED FORMAT I/O BOX



AoIP Box ID Switch setting

The Hydra2 ID switch on the AoIP unit is located on the back of the unit, next to the Hydra2 Primary and Secondary SFP connectors as shown right. Note that the 2 switches on the right are unused.

HYDRA2 ID SWITCH LOCATION



Address 2

Some I/O boxes, such as MADI units, are fitted with 2 banks of DIP switches Address 1 and Address 2 to provide a 16 bit ID and therefore a greater range of values.

Please note that only ID values between 0 and 255 are currently supported. Any switches labelled Address 2 should be set to the all off '0' position.

SMALL FORM-FACTOR PLUGGABLE (SFP) OVERVIEW

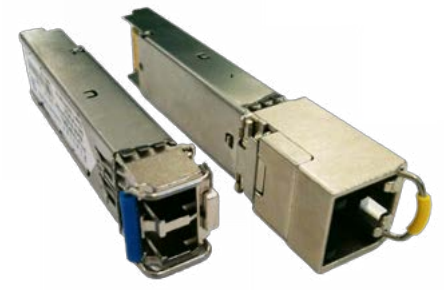
Connections between the AoIP unit and all Hydra2 network connections between I/O boxes are all made via SFP modules.

SFPs can be provided for RJ45 copper connections, as well as singlemode or multimode fibre on LC connectors. This allows for each port's connection type to be chosen to suit cable-run distances and the existing infrastructure. SFPs can be changed easily on a port by port basis, as and when required.

If Calrec are supplying SFPs for your installation, the correct quantity of SFPs are supplied pre-fitted. The type of each connection copper, singlemode fibre or multimode fibre should be specified at the time of order to ensure the correct SFP types are supplied. Additional SFP modules can be ordered if required.

If a system is to be connected to an existing Hydra2 network, please discuss this with your Calrec project leader, sales person or local distributor to ensure that SFPs are provided and ports provisioned for the additional router to router connections.

SFP MODULES



- Both SFP types above have a handle latching mechanism, shown in the locked position. The unit on the left is a singlemode duplex LC fibre module. The unit on the right is a copper RJ45 module type which must support LOS detection.

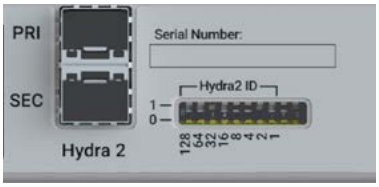
SFP Slot Orientation

SFP modules plug into rear panel slots on AoIP & other Fixed Format I/O boxes, and into front panel slots on router and Modular I/O controller cards.

The modules can be fitted or removed whilst the system is powered up and without removing or opening any card or box casings.

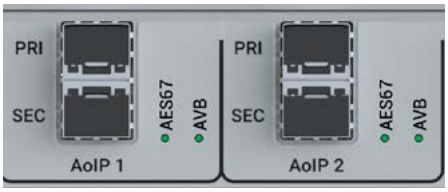
Note the orientation of the SFP modules as shown in the illustrations on this page.

HYDRA2 SFP CONNECTIONS



- AoIP SFP slots for Hydra2 interfaces on rear shown without SFPs fitted.

AOIP SFP CONNECTIONS

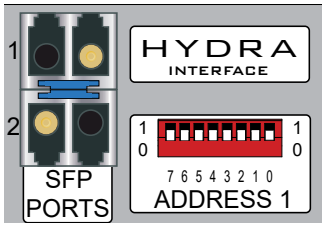


- AoIP SFP slots for AES67 interfaces on rear shown without SFPs fitted.

SFP modules fitted in AoIP units are arranged so that the primary SFP module is orientated with the RJ45 connector catch and the Fibre LC connect key at the top.

The secondary SFP module is mounted the opposite way around so that the RJ45 connector catch and the Fibre LC connect key are at the bottom.

FIXED FORMAT I/O BOX SFPS



- I/O box shown with singlemode fibre SFPs (button release) fitted.

For Fixed Format I/O boxes, the modules are orientated so that the release catch for the RJ45/LC connector plugs, once inserted, are on the outside edge.

MODULAR I/O BOX SFP CONNECTIONS

- Modular I/O controller card SFPs are both orientated the same way around with the RJ45 connector catch and the Fibre LC connect key on the right. (Button release singlemode fibre SFPs shown).

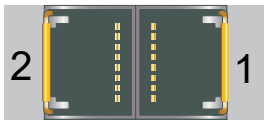
For Modular I/O box controller cards, both SFP slots are orientated so that the release catch on the cable/fibre connector is on the right-hand side.

SFP Latching and Extraction
Calrec source SFP modules from various manufacturers. All types used conform to the same specification, however the latching mechanisms can vary slightly.

The standard copper SFP and some fibre SFPs, as shown in the photograph on the previous page, have latch/extraction handles. On insertion, the handles should be set against the outer edge (the same side as the release catch on the RJ45/ LC connector plug that fits into the SFP) to lock it into place and prevent accidental removal if cables are pulled.

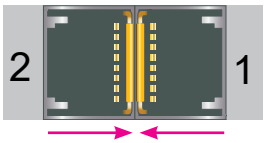
To remove this style of SFP, remove the cable/fibre and slide the handle (copper) or lift the handle out (fibre) to the inside edge, as shown in the diagram to the right. The module can then be removed by pulling on the handle.

SFP WITH HANDLES - LATCHED



- Both RJ45 SFPs shown are locked in place - latch / extraction handles in outer position (or 'down' position for fibre).

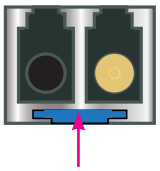
SFP WITH HANDLES - UNLATCHED



- Both RJ45 SFPs free to remove - latch / extraction handles in inner (or 'lifted' for fibre) position.

Other SFPs automatically latch into place when they are inserted fully and they have a release button on their inside edge. The fibre SFPs shown in the orientation diagrams and on this page are of this type and have blue release buttons. To remove, depress the button using a small flat blade, screwdriver or similar tool. The SFP module will then be free to be removed.

AUTO-LATCHING SFP CONNECTORS



- For Fibre SFPs depress the release button to remove.

SFP Slot Covers
Dust covers should be fitted to all SFP slots that do not have SFP modules fitted in them in order to maintain connection reliability.

Loose SFP Storage
SFP modules are small, yet reasonably expensive devices. When removing or changing SFPs, take care to keep track of them and store loose modules in a clean, dry, and anti-static environment. Fibre SFPs should always have a dust cover fitted into their optical transceiver end when no fibre is connected to them.

Calrec will not be liable for lost or missing SFP modules, or damage due to poor storage. SFP design varies depending on the manufacturer, please ensure that SFPs are correctly latched in place after fitting them. In the event that a connection is not automatically established after hot-plugging an SFP, please reset the unit the SFP is plugged in to.

COPPER SFP CONNECTIVITY

Hydra2 network connections can be made via copper SFP modules. Copper connections require shielded F/UTP Category 5e or Category 6 cables with shielded RJ45 mating connectors. Core connections should only be made using optical/fibre SFP modules.

It is important to note that Copper SFPs must support LOS (Loss of Signal) detection - these are not standard for copper SFPs, but are commonly available, Calrec supplied copper SFPs do support LOS.

Calrec do not supply copper cables as it is often preferable to terminate them after they have been run through cable ducting to avoid damaging the terminations, and to be able to cut them to the precise length required.

Shielded Cables and Connectors

Shielded cabling and connectors are required in order to meet EMC (electro-magnetic compatibility) standards to comply with the radiated emission limits set in the EN55022 standard, as well as to guarantee performance in electrically noisy environments.

F/UTP Cat5e/Cat6 cable has an overall foil shield around the conductor cores. Shielded RJ45 connector plugs have a metallic shield around them which should be clamped/bonded to the shield within the cable. The connector shield connects with the chassis of the RJ45 socket that it is plugged into, providing an earth to the cable shield.

SHIELDED RJ45 CONNECTOR

Conductive connector mating screen clamped / bonded to cable shield

The method of attaching the connector shield to the cable shield can vary. Please refer to the connector manufacturer's information for further guidance.

Maximum Cable Length

The maximum length of Cat5e/Cat6 cables is 90 m/295 ft. This is the absolute maximum and needs to include any patch points and cables that may be in the path. Hydra2 cable runs can NOT be extended using Ethernet switches, hubs or repeaters. If a run between Hydra2 hardware exceeds the maximum recommended distance for copper cabling, fibre and optical SFPs should be used instead.

Cable Routing Considerations

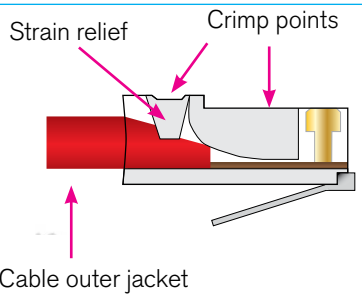
The layout and twist rate of the data cores within Cat5e/Cat6 cables are integral to their performance at high speed over distance. Poor practise during installation can seriously impact upon this. The following are general rules of good practise but please refer to the cable manufacturer's information for comprehensive installation rules:

- When running Cat5e/Cat6 network cabling, it is important to avoid kinking the cable. Kinks can seriously impair performance. Cable manufacturers advise that kinked cables should be discarded and replaced as the damage caused cannot be addressed simply by straightening them out.
- Cables should not be bent in tight angles, this too can seriously impair performance. Please refer to the cable manufacturer's specification on minimum bend radii.
- Excessive pulling force when routing cables can deform the twist rate of the cable cores, causing irreparable damage. Cable manufacturers specify a maximum pulling tension.
- Cable ties should not be over-tightened as this deforms the internal structure of the cable.
- Cable ties should be tight enough to support the cable weight but not so tight as to cause any visible deformation to the cable's outer jacket. Large, heavy bundles of cables can be difficult to support using cable ties without causing damage. 'Velcro' style hook-and-loop cable straps can be a good alternative to plastic cable ties.
- Whilst neatly bundled parallel cable runs are tidy and aesthetically pleasing, they can increase cross-talk, which can impact on performance. Avoid neat bundling of network cables over any kind of distance the majority of a cable length is normally unseen, running under floor or through ducting where they should be loosely laid rather than neatly bundled.

Termination - Strain Relief

Poor termination and lack of strain relief is one of the most common causes of high speed network cable problems. To properly relieve strain on the data cores, the outer jacket of the cable should be inserted into the RJ45 housing and held in place once crimped at the strain-relief point, as shown in the diagram above. This also maintains the integrity of the twist rate and shield into the termination, ensuring the full length of the cable conforms to its specification. Slide on outer boots offer additional strain-relief protection but are not sufficient on their own.

STRAIN RELIEVED RJ45 TERMINATION



- Note, this is a simplified diagram that does not include the shield.

In order to be able to crimp the cable jacket inside the RJ45 and land the data cores on the terminals, the amount that the jacket is stripped back in relation to the cores needs to be accurate. Cables with exposed data cores should not be used as they will be unreliable.

Termination - Pin-Out

Hydra2 network cables use the standard gigabit Ethernet pin-out. Performance relies on the positive and negative leg of each signal pair using cores that are twisted together. Calrec recommends that 'straight-through' or 'pin-for-pin' cables are used. 'Cross-over' style cables can be used, however they must be gigabit standard cross-over. Older pin-outs, designed for use with slower Ethernet standards only use two of the four pairs, even though all four pairs are terminated. Cross-over variants of this style only cross the pairs that are used (A & B). Gigabit cross-over cables require that the blue (C) pair is crossed with the brown (D) pair as well as the orange (A) pair being crossed with the blue (B) pair.

Testing/certification

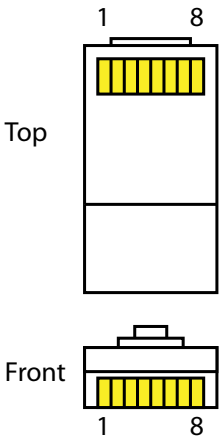
Calrec strongly recommend that all Hydra2 network cabling is properly tested or certified prior to on-site commissioning of the system. Simple test devices that only check the pin-out of the terminations are not sufficient to prove the performance and reliability of high speed data cabling. Certification level test equipment can give a simple pass/fail response but in doing so will test various important factors as well as pin-out. Certification type tests include determining cable length, measuring skew (timing differences between pairings due to variations in length caused by intentional differences in twist rate), measuring for loss, signal to noise ratio and BERT error checking on data.

