HYDRA2

Gigabit Ethernet Networking

C A L R E C

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INTRODUCTION

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INTRODUCTION

The Hydra2 system is designed to provide seamless, scalable audio networking of consoles and audio interfaces. It allows large numbers of audio inputs and outputs that may be physically remote, to be easily shared and controlled.

The term network is used, rather than routing matrix, to reflect the sophisticated nature of the control software that makes the connecting of resources very straightforward, even with ad hoc networks that change regularly. Audio interfaces and consoles may be added and removed without the need for manual intervention – the control software recognizes the changes and rapidly informs all parts of the network so that new resources are made available to console operators just seconds after they are plugged in.

A network's topology may be designed to meet the specific requirements of the broadcast facility, allowing trunks of varying capacity to be created between different parts of the network to reflect anticipated demand. Of course, there's no manual tie-line management required, the control software transparently organizes all routing, including redundant connections.

Controlling the network couldn't be simpler. All on-line resources are made available to all consoles (unless intentionally isolated for security) – no matter where they are physically connected to the network. Input and output ports may be patched at any time, either manually, or en masse, as part of a snapshot memory load.

Hydra2 provides 1-to-N routing, meaning that an input may be routed to any number of destinations without restriction. This means the input may be connected to a channel on multiple consoles, and patched directly to one or more output ports on the network. If the input happens to be a microphone pre-amp, then Calrec's road-tested ownership scheme resolves which console has control of gain and phantom power.

Hydra2's interconnections are made using either copper or fiber connections. Distances are only limited by the connection type and may run to many kilometers. The capacity of the network is vast, both in terms of the number of input and output ports and the switching capability.

Each connection between Hydra2 units can carry 512 signals in both directions simultaneously at 48kHz. More than enough for any single IO unit. The real power comes in connecting routers together. Should more connection capacity be required, then simply make another connection between routers to double the connection bandwidth in both directions. Of course all connections should be complemented with a secondary redundant connection, just in case!

Audio interfaces are available in a growing range of units. At the moment, analogue, AES3, MADI and SDI interfaces are available. New formats can easily be supported as they arrive.

Hydra2 also supports non-audio data, in particular transportation GPIO.

As with all Calrec products, reliability is our first concern. All Hydra2 hardware and audio interfaces are designed to the highest standards, with particular attention being paid to power generation and distribution, thermal management and physical robustness – the cornerstones of product reliability. In the event of a fault occurring, a redundancy scheme automatically deploys backup hardware to quickly restore operation. All critical components can have their own hot (powered-up and ready to operate) backup and all network interconnections may be duplicated. In fact, where backup infrastructure exists, secondary routes are created at the same time as primary routes, to speed the process of switching over, in the event of a component failure.

Hydra2 is a companion technology to Calrec's Apollo and Artemis consoles. Each of these consoles contains a Hydra2 router which is used to connect to a variety of audio interface units. It also allows general port to port routing, independently of the console. It is a very simple job to connect several consoles together - all that is needed is a copper or fiber connection between each console – as soon as they are connected together, they behave as a network, without the need for any more hardware or software to be installed.

HYDRA2
FIXED FORMAT IO UNITS

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FIXED FORMAT OVERVIEW

All Hydra2 inputs and outputs are contained within robust small format boxes providing input and output facilities for use in areas such as:

- Equipment room racks
- Studio wall box
- Studio gantry/lighting grid
- Control room rack
- OB truck
- OB Flight cases
- Remote OB locations

