L-ACOUSTICS LC16D
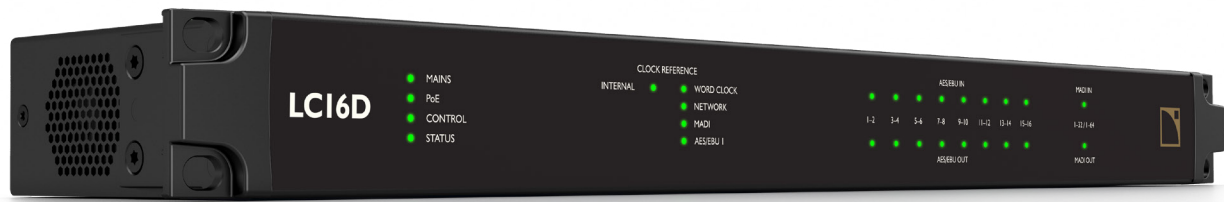## FEATURE OVERVIEW
August 2024

LC16D

INTRODUCTION

LC16D is a multichannel converter that bridges MADI and AES/EBU legacy digital formats bidirectionally with a Milan-AVB network. Supporting up to 128 Milan-AVB inputs and outputs simultaneously, LC16D offers dynamic mapping of channels, and comprehensive synchronization choices, with remote control via a simple to use embedded web interface. Flexible power options and seamless Milan-AVB network audio connections deliver robust redundancy features as standard, all housed in a compact and rugged 1RU chassis.

Key Features

- **High density, bidirectional interface** with seamless network redundancy
  - AES/EBU and MADI to/from Milan-AVB
  - 16 AES/EBU inputs and outputs
  - Up to 64 MADI inputs and outputs

- **Power redundancy**
  - 1 x AC mains and 2 x Power over Ethernet (PoE) inputs

- **Comprehensive clocking options**
  - Select from up to 6 clock sources
  - Selected reference distributed to all output formats

- **Dynamic channel mapping**
  - Any AES/EBU or MADI input to Milan-AVB output
  - Any Milan-AVB input to AES/EBU or MADI output

- **Embedded web interface for setup and supervision**
  - Accessble from any device with a network connection and web browser

- **Save, load and manage configurations**
  - Up to 10 user configurations

LC16D is designed as a plug-and-play device: out of the box all legacy digital inputs and outputs are presented to the Milan-AVB streams with a one-to-one channel mapping, AES/EBU first and then MADI. Only the required clock reference needs to be selected and LC16D is ready to pass audio. While providing this straightforward conversion the freedom to dynamically map channels is also available. Collectively, up to 80 legacy digital input sources and 80 output destinations can be connected to and from the Milan-AVB network. The remaining Milan-AVB channels, from the available 128 outputs, can be utilized to combine selections of AES/EBU and MADI input channels, creating custom Milan-AVB streams for optimized distribution to multiple network destinations. The dynamic mapping function also allows diverse Milan-AVB sources across multiple streams to be routed to the MADI and AES/EBU outputs from the network, bringing additional flexibility and versatility.

APPLICATIONS

By acting as an on-ramp and off-ramp for a redundant Milan-AVB network, LC16D can be deployed as part of any system where the audio network needs to be interfaced with AES/EBU and MADI formats. The extensive feature set makes it the perfect tool for rental, fixed installation, broadcast, corporate, yachts, home cinemas, and recording studio applications. Whether at the Front-of-House position, interfacing multiple digital consoles and devices, or at the monitor position, enabling connection to amplified controllers and IEM systems, the ease of configuration, dynamic mapping, and clocking options make it a flexible addition to any system.
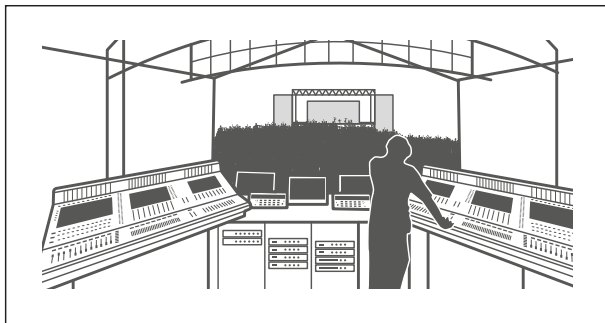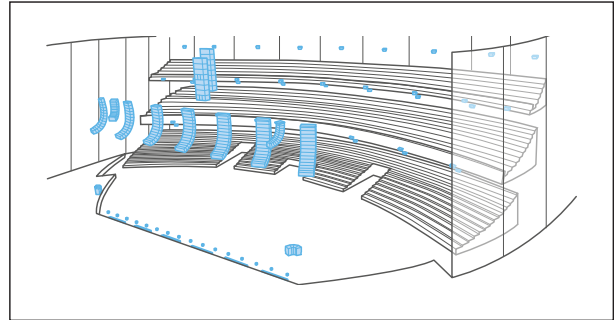