Cables that fail certification tests or fail to perform, may appear to function fine in other applications, such as a PC LAN connection where errors leading to retries and therefore delays are acceptable and often unnoticed.

Temporary / Reusable Cables

Cabling that is not part of a permanent infrastructure, such as temporary runs used for outside broadcasts, should be carefully coiled and uncoiled to avoid kinking and they should be regularly tested. Cables showing any sign of damage should be replaced.

RJ45 PIN NUMBERING



STANDARD HYDRA2 RJ45 PIN-OUT

Pin	Colour	Signal
1	Orange-White	A+
2	Orange	A -
3	Green-White	B+
4	Blue	C+
5	Blue-White	C -
6	Green	B -
7	Brown-White	D+
8	Brown	D -

- For standard wiring, both ends of the cable should be terminated as above

FIBRE SFP CONNECTIVITY

Optical SFP modules for fibre connectivity can be used for console to processing core, router to router, and router to I/O connections.

Fibre connectivity is required when the cable run between units exceeds the 90 m maximum permissible length for Cat5e/ Cat6 copper cabling. Fibre can also be used for shorter runs if it is simply the preferred medium.

Note, this section only concerns fibre connections made via SFPs. Like all I/O boxes, MADI units have pluggable SFPs for their Hydra2 connections to routers, but they may also have fibre connectors that pass the actual MADI audio format in and out of the system. The MADI I/O format fibre connectors are of a fixed type such as FDDI. Various MADI I/O boxes are available to provide different types of MADI fibre interface. Please refer to the Hydra2 installation manual for more details on MADI I/O options.

Singlemode vs Multimode

The core within multimode fibre is relatively thick when compared to singlemode. Light travels through multimode fibre at multiple angles, 'bouncing' off the sides of the core as it travels, taking multiple paths or 'modes' of varying length from one end to the other, resulting in pulses being lengthened as they travel. Singlemode fibre has a very fine core and light travels in a single, direct path from one end to the other without affecting pulse length. The result is that singlemode fibre has a higher bandwidth capacity and, importantly, low signal loss allowing much greater distances to be achieved. Light can be transmitted into multimode fibre using LEDs or low powered lasers whilst singlemode requires a higher powered laser.

Calrec recommend the use of singlemode fibre whenever possible in order to maximise the flexibility in the location of hardware and maintain uniformity across the system by using a single type. If a multimode infrastructure is in place, fibre length, the number of inter-connects and equipment location become more important.

SFP modules are available for both singlemode and multimode fibre types. It is important to select the correct SFP for the type of fibre being used in the installation. If using a mixture of singlemode and multimode fibre, it is important to ensure the correct SFPs are matched to the correct fibre type.

Identification

The release button/handles of fibre SFPs are colour coded - blue for singlemode, black for multimode. Blue LC connectors, as shown here, should be used to terminate singlemode fibre and beige coloured connectors for multimode.

Duplex Connectors / Terminations

Standard Calrec fibre SFPs, both multimode and singlemode, use duplex LC connectors.

The duplex termination requires two fibres per connection, one is a send path, the other is a receive path. When terminating the fibre, the send from one end should connect to the receive of the other and therefore they 'cross-over', terminated A to B and B to A.

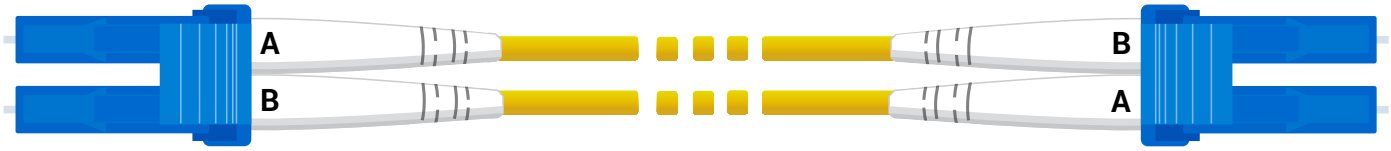
Single Strand, Bi-Directional SFPs

To reduce the amount of fibre, Calrec can supply singlemode SFPs that send and receive over a single, or simplex LC connector. In order to be able to pass data in both directions over a single strand, the light travelling in one direction needs to be of a different wavelength to the light travelling in the other direction. Therefore, bi-directional SFPs come as either type A or type B (as indicated by an A or B at the end of the model number) and they need to be paired up; a fibre should connect between a type A and a type B, and not between two Bi-Directional SFPs of the same type/ wavelength. The units are colour coded to aid identification between A types & B types.

SFP Fibre Specifications

Specifications are shown in the table to the right. The maximum distances shown here assume a single point-to-point connection with no intermediary interconnections. Losses should be measured across the total signal path including interconnects between points of SFP transceiver connection. Losses need to be less than the optical power budget of the SFP transceivers being used.

DUPLEX LC FIBRES CORRECTLY TERMINATED A TO B & B TO A



BI-DIRECTIONAL LC FIBRE CORRECTLY CONNECTED, TYPE A TO TYPE B

SFP/FIBRE SPECIFICATIONS

SFP Type	Connector	Power Budget	Fibre Type	Max Distance
SX Multimode	LC Duplex	7.5 dB	62.5/125 µm	275 m
			50/125 µm	550 m
LX Singlemode	LC Duplex	8 dB	8/125 µm	10 km
LX Singlemode bi-dir	LC Simplex	11.5 dB	9/125 µm	10 km
LH Singlemode	LC Duplex	23 dB	8/125 µm	70 km

POWER SUPPLY UNITS

The AoIP unit contains two power supply units which are supplied with AC power by two independent male IEC inlets. These dual power supplies provide full power redundancy, a feature of all Calrec products.

Although AoIP will run with only one PSU powered on, it is recommended that, to ensure power redundancy, these two IEC inlets should be supplied by separate AC power supplies.

A PSU failure or a loss of AC power input will generate a system status error message.

The two PSUs employ load sharing, if one PSU fails, the other will automatically take over the full load with no loss of audio or operation.

Disconnecting the PSUs
AoIP does not contain a separate mains power switch. To safely disconnect the mains power both IEC connectors need to be removed from the rear of the console, as shown below.

Power Distribution
The power supply modules both connect to the internal JG6265 main board providing 5v DC to AoIP's internal components.

AOIP REAR VIEW SHOWING PSU MAINS CONNECTIONS

AoIP–HYDRA2 Interfacing

HYDRA2 PATCHING

CALREC

AOIP – HYDRA2 PATCHING ON APOLLO / ARTEMIS

The main application >I/O>I/O Patch screen is used to route Hydra2 audio input & output ports for general use on Apollo and Artemis Consoles

This screen works on a source to destination basis, with the left hand side of the screen displaying a table of sources, and the right hand side displaying a table of destinations. See above right. All patches made from the I/O screen are saved as part of the user memory.

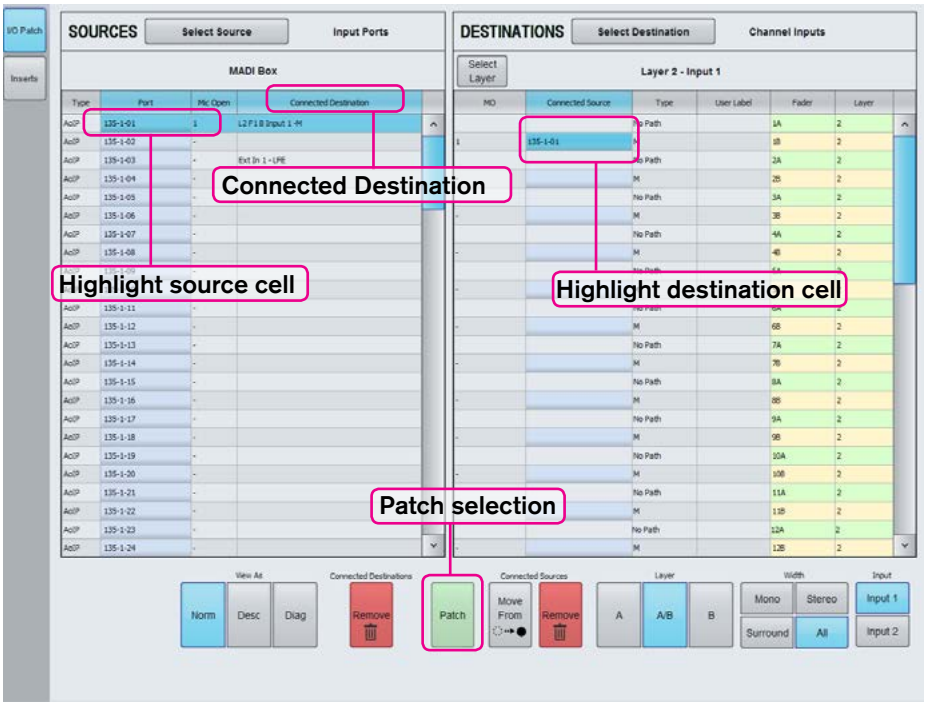
Patch AoIP Ports to Desk Inputs
Patching is carried out by highlighting the required light blue 'Port' cell in SOURCES, and highlighting the desired light blue fader cell in DESTINATIONS then pressing 'Patch'. The AoIP inputs are shown as 2 sets of 256 ports identified by the Hydra2 Box ID followed by the Device number followed by the Port number.

In the example shown to the right the AoIP port is identified as '135-1-01' which is the first port on the first AoIP device in an AoIP box with an ID of 135.

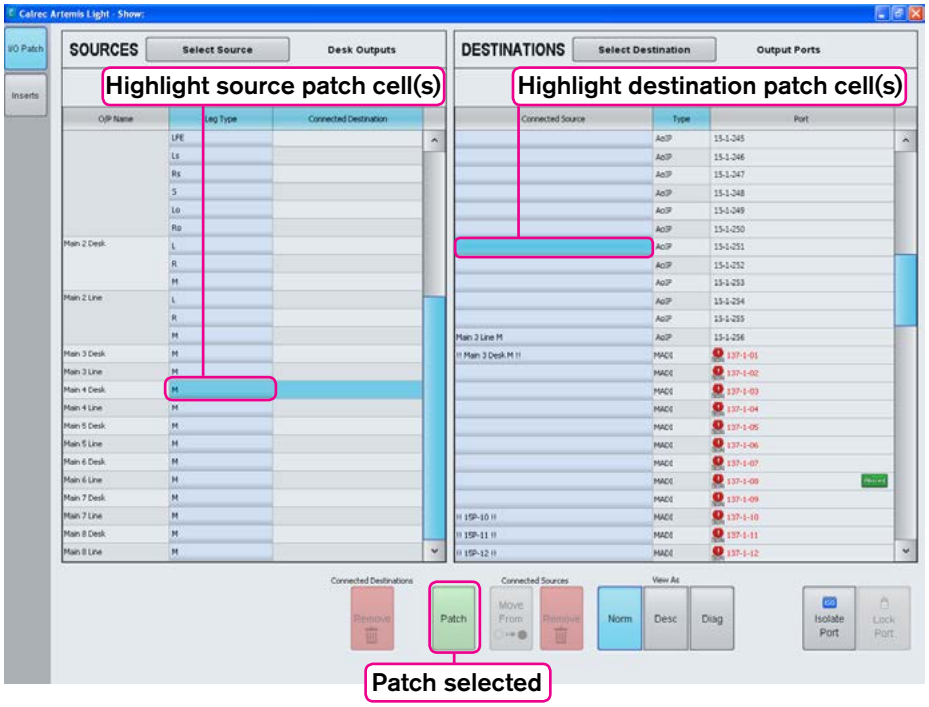
Patch Desk Outputs to AoIP Ports
Output patching is performed in exactly the same way as input patching, using the I/O screens in the main application. Patching is carried out by highlighting the required light blue Main Output Bus cell in SOURCES, and highlighting the desired light blue 'Port' cell in DESTINATIONS then pressing 'Patch'. The AoIP outputs are shown as 2 sets of 256 ports identified by the Hydra2 Box ID followed by the Device number followed by the Port number.

In the example shown to the right the AoIP port is identified as '15-1-251' which is the 251st port on the first AoIP device in an AoIP box with an ID of 15.