These boxes provide a range of analog and digital interfaces accepting Mic and Line signals, AES, SDI or MADI.
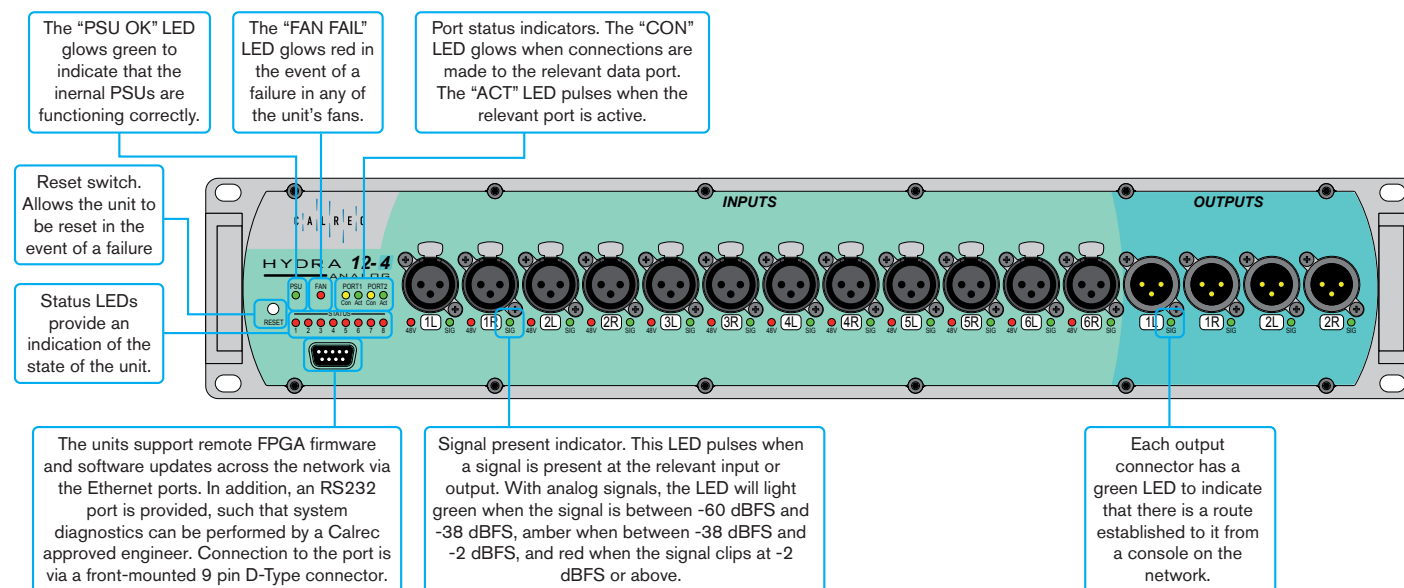
Dual network connections

All Hydra2 boxes provide dual network connections for either copper or fiber interfaces. Regardless of the type of connection chosen, full connection redundancy is guaranteed.

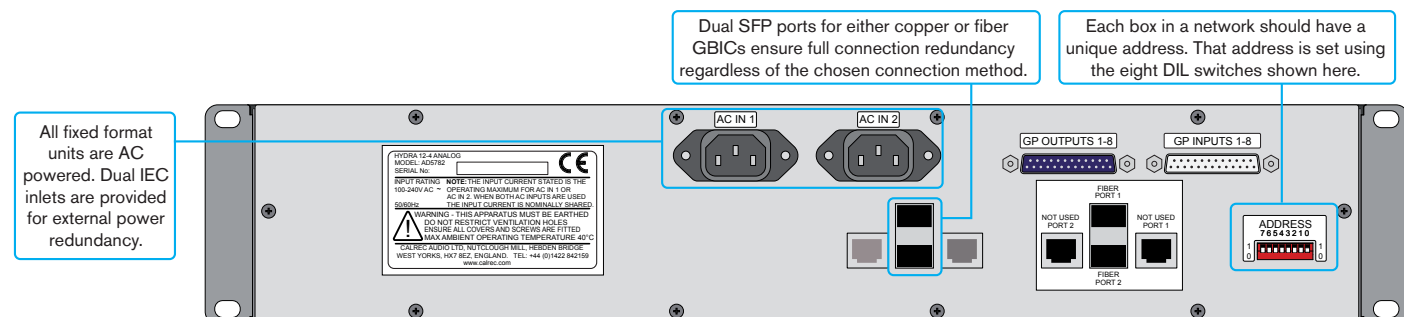The units are supplied with two SFP ports to receive plug-in GBIC modules. When RJ45 ports for copper connections are chosen, the 1000BASE-T circuits can be up to 90 m = 290 feet). By choosing appropriate fiber GBICs, distances can be increased to 550 m (1000BASE-SX) and with 1000BASE-LX distances up to 10 km are possible.

All external connections to the units are hot pluggable. When the fixed (not GBIC) RJ45 sockets are fitted, they should not be used in Hydra2 systems.

FIGURE 1 - COMMON FRONT PANEL ELEMENTS

The "PSU OK" LED glows green to indicate that the inernal PSUs are functioning correctly.

The "FAN FAIL" LED glows red in the event of a failure in any of the unit's fans.

Port status indicators. The "CON" LED glows when connections are made to the relevant data port. The "ACT" LED pulses when the relevant port is active.

Reset switch. Allows the unit to be reset in the event of a failure.

Status LEDs provide an indication of the state of the unit.

The units support remote FPGA firmware and software updates across the network via the Ethernet ports. In addition, an RS232 port is provided, such that system diagnostics can be performed by a Calrec approved engineer. Connection to the port is via a front-mounted 9 pin D-Type connector.