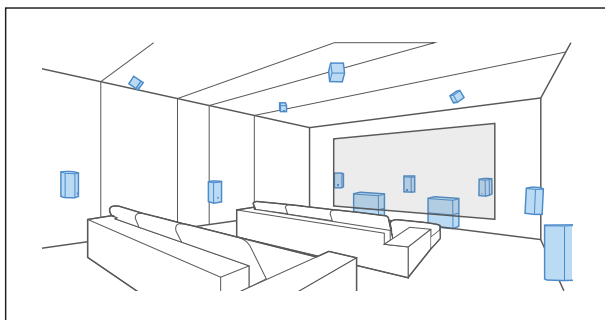Multi-Console: Simplify Festival and FOH interfacing
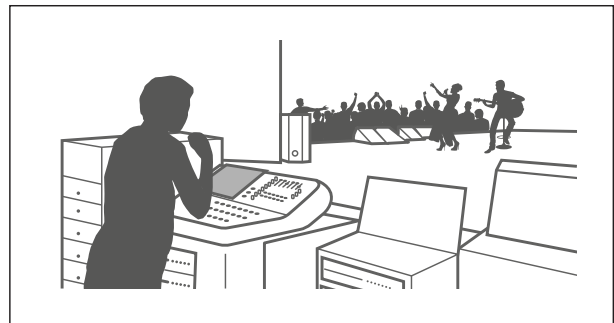
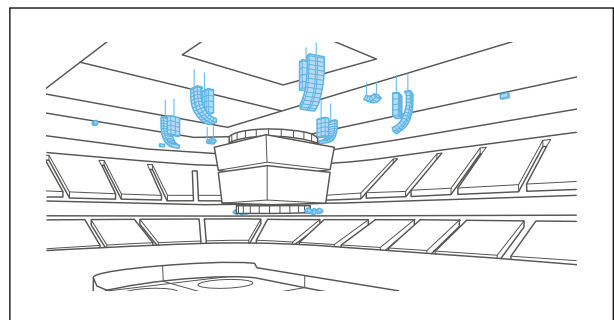Touring: Easily connect with amplified controllers and IEM systems
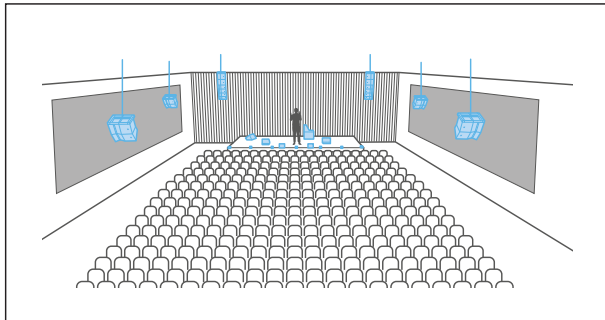
Broadcast and Corporate: Format conversion and signal distribution