PATCHING AOIP - HYDRA2 PORTS TO INPUT CHANNEL PATHS ON FADERS



PATCHING MAIN OUTPUT BUSES TO AOIP - HYDRA2 PORTS



AOIP – HYDRA2 PATCHING ON SUMMA

Summa desk inputs and outputs can be patched to physical I/O box ports or virtual Hydra patchbay ports, or to each other. To enter the I/O patching screen, tap 'I/O patching' in the Show menu.

Patches are made between sources and destinations.

- A source can be an I/O box input port, a Hydra patchbay output, or a desk output from the local Summa console.
- A destination can be an I/O box output port, a Hydra patchbay input, or a desk input from the local Summa console.

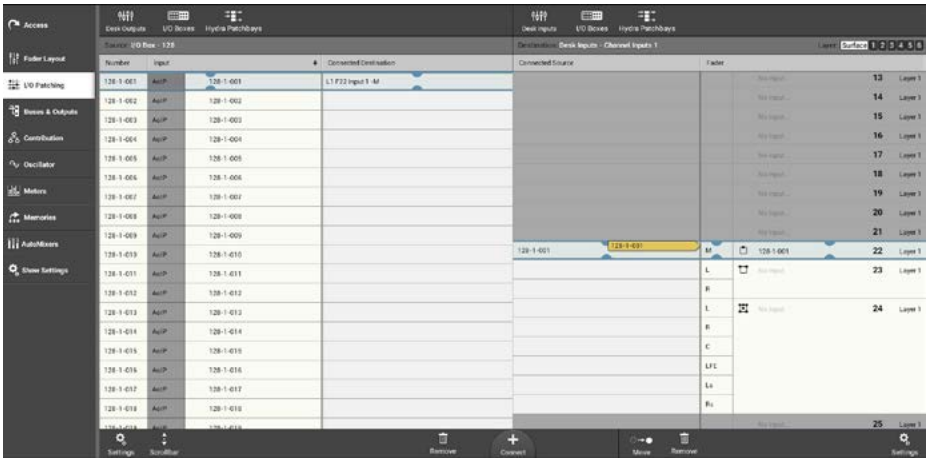
Each source can be patched to multiple destinations but a destination can only have one source.

The I/O Patching Window
The I/O patching window is split into two halves. Sources are displayed on the left and destinations on the right. Each side has a series of buttons running along the top for you to select which source/ destination type you wish to access.

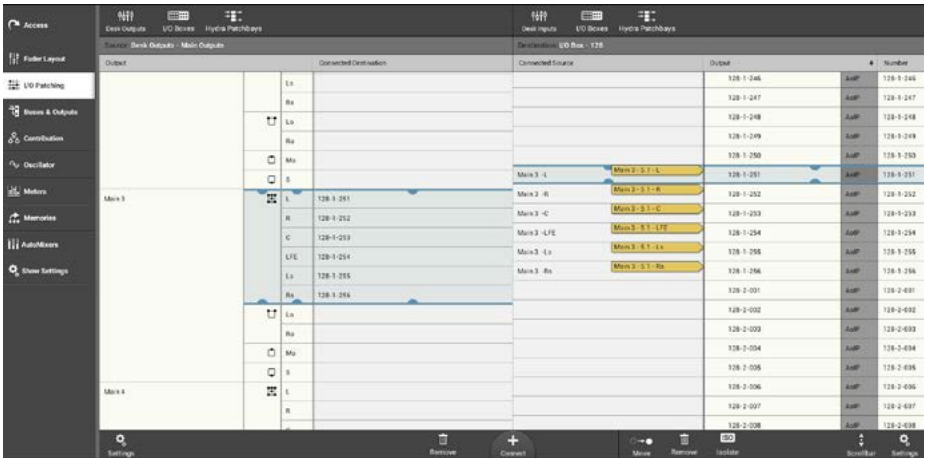
Selecting Sources and Destinations
Tap a source or destination selection button and a pop-up reveals all available options of that type, either as a set of buttons, or, in the case of I/O boxes, within a sortable table. The image above right shows desk input patching from AoIP ports. The image below right shows the desk output patching to AoIP ports. Tapping to select one of these options, i.e. 'Aux Outputs', populates the source/ destination window with the associated ports.

Note that for Summa, Brio and RP1 as can be seen from the patching process images. The Hydra2 patching process is very similar across the Console Range however each consoles input and output patching screens have been shown for completeness.

PATCHING AOIP - HYDRA2 PORTS TO INPUT CHANNEL PATHS ON FADERS



PATCHING MAIN OUTPUT BUSES TO AOIP - HYDRA2 PORTS



AOIP – HYDRA2 PATCHING ON BRIO36

Brio 36 desk inputs and outputs can be patched to physical I/O ports or virtual Hydra patchbay ports, or to each other. To enter the I/O patching screen, tap 'I/O patching' in the Show menu.

Patches are made between sources and destinations.

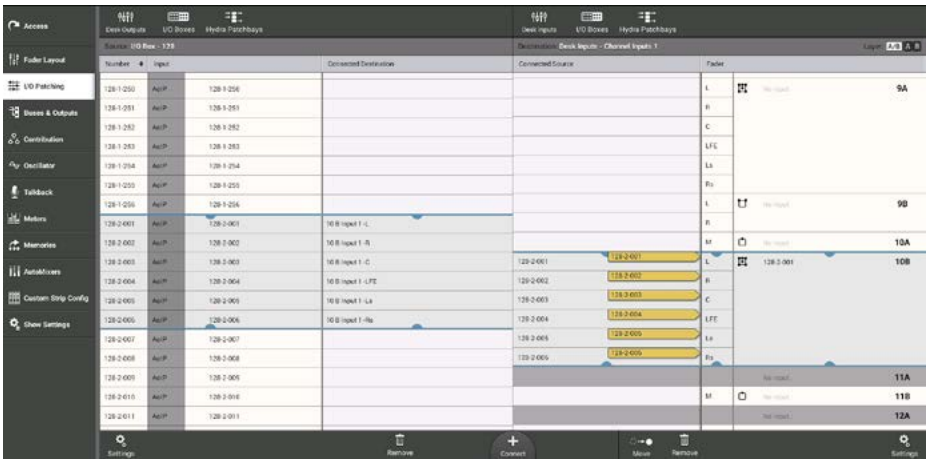
- A source can be an I/O box input port, Hydra patchbay output, or console DSP output from the local Brio console.
- A destination can be an I/O output port, Hydra patchbay input, or console DSP input from the local Brio console.

Each source can be patched to multiple destinations but a destination can only have one source.

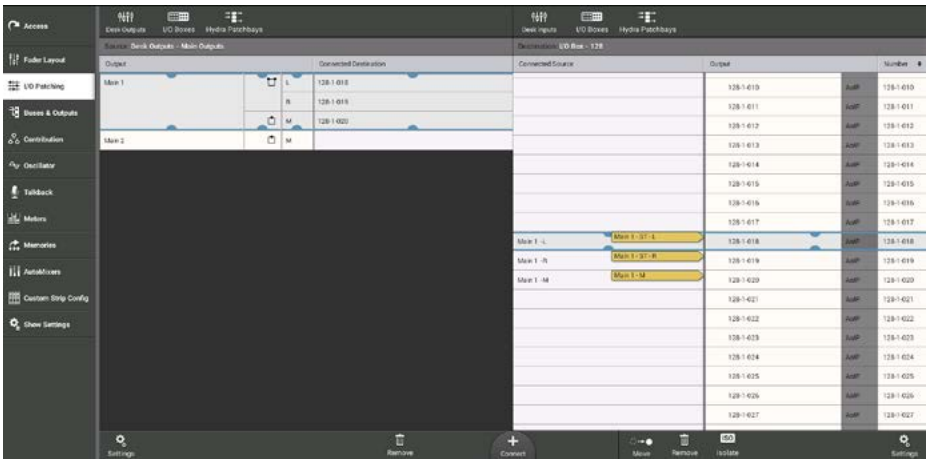
The I/O Patching Screen
The I/O patching screen is split into two halves, sources are displayed on the left and destinations on the right. Each side has a series of buttons running along the top for you to select which source/ destination type you wish to access.

Selecting Sources and Destinations
Tap a source or destination selection button and a pop-up reveals all available options of that type, either as a set of buttons, or, in the case of I/O boxes, within a sortable table. The image above right shows desk input patching from AoIP ports. The image below right shows the desk output patching to AoIP ports. Tapping to select one of these options, i.e. 'Aux Outputs', populates the source/ destination screen with the associated ports.

PATCHING AOIP - HYDRA2 PORTS TO INPUT CHANNEL PATHS ON FADERS



PATCHING MAIN OUTPUT BUSES TO AOIP - HYDRA2 PORTS



AOIP – HYDRA2 PATCHING ON RP1

RP1 inputs and outputs can be patched to physical I/O ports or virtual Hydra patchbay ports, or to each other. To enter the I/O patching screen, tap 'I/O patching' in the Active Show menu.

Patches are made between sources and destinations.

- A source can be an I/O input port, Hydra patchbay output, or console DSP output from the RP1 console.
- A destination can be an I/O output port, Hydra patchbay input, or console DSP input from the local Brio console.

Each source can be patched to multiple destinations but a destination can only have one source.

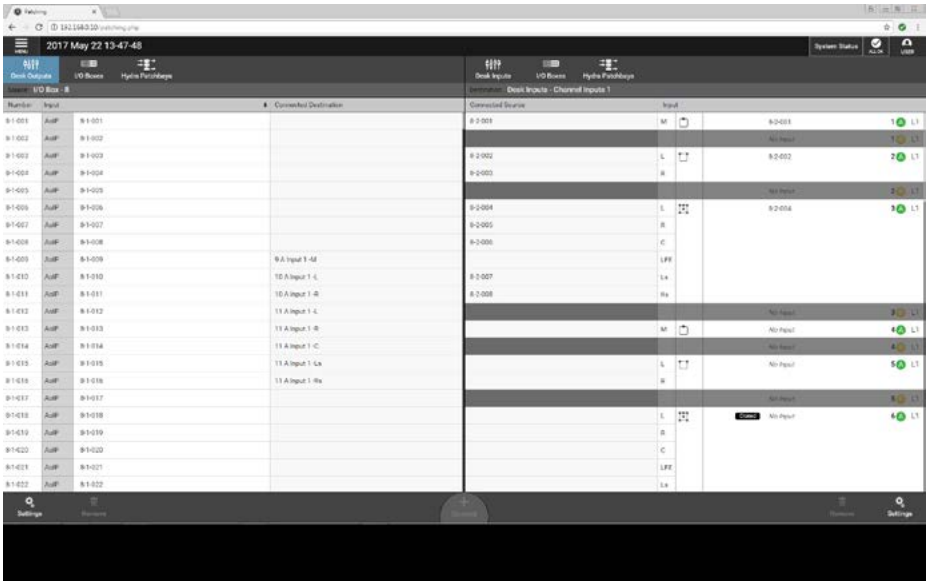
The I/O Patching Screen

The I/O patching screen is split into two halves, sources are displayed on the left and destinations on the right as shown above right. Each side has a series of buttons running along the top for the user to select which source/destination type they wish to access.

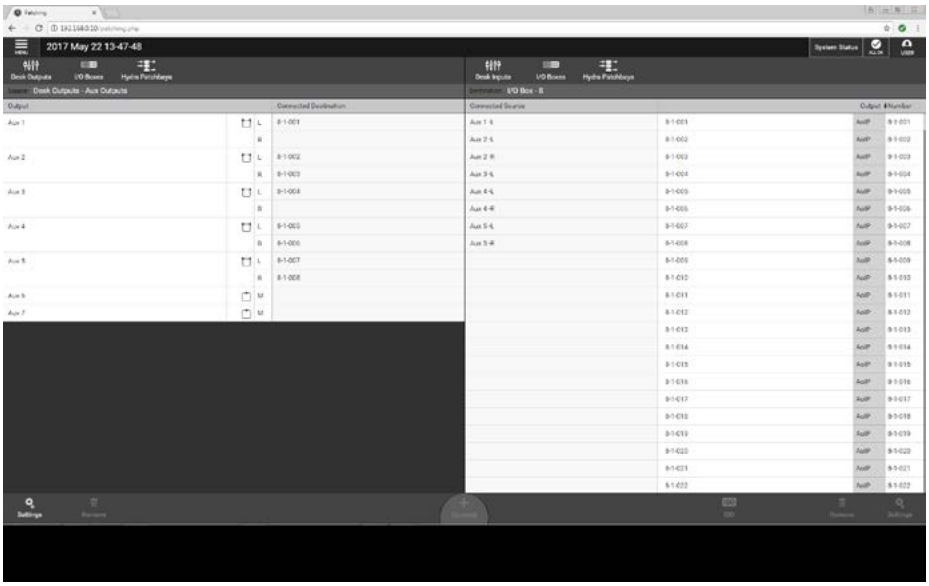
Selecting Sources and Destinations

Tap a source or destination selection button and a pop-up reveals all available options of that type, either as a set of buttons, or, in the case of I/O boxes, within a sortable table. The image above right shows desk input patching from AoIP ports. The image below right shows the desk output patching to AoIP ports. Clicking to select one of these options, i.e. 'Aux Outputs', populates the source/destination screen with the associated ports.