Signal present indicator. This LED pulses when a signal is present at the relevant input or output. With analog signals, the LED will light green when the signal is between -60 dBFS and -38 dBFS, amber when between -38 dBFS and -2 dBFS, and red when the signal clips at -2 dBFS or above.

Each output connector has a green LED to indicate that there is a route established to it from a console on the network.

FIGURE 2 - COMMON REAR PANEL ELEMENTS

Dual SFP ports for either copper or fiber GBICs ensure full connection redundancy regardless of the chosen connection method.

Each box in a network should have a unique address. That address is set using the eight DIL switches shown here.

All fixed format units are AC powered. Dual IEC inlets are provided for external power redundancy.

Power

Hydra2 units are mains powered and all feature two internal power supply units, providing internal PSU redundancy. AC connections are made using the dual rear IEC connectors for external supply redundancy.

Common features

Some status LEDs on connectors are common to the front panel of all Hydra2 boxes. Such elements show the status of connections, the presence of signals or allow access to diagnostic information. These elements are shown in Figure 1.

Certain connections are also common to the rear of all Hydra2 boxes. These power and data connections are shown in Figure 2.

GPIO module

All IO units of 2U height or greater may be fitted with an optional GPIO module. This provides eight opto-isolated inputs and eight relay outputs on two 25 pin D-Types.

ANALOG

Analog input signals can be at either mic or line level. Input impedance is switched dependant on the gain of the path that the input signal is routed to.

Variants

Boxes with XLR connections are available in three sizes:

- 12 mic/line inputs, 4 line outputs
- 24 mic/line inputs, 8 line outputs
- 48 mic/line inputs, 16 line outputs
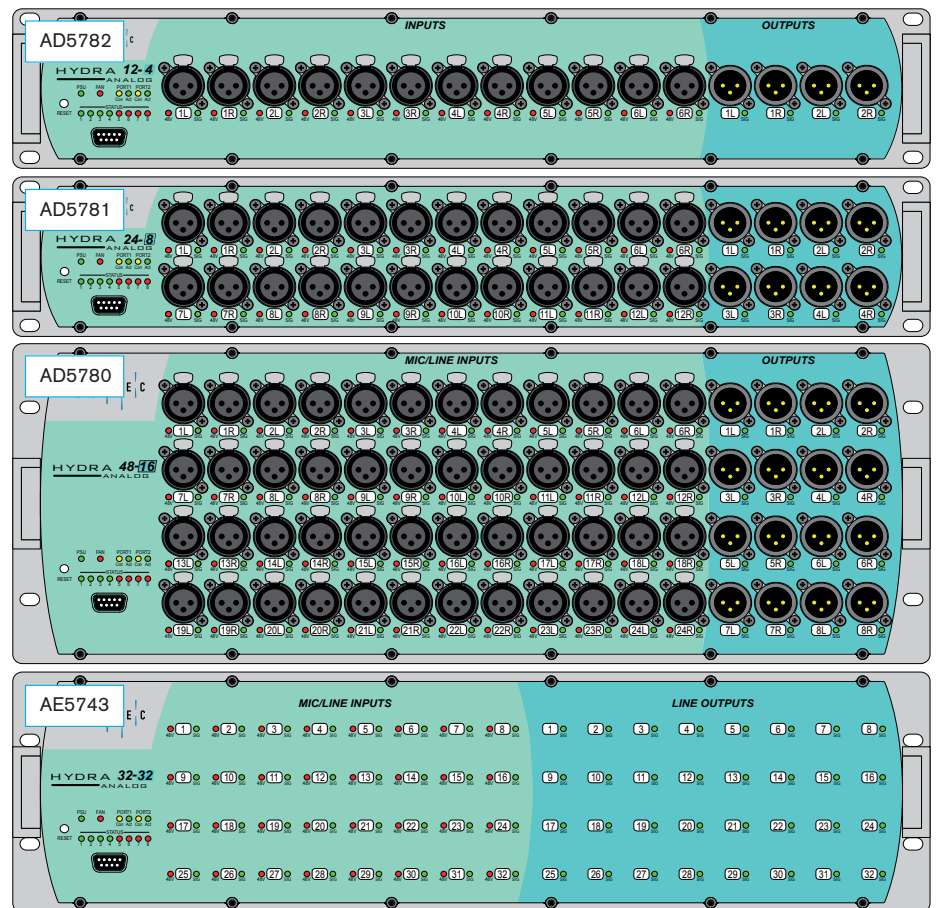
XLR versions have front mounted connectors.