PATCHING AOIP - HYDRA2 PORTS TO INPUT CHANNEL PATHS ON FADERS



PATCHING AUX OUTPUT BUSES TO AOIP - HYDRA2 PORTS



AOIP – HYDRA2 – STREAM RELATIONSHIPS

Hydra2 and Stream Relationships
The 512 inputs and 512 outputs from/to the Hydra2 side of the AoIP unit, are rearranged into 2 sets of 256 TDM ports identified by the Hydra2 Box ID, followed by the device number followed by the port number.

So the format for the I/O Patching on the Hydra2 side is:-
XXX-Y-ZZZ where XXX is the Hydra2 Box ID (1-254), Y is either port set 1 or port set 2 depending on if its the first or second set of 256 ports and ZZZ is the port number (1-256).

So as an example:-**15-1-251** is port 251 on AoIP device 1 in an AoIP box with an ID of 15.

There is a one-to-one correlation between the Hydra2 side and the AoIP's AES67 Stream side in that Hydra2 port 1 appears as the channel 0 entry on the 1st AES67 stream, Hydra2 port 2 appears as the channel 1 entry on the 1st AES67 stream, Hydra2 port 9 appears as the channel 0 entry on the 2nd AES67 stream, etc.

Each of the two Coveloz devices in the AoIP unit, arranges the 256 ports from the Hydra2 side into 32 AES67 IP streams of 8 channels each.

These derived streams are identified by default as:- 'source'-IP address-stream number although they can be given a user name e.g **source-192.168.0.1-01**

When they are received the streams are patched to TDM ports which are defined as:-
TDM.0-I32S which contains the 1st streams 8 channels (Channel 0 - 7) , up to **TDM.31-I32S** which contains the 32nd streams 8 channels (Channel 0 - 7) for the set of 256 Hydra2 ports.

These streams are managed via the stream manager, which is effectively a crosspoint router sending AES67 Source streams which came from Hydra2 output ports and receiving other advertised network AES67 Source streams in and patching them to local TDM destinations, which become Hydra2 input ports.

The destination stream name is then made into a concatenation of source>destination which appears as:-
source-192.168.0.1-01->TDM.0-I32S

It should be noted that the patching of source streams to TDM destinations is on a one-to-one basis per stream and, although the streams can be expanded to display each channel, it is not possible to patch at the channel level.

If more complex patching arrangements that aren't a simple one to one patch arrangement at the channel level are required, they will need to be made on the Hydra2 patching pages..

AoIP–HYDRA2 Interfacing

SETTING UP STREAM MANAGEMENT

CALREC

CONNECTING A LAPTOP TO AOIP FOR SETUP

The Setup port on the front of the AoIP unit is intended to be used for setup purposes where a laptop or PC is connected as shown below right. Using the Coveloz UI Web browser, the user can setup AES67 streams to be passed to and from the IP network via the primary and secondary AoIP ports on the rear of the AoIP unit.

The laptop will need to have at least one ethernet port (or USB LAN connector) preferably 1Gbps which should be connected to the Setup port on the front of the unit.

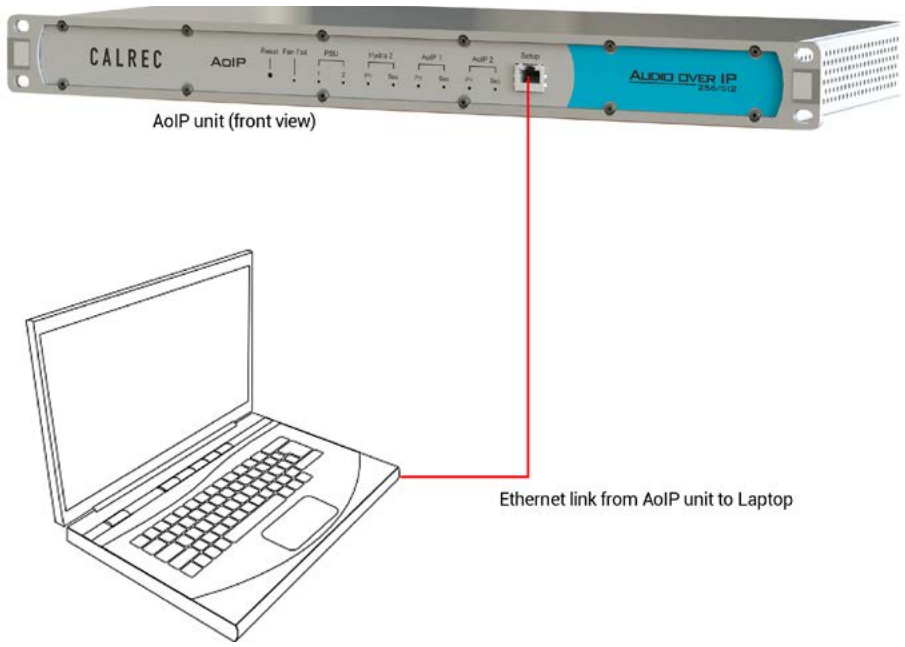
Note that the Default IP addresses for the Coveloz UI via the front Setup port is 192.168.1.2 for the first AES67 device and 192.168.1.3 for the second AES 67 device both sitting on the same subnet using a subnet mask of 255.255.255.0.

We would recommend that the user leaves these as the default addresses for setup so that unfamiliar users can always access the system as required.

Once the PC/Laptop is connected to the AoIP unit via a cat5e cable it will need to be configured to use a TCP/IPv4 address for its LAN connection. See "Configuring the Ethernet adapter in the PC/Laptop" on page 35.

SETUP PORT ON THE FRONT OF AOIP UNIT

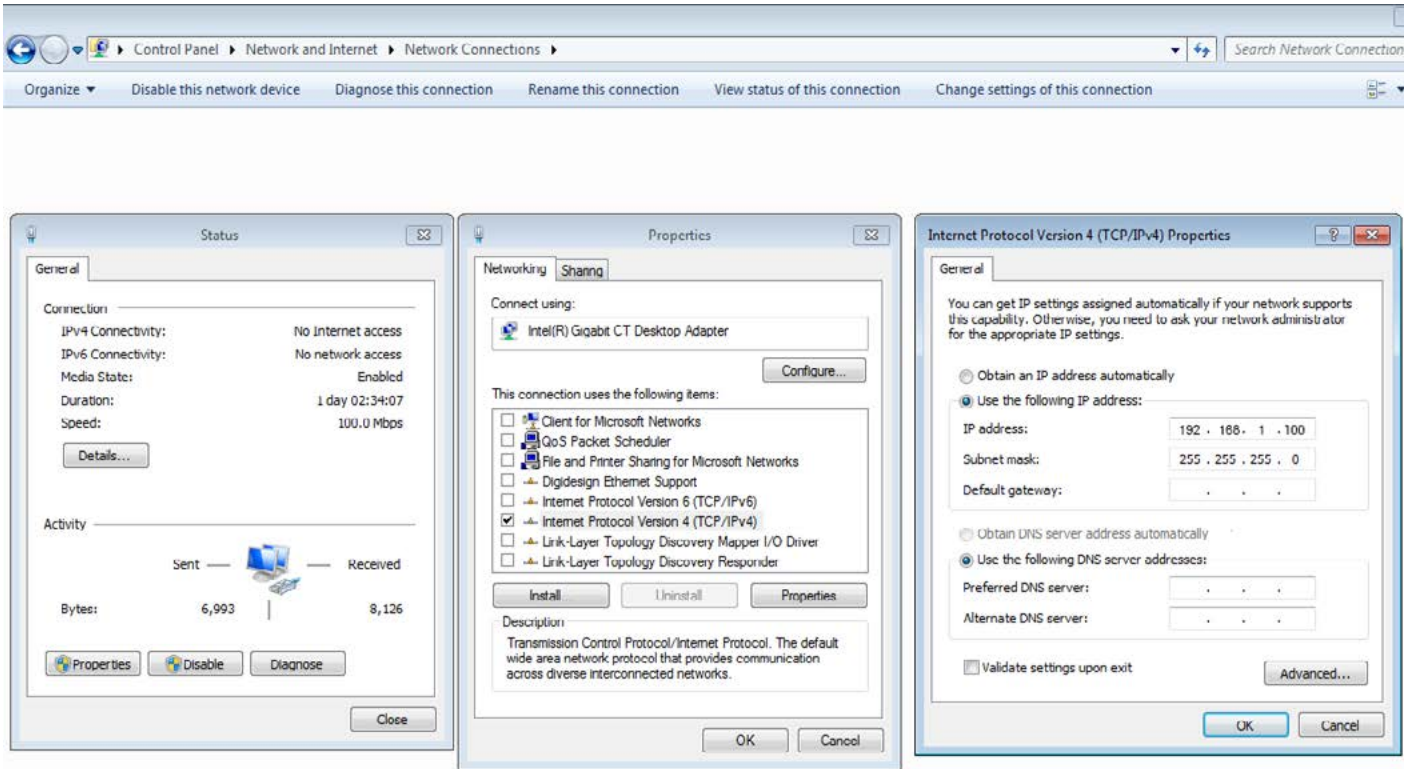
CONNECTING A LAPTOP DIRECTLY TO RP1



CONFIGURING THE ETHERNET ADAPTER IN THE PC/LAPTOP

Configuring Ethernet adapters

The Ethernet adapter card in the Laptop or PC need to be configured to the same Subnet to connect to the AoIP unit.



On the PC/Laptop go to Control Panel> Network and Sharing Center, click on the change adapter settings and click on the connection called CalrecDeskConnection. This opens the CalrecDeskConnection Status window (shown above left).

Clicking on the Properties button in that window accesses the Calrec DeskConnection Properties window (shown above middle). In this window only the Internet Protocol Version 4 (TCP/IPv4) box should be ticked all the rest should be unticked.

Clicking on this option to highlight it and then on the Properties button accesses the Internet Protocol Version 4 (TCP/IPv4) Properties window (shown above right).

Click on 'Use the following IP address:' radio button and enter the IP address of the system being connected to e.g. **192.168.1.100** The other field that needs configuring is the 'Subnet Mask' which should be set to **255.255.255.0** this completes the Ethernet adapter configuration.

The IP address entered should be compatible with the address of the setup port on the AoIP unit it is being connected to, for instance, entering an IP address of 192.168.1.100 with a subnet mask of 255.255.255.0 will allow the user to connect to the AoIP units by simply typing in the IP addresses of the AoIP management ports 192.168.1.2 for the AoIP1 management port and 192.168.1.3 for the AoIP2 management port into a web browser.

Currently we use Chrome for this purpose. Note, once the IP address is entered, the Coveloz UI home page for each device will be shown. See "Starting the Coveloz UI" on page 38

AoIP–HYDRA2 Interfacing

STREAM MANAGEMENT

CALREC

AOIP STREAM MANAGER

Starting the Coveloz UI
Once the IP address of the required Coveloz device, (in this example the first device in the unit) has been entered into the user's browser, the Stream Manager home page appears as shown above right.

The home page gives the user an overview of Source and Destination streams available to/from this device.

In the sources column is shown a list of all the streams that are available to this device with the status of the stream, if its enabled as a source and it's stream name which is used to identify itself to others in the network.

The first two streams in the list are shown as enabled, each of these streams represent a block of 8 audio channels.

Audio sources to streams
To show how this works in practice a mono, stereo and a 5.1 channel are configured and direct outputs from these channels are patched, into the first 9 AoIP outputs of the first device in the AoIP unit from 8-1-001 to 8-1-009, as shown in the image below right on a RP1 unit.

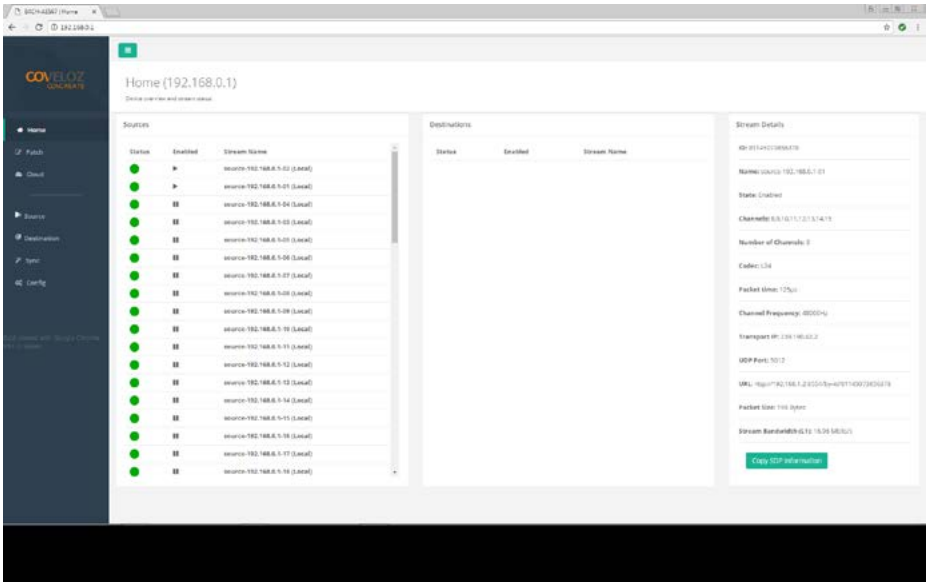
These appear as two source streams in the Coveloz Stream Manager:- 'source-192.168.0.1-01 (Local)' containing AoIP inputs 1-8 & AoIP input 9 appears on 'source-192.168.0.1-02 (Local)'.

These two streams have been turned 'On' as indicated by the play icon in the Coveloz UI making these 'talker' channels available to the IP network.

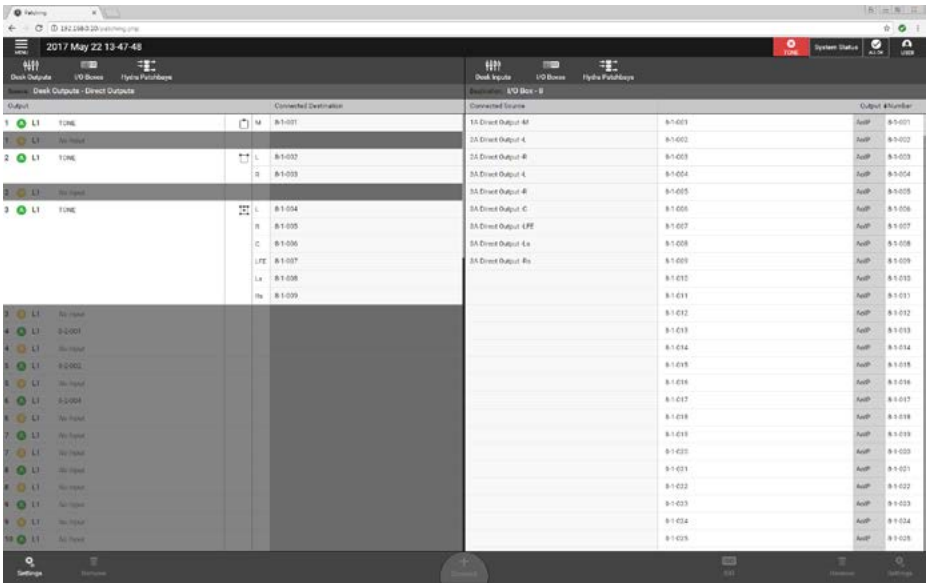
The destinations column shown in the middle column above right, will show any stream coming into the device when it is patched to a TDM I32S output, which in turn appears as input ports on the patching screen for the AoIP unit.

Note that for the first device there are no destinations shown as there are no sources coming into this box that have been attached to the TDM I32S 'listener' channels.

COVELOZ STREAM MANAGER HOME PAGE FOR FIRST DEVICE IN UNIT



RP1 PATCHING SCREEN SHOWING DIRECT OUTPUTS PATCHED TO AOIP 1



Source Stream Details
The third column on the Coveloz stream manager home page shows the details of each source or destination stream that the user selects. This stream detail is also known as Session Description Protocol (SDP) which is used to describe multimedia communication sessions for the purposes of session announcement, session invitation, and parameter negotiation. SDP does not deliver media itself but is used between end points for negotiation of media type, format, and all associated properties. The set of properties of properties and parameters are often called a session profile.

Receiving Streams
The Stream Manager home page for the second Coveloz device in the unit appears as shown above right.

In the sources column is shown a list of the 32 local stream sources from:- ‘source-192.168.0.3-01 (Local)’ up to ‘source-192.168.0.3-32 (Local)’ and following those are shown the incoming network streams from other sources which have been made available

In this case there are 2 other streams:- ‘source-192.168.0.1-01 (Advertised)’ and ‘source-192.168.0.1-02 (Advertised)’.

These can be seen at the bottom of the sources column where the two streams from the first device in this AoIP unit as described on the previous page make an appearance.

The destinations column shown in the middle column above right, shows the two streams have been attached to TDM.0-I32S and TDM.1-I32S respectively.

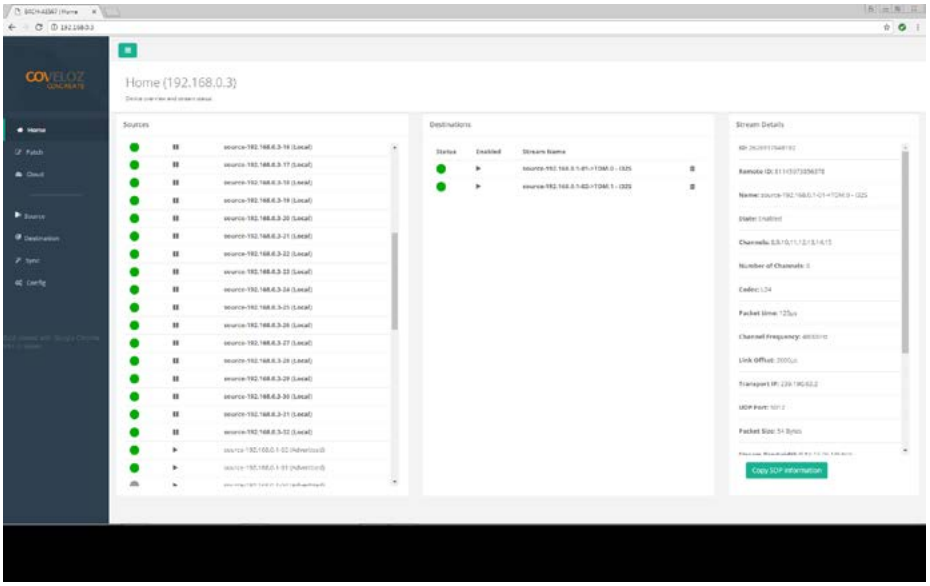
The attachment of audio sources (talker) channels to audio destinations (listener) channels, is carried out on the stream patching screen. See ”Patching Streams” on page 40.

Destination Stream Details
An examination of the stream details for the source stream and the corresponding stream details for the destination stream shows that the ID for the source stream matches the remote ID of the destination stream.

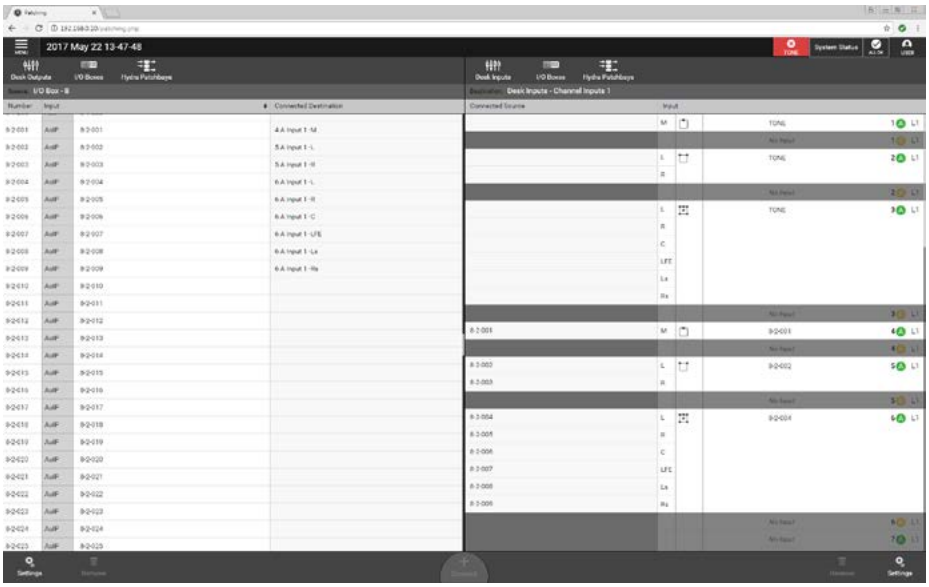
Note that the destination stream has the ‘>TDM.0-I32S’ Output name appended to the source stream name.

Audio destinations from streams
The image below right shows the corresponding AoIP inputs from the second Coveloz device being patched to a matching set of mono, stereo and 5.1 channels back on to the same RP1 unit.

COVELOZ STREAM MANAGER HOME PAGE FOR SECOND DEVICE IN UNIT



RP1 PATCHING SCREEN SHOWING AOIP 2 INPUTS PATCHED TO CHANNELS



Using this example, sending tone or material from the source channels allows the user to confirm that the audio path from source to destination via the AoIP streaming in AES67 format is correctly configured and available.

Patching Streams

Once the network streams have been created they will be 'advertised' over the network to all other devices. From here, any compatible device can subscribe to the multicast stream and begin receiving the content on the stream. Each AoIP unit will see these source 'talker channels'. Selecting the Patch page on the Coveloz UI shows a X-Y matrix patching arrangement as shown above right.

Arranged in rows down the left hand side of the display are the 'talker' network streams that have been 'advertised' and along the bottom of the display are the 'listener' outputs that can be connected to.

Note that the outputs shown above right also include, an 8 channel I2S output and a set of Test Pattern Checker outputs. However the important outputs are those labelled '>TDM.0-I32S' to '>TDM.31-I32S'.

These are the 32 x 8 channel stream receivers that take in the stream data format that can be patched to the receivers TDM outputs and converted back into Hydra2 Audio data format ready to be used as inputs from the AoIP unit.

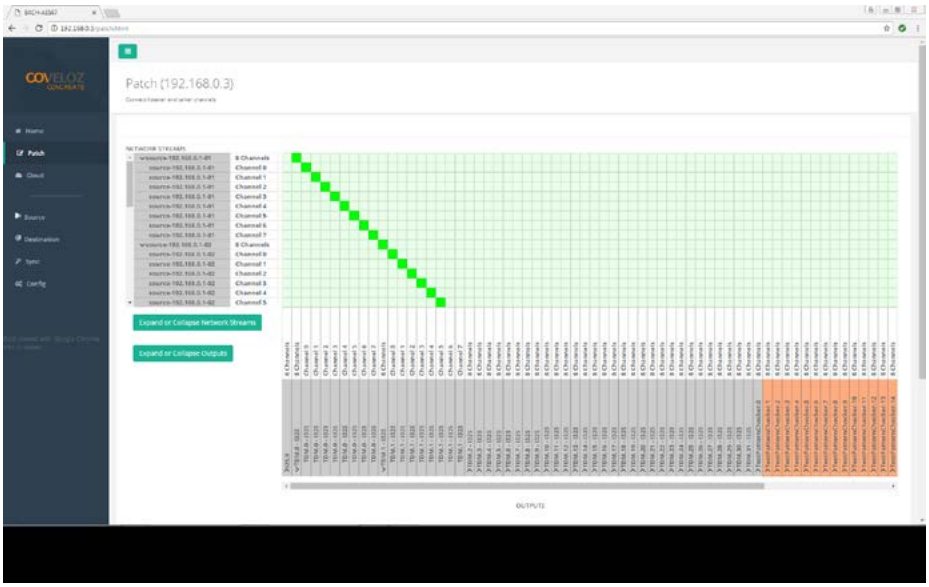
The patching mechanism is simply a crosspoint router where clicking on the corresponding square where the required source meets the required destination patches or unpatches the talker stream to the listener TDM output.