A version with EDAC/ELCO connectors is also available providing 32 mic/line inputs and 32 line outputs. The EDAC/ELCO connections are made to the rear of the unit.

These options are shown in Figure 1.

48v Indicators

Each input port has an LED associated with it which will glow when 48v phantom power is present at that port.

AES3

AES3 signals are sent and received on BNC connectors. Sample rate converters are switchable on all inputs from the surface.
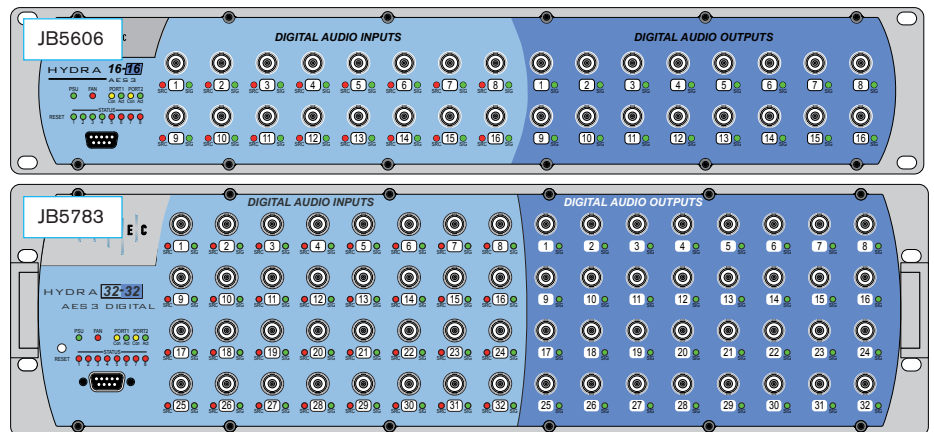
Variants

AES3 boxes are available with 16 or 32 inputs and outputs. These options are shown in Figure 1.

SRC LEDs

LEDs next to each input port indicate whether the sample rate converter for that input is in use.

FIGURE 1 - AES3 UNITS

MADI UNIT

The Hydra2 MADI IO unit provides two MADI interfaces in a compact 1U enclosure.

Channel count
Each interface in the MADI unit can operate in either 56 or 64 channel mode. Switches on the front of the unit allow selection for each interface.

Interface medium
The unit can transmit over a coaxial (copper) AND optical (fiber) medium. It can receive over coaxial OR optical medium. Switches on the front panel allow selection of the receiving medium.

Fiber interfaces may be single-mode or multi-mode and must be specified upon purchase.

When using the fiber to interface with external equipment, please refer to Figure 2 to ensure that your equipment can transmit and receive within the range of supported wavelengths.

For detailed information on fiber interfaces and connections, please refer to the 'Fiber Optic Interfaces' section of this document.

Note:
There is no sample rate conversion available on MADI inputs or outputs. It is therefore vital to ensure that any equipment connected vis MADI is synchronized to the same source as the Apollo system.
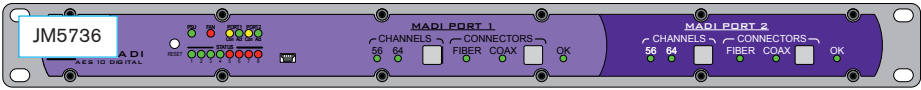
FIGURE 1 - MADI IO UNIT

FIGURE 2 - FIBER INTERFACE SPECS

	Single-Mode	Multi-Mode
Fiber Connector Options	SC	SC, ST
TX Wavelength	1260-1360nm	1270-1380nm
RX Wavelength	1260-1360nm	1270-1380nm

HYDRA2
MODULAR IO UNIT

STAGEBOX

Targeted primarily at studio floor and outside broadcast applications, the unit has all audio (including SDI) and control connections (Hydra 2 links, GPIO, RS232) located at the front of the unit. Power cables connect at the rear. It is designed to provide a mix of audio interfaces, with a high density of connections, saving rack space and cost.

A diagram of the Stagebox front panel is shown in Figure 1.

 Key features are:

- 3U rack
- 21 slots (4HP wide, 0.8in)
- 1 slot dedicated to the Hydra2 interface module, 20 available for other audio interfaces
- Each unit limited to 512 bi-directional signals (at 48kHz)
- Cards with XLRs take up two slot widths
- Card types may be freely mixed
- Cooled by low-noise fans
- Primary and secondary Hydra 2 links provided
- Two PSU modules provide redundant power
- PSU modules may be hot-swapped without interruption to operation
- Interface cards may be hot-swapped

The interfaces listed in Figure 2 are currently or will very soon be available. Those in Figure 3 will be available later, depending on demand.

Note that the SDI embedders and de-embedders will support SD, HD and 3G SDI streams. They will be able to decode all four groups (16 channels) and later, the de-embedder will support extraction of 32 audio channels from 3G SDI, as proposed by SMPTE.
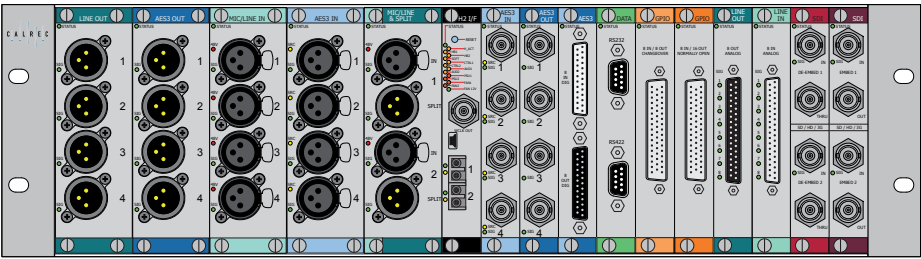
FIGURE 1 - MODULAR STAGEBOX

FIGURE 2 - PRESENT INTERFACES

Module	Description	Connector	Width (slots)
AD5840	4 Analog mic/line	XLR	2
AD5838	8 Analog in	DB37	1
DA5867	4 Analog out	XLR	2
DA5839	8 Analog out	DB37	1
JB5860	4 AES in	BNC	1
JB5837	4 AES out	BNC	1
JD5842	8 AES in/out	2 x DB25	1
VO5841	Dual SDI de-embedder	BNC	1
VI5872	Dual SDI embedder	BNC	1
WY5858	8 GPI / 8 GPO	DB50	1
UJ5836	Hydra2 interface		1

FIGURE 3 - INTERFACES AVAILABLE IN FUTURE

Module	Description	Connector	Width (slots)
AL5870	2 Mic/line each with 1 split	XLR	2
AL5875	1 Mic/line with 3 splits	XLR	2
JR5871	RS422 / RS232	2 x DB9	1
WY5859	8 GPI / 16 GPO	DB50	1

Possible combinations for one Stagebox frame include:

- 40 mic/lines on XLR
- 80 line inputs and 80 line outputs on DB37s
- 80 unbalanced AES3 inputs or 80 unbalanced AES3 outputs on BNC, or combinations thereof.
- 160 balanced AES3 inputs and 160 balanced AES3 outputs on DB25.

- 32 Embedders or 32 de-embedders (for 16 channel de-embedding), or combinations thereof.

Figure 4 shows the two plug-in power supplies, installed from the rear of the frame.

FIGURE 4 - MODULAR STAGEBOX REAR

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ARCHITECTURES

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SINGLE CONSOLE NETWORK

In its simplest form, a Hydra2 network consists of a router card, within a console, connected to some audio interfaces units, as shown in Figure 1.