This patching matrix will only allow 1-to-1 patching, if the user wants 1-to-many this will need to be taken care of in the Hydra2 domain.

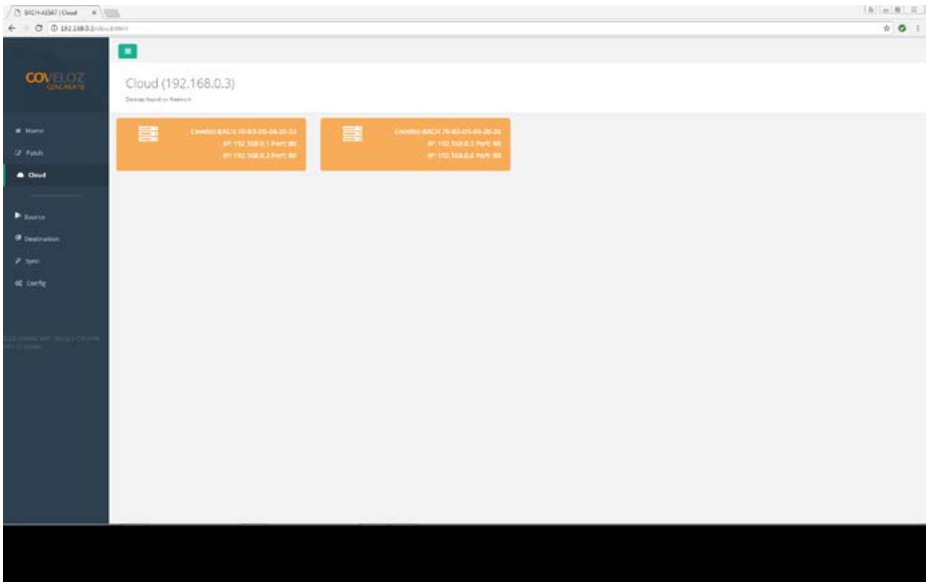
When a crosspoint is made in the "Patch" page, an entry is automatically created in the "Destination" page where the receiving stream can be toggled on/off, deleted or moved to a different TDM slot.

Note there are two expand/collapse buttons available one for the input Network streams and one for the TDM outputs. These expand the stream/output to show the routing of the 8 channels contained within the stream/TDM output. The image at the top shows our two streams being received on the second device patched to the first two TDM outputs in expanded format showing the typical one to one diagonal routing pattern. Note although the expanded format shows the channels, it does not allow patching at the channel level.

COVELOZ STREAM MANAGER PATCH PAGE FOR SECOND DEVICE IN UNIT



COVELOZ STREAM MANAGER CLOUD PAGE FOR SECOND DEVICE IN UNIT



Cloud Discovery

Selecting the Cloud page on the Coveloz UI shows the devices found on the IP network. In this case it shows the two Coveloz BACH-AES67 devices and identifies them with their MAC addresses and their Primary and Secondary data ports. This allows this device to see what devices are available to it.

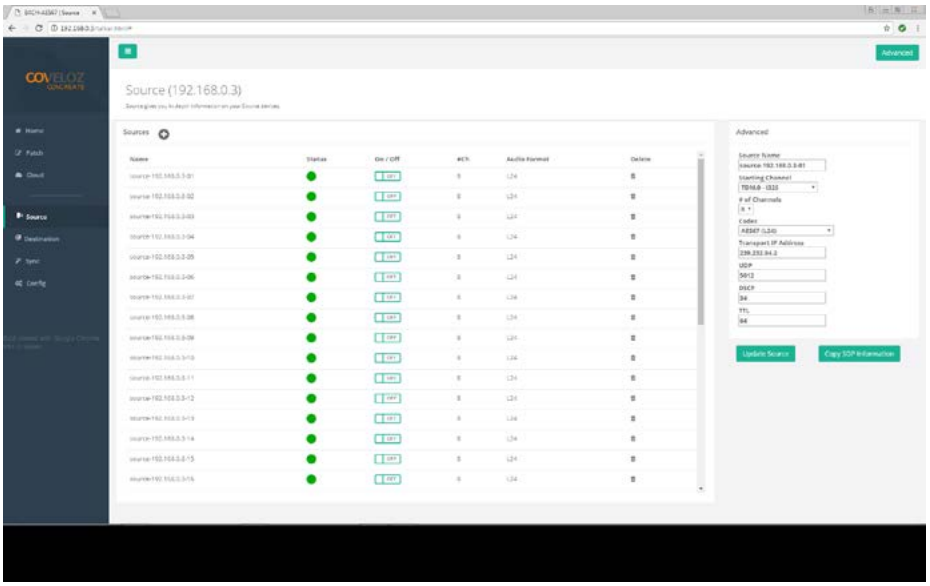
Source Information
Selecting the Source page on the Coveloz UI gives in-depth information and control on source devices.

The source page shows all the sources arriving into this device, showing the source Name, Status, Talk On/Off switch, number of channels in the stream, the Audio Format of the stream and a Delete field (if you want to remove a source stream from this page).

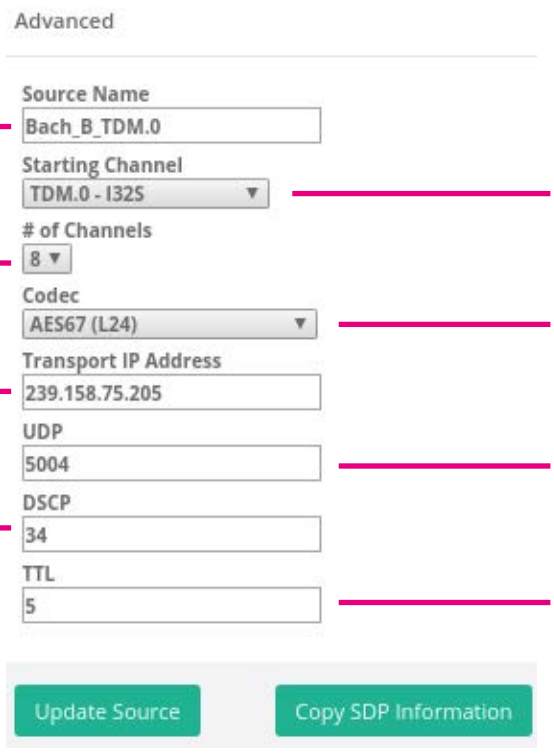
Also shown is a 'Sources +' button which allows the user to add streams to the Source list via the advanced table.

At the top right of this page is shown an advanced button. This opens the advanced table on the right of the page, which is shown in more detail below. This allows the user to change or create stream entries and a range of other Network parameters for Transport IP address, UDP port, DSCP value and TTL duration.

COVELOZ STREAM MANAGER SOURCE PAGE FOR SECOND DEVICE IN UNIT



COVELOZ STREAM MANAGER SOURCE CREATION WINDOW ADVANCED TABLE ENTRIES FOR DEVICE IN UNIT



User defined source stream name.

Set number of audio legs per source stream (1 – 8 channels).

Transport IP or Multicast address is the address on the switch that the source audio is streamed to.

"Differentiated services code point" defines the traffic priority and packet drop probability. DSCP = 36 can also be listed as "AF41" on other devices.

This value should be used for AES67 audio streams.

TDM start number = TDM.0-I32S > Hydra ports 1 – 8, TDM.1-I32S > Hydra ports 9-16 etc

Audio codec: For AES67 on Apollo, codec will always be "AES67 (L24)".

UDP port number (Redundant path port number will be x + 2 (x = primary UDP port

"Time to live" value defines the number of network hops a packet can travel over before the packet is dropped.

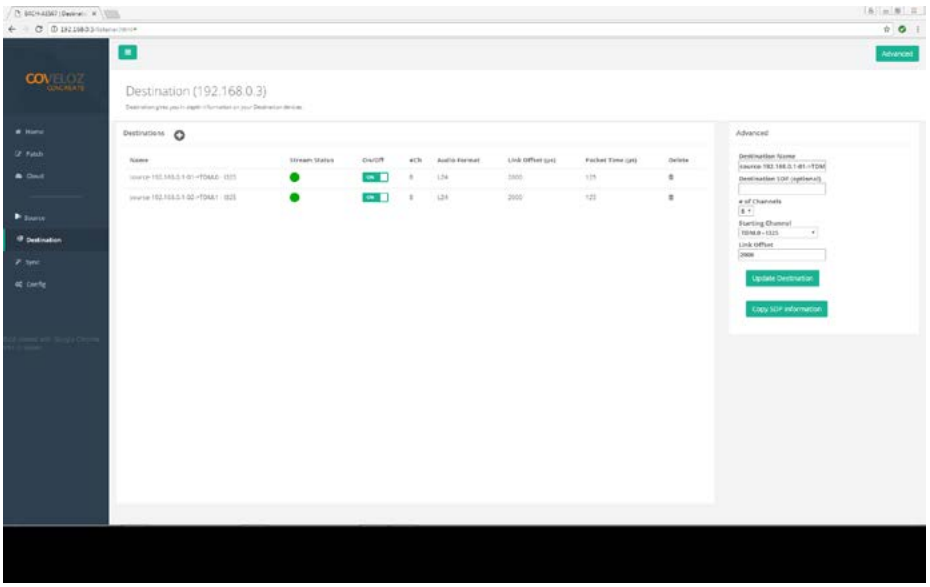
Destination Information
Selecting the Destination page on the Coveloz UI gives in-depth information and control on destination devices.

The destination page shows all the patched destinations that have been made on this device, showing the destination Name, Status, Listen On/Off switch (which disconnects the stream from the TDM buses), number of channels in the stream, the Audio Format of the stream, the Link Offset & Packet Time in microseconds and a Delete field if you want to remove a destination stream from this page.

Also shown is a 'Destinations +' button which allows the user to edit the destination list via the advanced table.

At the top right of this page is shown an advanced button, this opens the advanced table on the right of the page also allowing the user to change these field entries.

COVELOZ STREAM MANAGER DESTINATION PAGE FOR SECOND DEVICE IN UNIT



COVELOZ STREAM MANAGER DESTINATION WINDOW ADVANCED TABLE ENTRIES FOR DEVICE IN UNIT

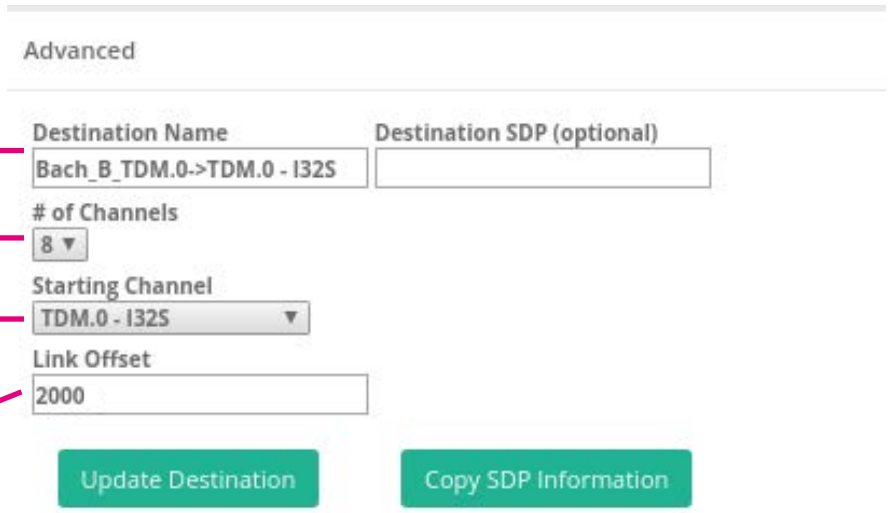
From here destinations can be input manually if (for any reason) the AES67 device creating the stream cannot be discovered in the "Patch" page.

User defined destination stream name.

Set number of audio legs per source stream (1 – 8 channels).

TDM start number =
TDM.0-I32S > Hydra ports 1 – 8,
TDM.1-I32S > Hydra ports 9-16 etc

Link Offset is the duration in microseconds of the network latency the minimum theoretical setting being two times the packet time i.e. 250us and the default setting is 2000us which is sixteen times the packet size i.e. 2ms.