The network allows the convenient placement of resources wherever they are needed with a minimum of infrastructure cost – fiber or copper cabling may be used. A variety of fixed format and modular boxes allow interfacing solutions to be tailored for studio floors, equipment rooms, and control rooms.
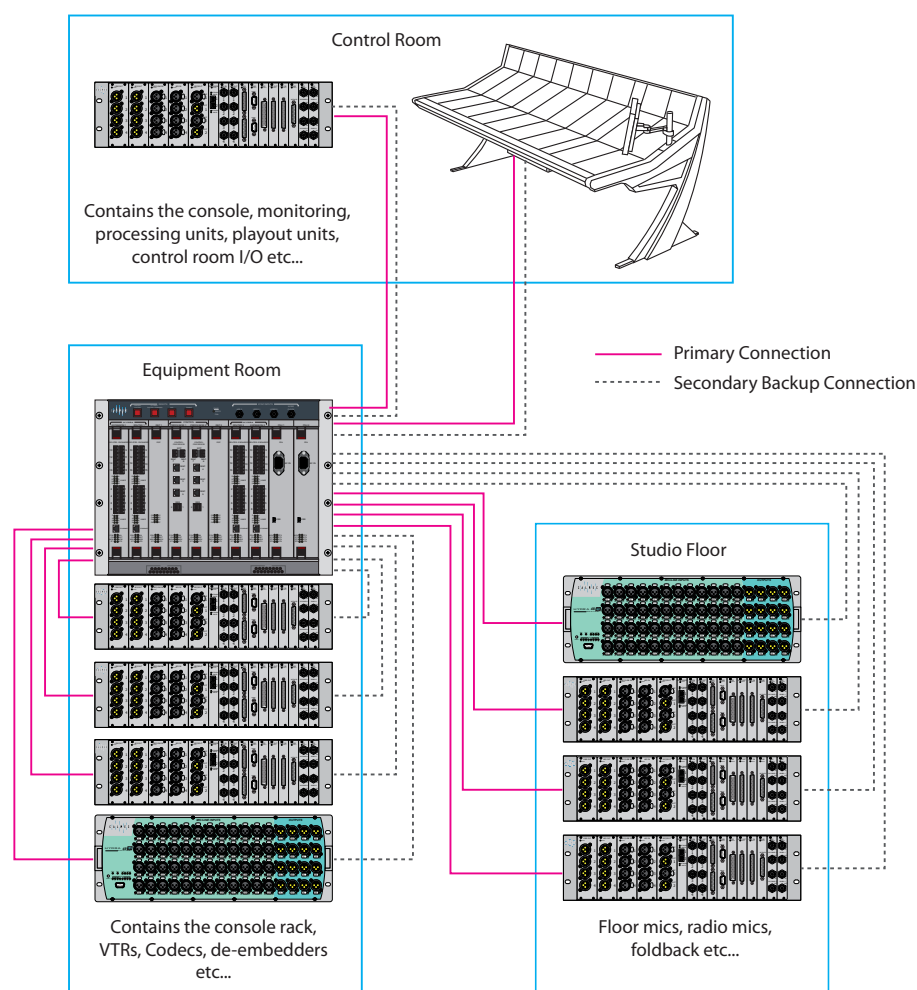
The router card is located in the Apollo or Artemis rack, alongside the DSP and control processors. The router has a capacity of 8192 routes and may have up to that many destinations ports connected to it The console DSP card consumes 2048 destination ports, making it possible to connect up a further 6144 output ports to the router for general input to output patching.

Audio interface units are connected to the router by copper or fiber connections through mini GBIC connectors located

at the front of the router card. Each router card has receptacles for up to 16 connections. If more than 16 audio interfaces are required, then an expansion card may be plugged into the card cage, providing connections for up to 16 more.

Each Router, expansion card and cable may have a redundant duplicate that automatically deploys if a problem is detected. A system of heartbeat messages constantly flowing around the network allows faults to be quickly detected. Most audio connections on the network have their backup connection made at the same time, which keeps the fault response time as short as possible. In a simple network, if a cable is disconnected, audio is restored through the backup connection in less than a second. This time may increase for larger networks.

FIGURE 1 - SINGLE CONSOLE NETWORK

Control Room
Contains the console, monitoring, processing units, playout units, control room I/O etc...

Equipment Room

—— Primary Connection
----- Secondary Backup Connection

Studio Floor

Contains the console rack, VTRs, Codecs, de-embedders etc...

Floor mics, radio mics, foldback etc...

MULTIPLE CONSOLE NETWORKS

To connect two consoles together, it is only necessary to make a connection from any one of the 16 mini GBIC connectors on one router to the other. As with audio interface units, this may be done with copper or fiber.

This creates a trunk with a capacity of 512 signals in each direction. The trunk acts like a tie-line between the two routers, although it is entirely managed by the software running on the two routers it connects.

Depending on the number of audio interfaces and their intended use, it may be necessary to increase the trunk capacity. This is achieved simply by adding more router to router connections. Each one increases the trunk capacity by 512 signals in each direction. Of course, multiple connections are transparently managed by the router software.

By connecting consoles together, all audio interfaces are made available to both consoles, as are each console's outputs (busses, direct outputs, clean feeds, insert sends and monitoring)

Larger and more complex networks of consoles may be built up by connecting them with trunks. The router software currently supports a star topology. Figure 1 gives an example of a possible configuration. The key to this topology is that their must be a single router at the centre of the star.