The AES67 standard for audio streaming and synchronization interoperability, defines "low latency", as latencies below 10ms. Actual latency is determined by a number of factors, such as network environmental parameters (i.e. speed, size, topology, actual traffic conditions etc.), device implementation (software and hardware), actual stream/packet setup and configured receiver latency (packet jitter compensation delay).

With a typical AES67 packet setup (i.e. 48 samples/packet, 1..8 channels, 24-bits, 48kHz) the minimum end-to-end latency which can be expected on a smaller Gigabit Ethernet network is typically 2ms.

Synchronisation Control

Selecting the Sync page on the Coveloz UI gives the user the ability to synchronise the network clocks of the Bach-AES67 devices. Primarily this page is about setting up PTP clocks and the Ethernet ports behaviour.

Note that if a valid sync signal is not acquired, the start-up config will not be applied and the device will not function.

The left hand column, shown right, on the Sync page is labelled 'Configuration' and displays the 'Domain' and Priority1 fields.

Multiple PTP clocks can exist on the same network/vLAN but it is possible to keep them separate by placing them in different domains. The Priority1 value (0-128) is used in the Best Master Clock algorithm to determine which AES67 device will become the PTP Grand Master Clock.

Underneath this are shown the Sync interval, Announce interval and Announce Receipt timeout fields for the Primary (ETH1) and Secondary (ETH2) AES67 ports on this card.

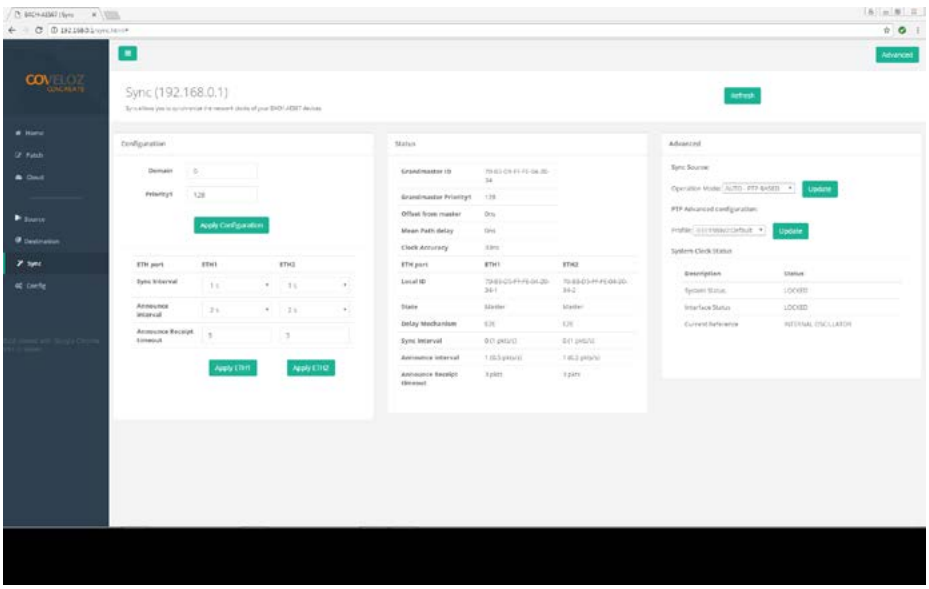
Different PTP profiles exist and are selected here. Profiles define the intervals at which sync packets are exchanged between PTP devices. This should be uniform across the sync domain.

The middle column shown is the Status Column which shows the ID of the current Grandmaster clock and its Priority1 status along with its Offset from master, Mean Path delay and Clock Accuracy.

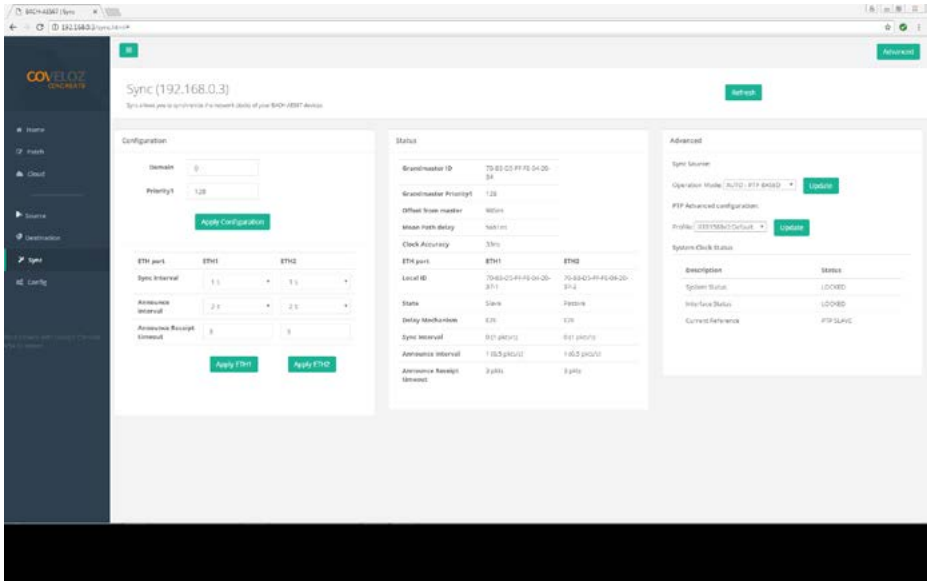
In addition it shows the current sync state of each AES67 port (Eth1 & Eth2.) Each card may take up to 2-3 minutes to lock correctly and apply the device startup config.

This area shows each Ethernet ports Local ID, State, Delay mechanism which is set as End to end by default, Sync Interval, Announce Interval and Announce Receipt timeout.

COVELOZ STREAM MANAGER SYNC PAGE FOR FIRST DEVICE IN UNIT



COVELOZ STREAM MANAGER SYNC PAGE FOR SECOND DEVICE IN UNIT



The right hand column is opened using the Advanced button and shows the operation mode of the clock source which can be set to INTERNAL, PTP-SLAVE or AUTO-PTP BASED which is the default.

The PTP Advanced configuration lets the user set the PTP profile as described earlier it is normally left set to IEEE1588v2:Default.

The bottom right image shows the system and interface statuses which should be LOCKED and the current reference which if the device is being used as the Grandmaster clock will show INTERNAL OSCILLATOR as shown on the sync page for the first device or if it is following a clock it will appear as a PTP-SLAVE as shown on the sync page of the second device.

Synchronising with PTPv2-IEEE1588
The following PTP Terms are used when deciding which device is Grandmaster.

Best Master Clock Algorithm:
This is used by all devices within the same domain to determine which device is most suitable to become the Grandmaster.

The following attributes are used to determine this (in order of priority):-

Priority1 – the user can assign a specific static-designed priority to each clock, preemptively defining a priority among them.

Class – each clock is a member of a given class, each class getting its own priority.

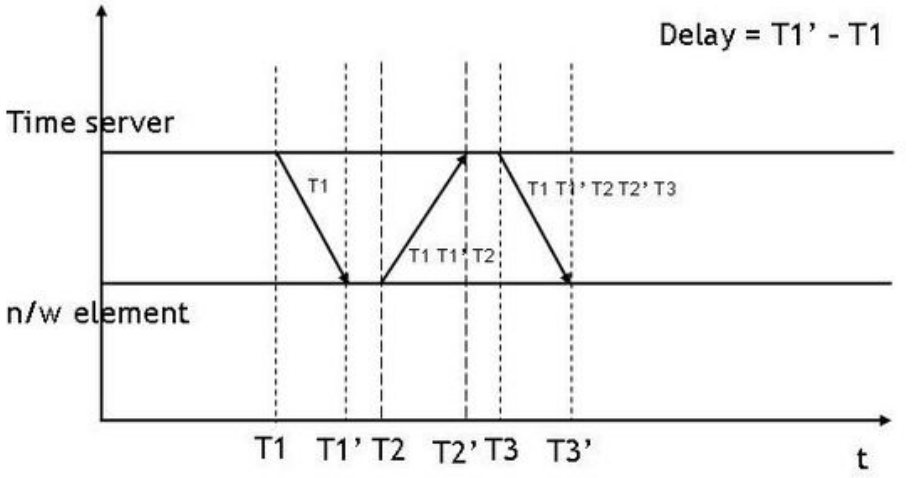
Accuracy – precision between clock and UTC, in nanoseconds (ns).

Variance – variability of the clock.

Priority 2 – final-defined priority, defining backup order in case the other criteria were not sufficient.

Unique identifier – MAC address-based selection is used as a tiebreaker when all other properties are equal.

A PTP CYCLE



Once the PTP GMC has been determined, all clocks will begin to sync to the newly elected clock.

- Master will send "sync_message" to all slaves (packet timestamped from GMC)
- Slave will timestamp the packet on reception
- Slave replies with "delay_request" to the GMC
- GMC will timestamp the packet on reception
- GMC sends "delay_response" to the slave.
- This packet will include the GMC receipt timestamp of the "delay_request"

By calculating the offset between the timestamps of these message being sent and subsequently received. A slave device can correctly adjust its clock to match that of the GMC to less than 1ms.

Error Indications in Status
The status indication circles shown on the Source and Destination entries can display different states depending on the status of the streams. The image to the right shows the various status messages that can occur.

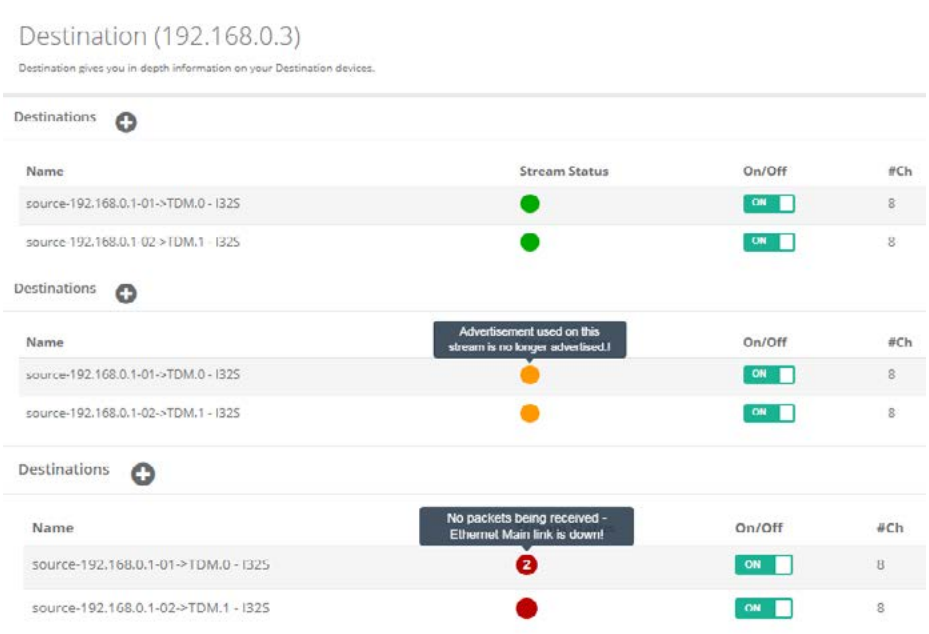
A Green circle is a good indication that everything is OK.

A Yellow circle is a warning that there is a problem such as the stream is no longer being advertised or a redundant link issue.

A Red circle indicates that there is a serious error, such as a stream is not being received or some other problem meaning that there is no live stream.

A number inside the circle shows the number of error messages present.

COVELOZ STREAM MANAGER STATUS COLOURS AND MESSAGES



Device Configuration
Selecting the Config page on the Coveloz UI gives the user, the ability to configure the device and to update the operating firmware on the Coveloz BACH-AES67 devices.

Settings Column
Channel Sample Frequency is currently set at 48kHz.

Bach device Global Packet Time is used to specify the TX/RX frequency of UDP audio packets. This value is required to be uniform between all communicating devices.

TDM Interface mode for the Calrec AoIP unit the TDM interface will **always** be set to "I32S" which has 32 channels transmitted in 2 Groups of 16.

Configuration Management
Save to running startup: Saves the current card configuration to memory. The card will boot and apply the startup config.

Default Startup: A predefined configuration with 32 source streams of 8 channels pre made.

Factory Defaults: Blank device with no talker sources/listener destinations.