No matter how many consoles there are, and where the audio interface units are connected, the router software makes sure that they are all visible to the rest of the network. No manual setting up is required.
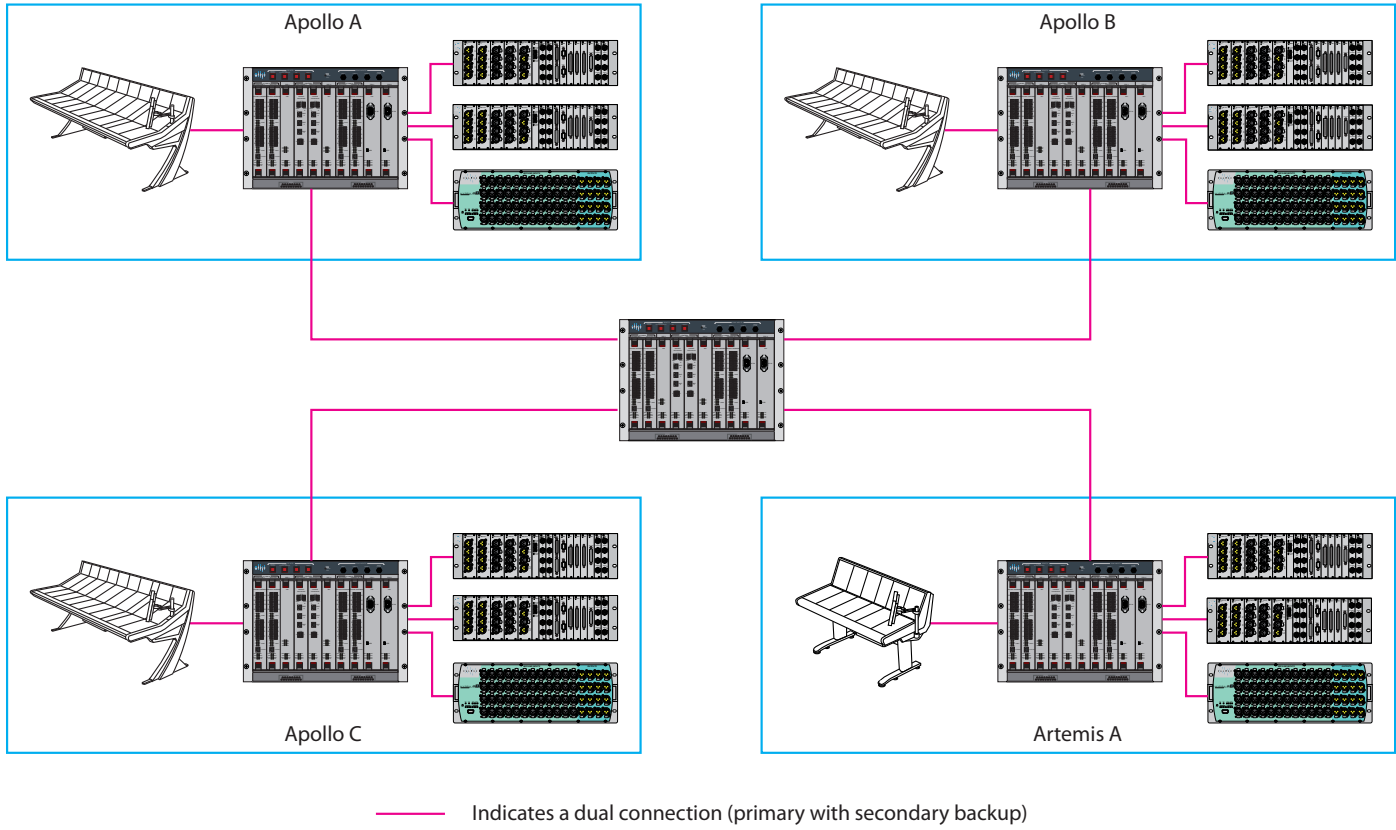
The router network is dynamic – if a new audio interface or console is connected to the network, its presence is automatically detected and its input and output ports made available within seconds. This makes it very quick and easy to make ad hoc networks, for example, connecting two mobile trucks together. It also makes it very easy to deploy extra resources as they are needed.

The star topology shown in Figure 1 contains a central router which does not have a console connected to it. This option has the advantage of offering a larger routing capacity as no routes need to be reserved for console DSP connections.

Later versions of the router software will support more complex topologies.

FIGURE 1 - MULTIPLE CONSOLE NETWORK

Indicates a dual connection (primary with secondary backup)

HYDRA2
FEATURES

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AUDIO PERFORMANCE

Audio performance across Hydra2 has been improved greatly in terms of latency, coherency and accessibility.

The latency across the network, for an AES3 to AES3 patch, has been measured at around 230uS (or 11 sample periods at 48kHz). This is about half of the Hydra 1 hop latency. It will be more for patches that involve more than 1 router.

Coherency is guaranteed between signals that take the same number of hops. For example, AES3 signals from boxes connected to the same router will be coherent.

Note that full AES3 frames are preserved across the network. This means that frames with embedded information, such as Riedel's Artist system, are passed intact.

The network supports multiple sample rates, as long as they are synchronous, for example, 48kHz and 96kHz or 44.1kHz and 88.2kHz.