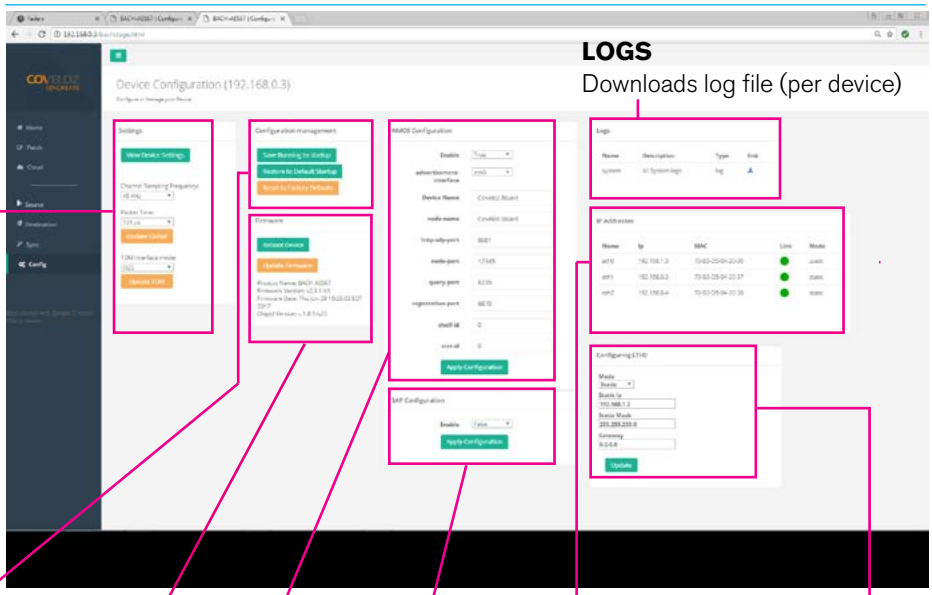
Note: (IP addresses are unaffected)

Firmware & Reboot
The update firmware button when pressed looks for a file on the attached PC such as:- 'bach_aes67_release-v2.3.1-b1.bin.gz' opening this file starts the firmware update process.

Note that there is no progress indicator on this and it can take up to 3-4 minutes to update. There is a message of completion at the end but it is important to leave it alone until completed at which point the device will self-reboot.

The reboot button will manually restart the device with its current settings.

COVELOZ STREAM MANAGER CONFIG PAGE FOR SECOND DEVICE IN UNIT



NMOS Configuration
This is not currently required for the AoIP unit and should remain unaltered.

SAP Configuration
There is a drop-down box used to Enable SAP (Session Announcement Protocol) SAP is used by Dante products to advertise sessions on a network.

Enabling this on the device allows 2-way comms with Dante devices.

IP Addresses
This provides information on all ethernet interfaces assigned to the device.

Eth0 – Management interface (accessible from the front facing "set-up" port on the AoIP unit.

Eth1 – Primary AoIP audio port

Eth2 – Secondary AoIP audio port

Configuring IP
Clicking on any of the IP addresses above opens the configuration box for that port. Once the addresses have been set click on the 'Update' button to change. However note below:-

****Eth0 needs to be on the same subnet as the Calrec HOST board (Defaults to 192.168.1.0/24)****

REFERENCE PROTOCOLS

AES11
- AES recommended practice for digital audio engineering - Synchronization of digital audio equipment in studio operations .

IEEE 1588-2008
- PTPv2: is the IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement & Control Systems or Precision Time Protocol.

RFC 768
– UDP: User Datagram Protocol.

RFC 791
– IP: Internet Protocol.

RFC 1112
– Host Extensions for IP Multicasting.

RFC 2236 / 3376 (v3)
– IGMP: Internet Group Management Protocol uses Multicast management to verify multicast subscriptions from devices remain valid.

RFC 2326 / 7826 (v2)
– RTSP: Real Time Streaming Protocol.

RFC 2474
– Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers.

RFC 2616
- HTTP: Hypertext Transfer Protocol.

RFC 2974
– SAP*: Session Announcement Protocol is used by Dante devices, utilises SDP to allow devices to agree on the terms / parameters used for streaming data This is limited to local area networks.

RFC 3190
– RTP Payload Format for 12-bit DAT Audio and 20- bit & 24-bit Linear Sampled Audio.

RFC 3261
– SIP*: Session Initiation Protocol
-Application layer protocol
This utilises SDP to allow devices to agree on the terms/parameters used for streaming data and can span multiple network topographies and subnets.

RFC 3264
– An Offer/Answer Model with the Session Description Protocol (SDP)

RFC 3550 / 3551
–RTP Real Time Transport Protocol
Session layer protocol

RFC 4566
–SDP: Session description protocol
Used to convey session (stream) information between devices

RFC 6762
–MDNS: Multicast registration

RFC 7273
– RTP Clock Source Signalling

* The difference between SIP and SAP (in a nutshell) is the frequency of the stream description packets being sent out. SAP will periodically broadcast information pertaining to the stream (SDP) to the entire multicast range whereas SIP is much more sophisticated and is very commonly used in conjunction with a proxy server to handle internet telephony such as Skype.

AoIP–HYDRA2 Interfacing

GLOSSARY OF TERMINOLOGY

CALREC

Audio stream
See RTP stream.

Audio Video Bridging
AVB
Describes enhanced Ethernet networks specified in IEEE 802.1BA, IEEE 802.1Q-2011 and IEEE 802.1AS.

Boundary Clock
A clock that has multiple Precision Time Protocol (PTP) ports in a domain and maintains the timescale used in the domain. It may serve as the source of time, that is, be a master clock; and may synchronize to another clock, that is, be a slave clock. See IEEE 1588-2008.

Byte
A unit comprising 8 bits of data. Over IP networks, data is transported in units of bytes.

Digital Audio Reference Signal
DARS
An audio clock signal defined in AES11.

CSRC
The contributing source (CSRC) is the source of a stream of RTP packets that has contributed to the combined stream produced by an RTP mixer.

DiffServ
Differentiated services (DiffServ) is a system for classifying traffic and providing quality of service (QoS) on an IP network.

DSCP
The differentiated services code point (DSCP) is a 6-bit field in the IP packet header that is used for classification purposes. DSCP is part of the differentiated services architecture.

End-to-end Transparent Clock
A transparent clock that supports the use of the end-to-end delay measurement mechanism between slave clocks and the master clock. See IEEE 1588-2008.

Ethernet
Ethernet is a physical & data link layer set of computer networking technologies for local area networks (LANs).

Ethernet uses a bus or star topology and supports data transfer rates from 10 Mbps through 100 Mbps (Fast Ethernet) onto Gigabit Ethernet, supporting data rates of 1 gigabit per second or 1000 Mbps.

EUI-64
A 64-bit globally unique identifier formed by combining a registered 24 or 36-bit company identifier and a company unique device identifier. The EUI-64 is similar to the EUI-48 which is used to assign Ethernet media access control (MAC) addresses.

Grandmaster identifier
GMID
An EUI-64 used in IEEE 1588 and IEEE 802.1AS synchronization standards to uniquely identify the grandmaster serving a synchronization domain.

Grandmaster
The master source of synchronization for clock distribution via PTP. The Grandmaster is a network device and is identified by an EUI-64.

IEEE
Institute of Electrical and Electronics Engineers is a professional association dedicated to advancing technological innovation and excellence. The IEEE publishes communications standards.

IETF
Internet Engineering Task Force is the volunteer standards-developing organization responsible for the Internet Protocol suite.

IGMP
Internet Group Management Protocol (IGMP) is a communications protocol used by hosts to report their multicast group memberships to IPv4 routers.

Internet Protocol
IP
The network layer protocol commonly used to transport data on networks built through interconnection of one or more local-area networks.

IPv4
Internet Protocol version 4 is the most widely deployed version of the Internet Protocol and is widely used on the Internet and on local area networks (LANs).

IPv6
Internet Protocol version 6 is the most recent revision of the Internet Protocol and is intended to replace IPv4 eventually.

Link offset
Link offset specifies the amount of time media spends on the network and in buffers at the sender and receiver. Link offset is also known as network latency or playout delay.

Media clock
The clock used by senders to sample and receivers to play digital media streams. The media clock for audio streams reads in units of samples.

Media packet
One of the data packets carrying media data as part of a media stream. A media packet contains one or more samples for one or more audio channels.

Media stream
See RTP stream.

Maximum transmission unit
MTU
The size of the IP packet, measured in bytes, that can be transferred using a specific data link connection. The MTU for an Ethernet data link is 1500 bytes.

Network clock
The time delivered by the network synchronization mechanism. The network clock reads in units of seconds.

Network layer
The network layer is layer 3 of the OSI model and is responsible for packet forwarding and routing of variable length data sequences from a source to a destination.

OSI model
The Open Systems Interconnect Model characterizes and standardizes the functions of a communications system in terms of abstraction layers.

Packet time
The real-time duration of the media data contained in a media packet. For example, a packet containing 12 samples of 48 kHz audio has a packet time of 12 ÷ 48 kHz = 250 microseconds.

Peer-to-peer Transparent Clock
A transparent clock that, in addition to providing Precision Time Protocol (PTP) event transit time information, also provides corrections for the propagation delay of the link connected to the port receiving the PTP event message. In the presence of peer-to-peer transparent clocks, delay measurements between slave clocks and the master clock are performed using the peer-to-peer delay measurement mechanism.

Precision time protocol
PTP
The general class clock distribution protocol standardized in IEEE 1588-2002, IEEE 1588-2008 & IEEE 802.1AS-2011.

Quality of service
QoS
Describes a system for classifying, marking and delivering traffic across a network in accordance with its performance requirements.

Receiver
A network device with ability to receive at least one media stream from the network.

Request for Comment
RFC
Request for Comments are documents published by the IETF relevant for the working of the Internet and Internet-connected systems. RFCs are referenced by number. RFC 791, for example, defines the Internet Protocol version 4 (IPv4).

RTCP
A companion protocol of the Real-time Transport Protocol (RTP), providing statistics and control information for RTP media packets.

Real-time Transport Protocol
RTP
Is defined in RFC 3550 and provides a means for applications to organize, mark and transport their media packets using UDP/IP networking.

RTP clock
Timestamps are carried in RTP packets containing stream data. Each stream has its own RTP clock. There is a constant offset between the media clock and the RTP clock.

RTP session
An RTP session is a media connection between sender and receiver. RTP sessions may be unicast or multicast. In teleconferencing RTP applications, multicast sessions may have multiple senders and receivers. However, under this standard, a session is allowed only one sender.

RTP stream
An RTP stream is a sequence of RTP packets with media data sent at regular interval. A stream may contain multiple channels. There may be multiple media streams per RTP session.

Session Description Protocol
SDP
A format for describing RTP sessions and their parameters including network addressing, encoding format and other metadata. SDP is defined in RFC 4566.

Sender
A network device with ability to source at least one media stream onto the network.

Session
See RTP session.

Session Initiation Protocol
SIP
A telecommunications connection management protocol defined in RFC 3261.

SIP URI
A SIP URI is a URI used by SIP to identify user agents. SIP URI take the form sip:<user>@<domain> or sips:<user>@<domain>.

Slave Clock
A clock that is synchronized to a master clock (the provider of time) within an environment that uses the Precision Time Protocol (PTP). A slave may, in turn, be a master to another clock and may simultaneously be a boundary clock.

Stream
See RTP stream.

Transmission Control Protocol/ Internet Protocol
TCP/IP
See Internet Protocol.

Transport Layer Security
TLS
A cryptographic protocol for secure communication over IP networks.

Transparent clock
A device that measures the time taken for a Precision Time Protocol (PTP) event message to transit the device and provides this information to clocks receiving this PTP event message. See IEEE 1588-2008. See also: end-to-end transparent clock; peer-to-peer transparent clock.

Transport layer
The network layer is layer 4 of the OSI model and provides end-to-end communication services for network applications.

User datagram protocol
UDP
Constitutes a simple transport layer for the IP network layer. Defined in RFC 768.

Uniform resource identifier
URI
An identifier for a network resource. An identification URI enables interaction with the resource over a network.

User agent
A SIP endpoint device such as a VoIP telephone.

Virtual LAN
VLAN
A single layer-2 network may be partitioned to create multiple distinct broadcast domains, which are mutually isolated so that packets can only pass between them via one or more routers, such a domain is referred to as a Virtual Local Area Network.

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