SYNC STRATEGY

Robust synchronization is at the heart of reliable and high-quality network performance. Hydra2 routers may be synchronized to analog video, tri-level sync, AES3 or wordclock sources. Dedicated sync inputs allow all of these sources to be connected simultaneously, and assigned an order of priority. The sync inputs present on the Apollo and Artemis racks are shown in Figure 1.

If a source fails, then the router locks to the source with the next highest priority. An example of this process is shown in Figure 2.

To provide the best quality network-wide synchronization, all routers require an individual sync reference. This strategy has been chosen over, say, distributing synchronization information across the Hydra2 network infrastructure, for 2 reasons; firstly, it provides a more resilient solution and, secondly, it avoids the problem of jitter accumulation inherent in passing a sync source across a network.

Note that sync sources to different routers need only be frequency locked, not phase locked, since phase differences are compensated for by the router.
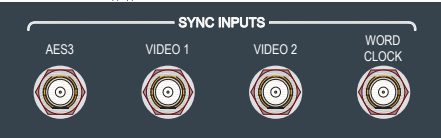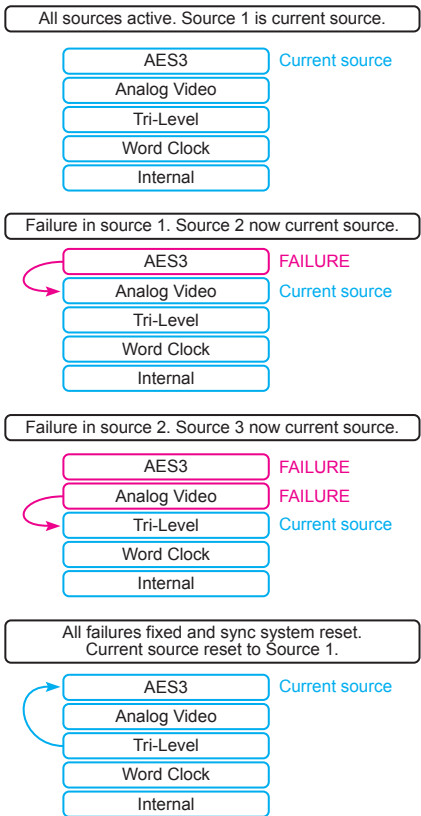
FIGURE 1 - SYNC INPUTS

FIGURE 2 - SYNC PRIORITY

MONITORING AND ALARMS

If any faults develop, alarms are generated and communicated via AWACS, Calrec's console alarm system.

In addition, the Hydra2 network may generate SNMP warnings for integration into a LAN-based monitoring scheme. This comprehensive approach to the rapid notification of failures helps to make system maintenance more responsive.

RELIABILITY

As with all Calrec products, reliability is a paramount consideration. Decades of experience underpin our uncompromising approach to power distribution, heat management and robust physical design – the cornerstones of Calrec's legendary product reliability.

At the heart of the Hydra2 network are the router cards. Each router card has a hot spare waiting to take over if a fault is detected in the primary card, with little or no disturbance to the audio.

All power supplies have redundant spares. Their outputs are diode-connected together so that, should one supply fail, a second is able to support the system without interruption. Of course, all power supplies are monitored so that any failures are reported via AWACS.

All Hydra2 audio interface units support both a primary and secondary cable connection. This means that should a cable be damaged or accidentally disconnected, the second takes over. In this case there is a brief interruption to the audio to and from that interface unit, of around one second.

If an audio unit becomes faulty, it is an easy matter for a technician to replace it. In the case of fixed format units, if a spare of a similar type is available, then it is a simple matter of setting the address to match the faulty unit (using the DIP switches on the rear of the unit), and plugging it in – the unit will automatically register with the network and start working within a few seconds.

In the case of modular units, individual interface cards may be replaced without interrupting the operation. For further protection, if system design permits, we would recommend spreading each interface type across several units. For example, if all mic inputs are distributed across four modular units, the loss of any one modular unit will result in the loss of one quarter of all mics. If crucial mics have backups, they can be connected to input ports on different boxes, providing a further level of resilience.

Reintroducing redundancy after a failure
It is as simple as swapping a failed unit for a working unit (which can be done while the system is powered and functioning) to re-introduce redundancy into the system.

If a secondary unit has taken over from a failed primary unit in the rare event of the failure in the system, a working spare unit can replace the failed primary unit.

The newly introduced spare unit will automatically take up the role of hot spare, ready to provide automatic take-over should the new primary unit fail.

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