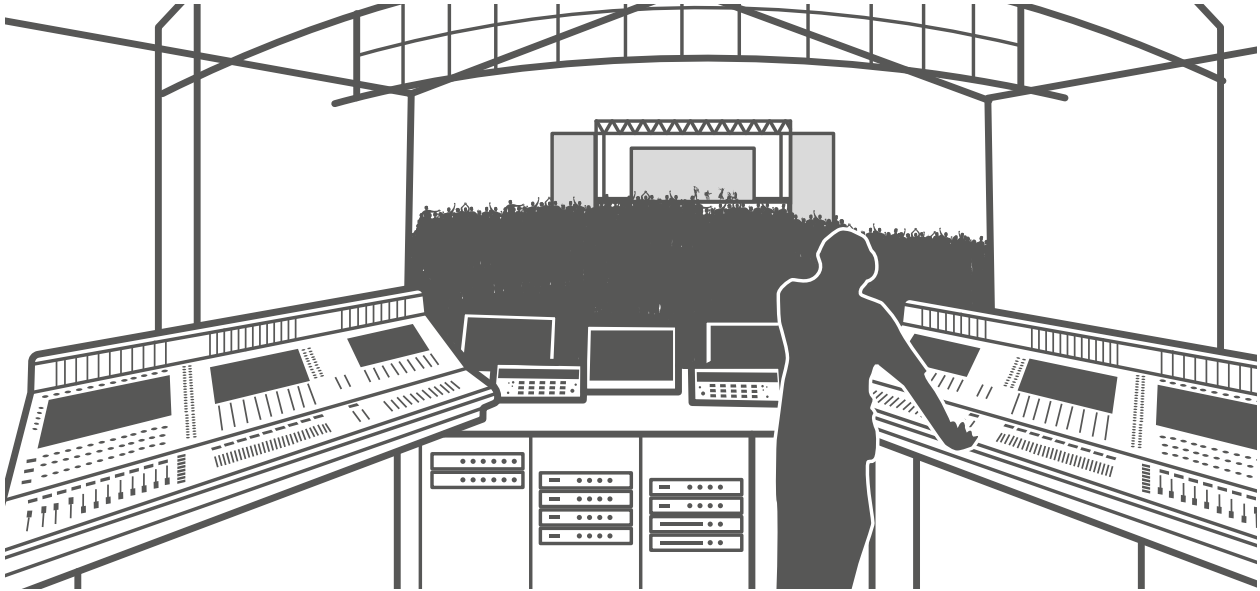Venues and Fixed Installations: L-ISA Processor II redundancy
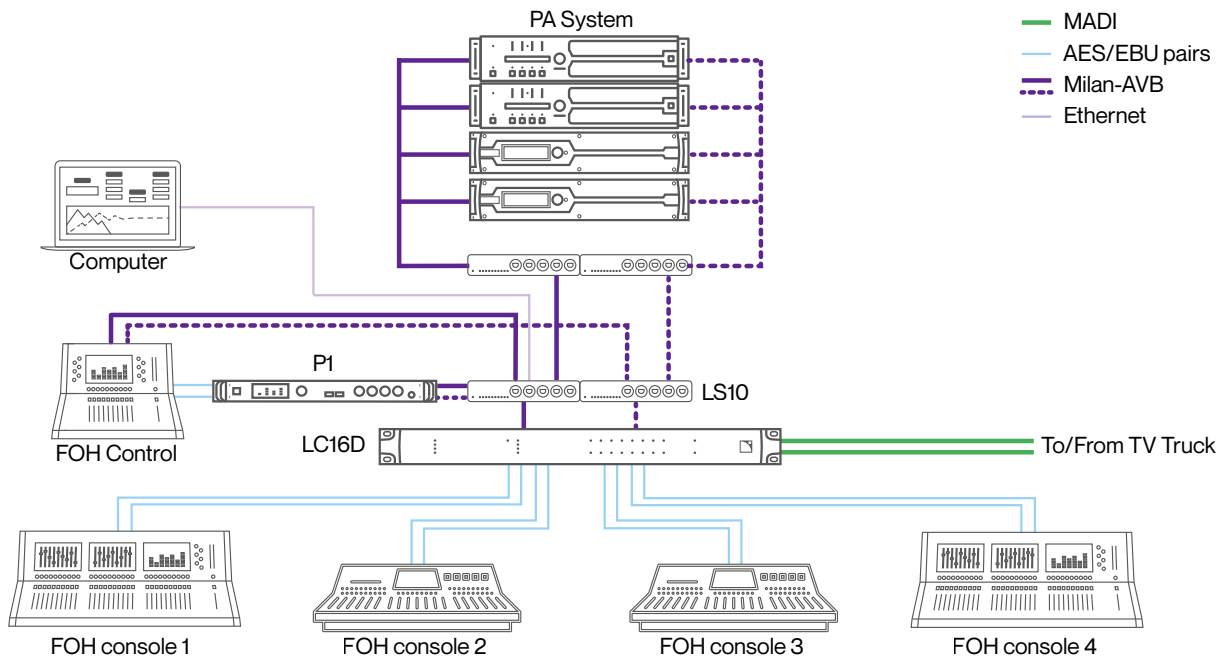

Residential: AV and Streaming Processor interface

Multi-Point Distribution: Milan-AVB network break-in and break-out

MULTI-CONSOLE APPLICATIONS: FESTIVALS

Connection Diagram

- MADI
- AES/EBU pairs
- Milan-AVB
- Ethernet

PA System

Computer

P1

FOH Control

LS10

LC16D — To/From TV Truck

FOH console 1   FOH console 2   FOH console 3   FOH console 4

LC16D Solution

In this example, there are cable drops for four artist consoles, with two pairs of AES/EBU inputs at each position. LC16D enables the artists mixing consoles to connect directly to the Milan-AVB backbone , with the P1 is receiving one input stream of eight channels from the redundant Milan-AVB network, plus the control console connected to its AES/EBU inputs. The control console manages the inputs from video playback, microphone announcements, and the TV truck. The P1 is bussing all these inputs together and drives the system through the redundant Milan-AVB network.

L-ACOUSTICS LC16D NETWORK AUDIO CONVERTER
FEATURE OVERVIEW

By using LC16D as an AES/EBU to Milan-AVB converter the number of available input connections into the drive system can be increased by up to 16 channels. With the ASRCs enabled on the AES/EBU inputs, multiple digital consoles can be connected without the need for a single clock reference to be distributed at the FOH position, allowing each digital console to continue using its own clock domain. This creates a plug-and-play digital audio distribution system that is streamlined and reliable and removes any need for additional A/D conversions in the signal path.

The output streams from LC16D can be mapped to the P1 through the Milan-AVB network, expanding the P1's input capabilities simply and efficiently. The embedded web server of LC16D gives access to the 10 configuration memories, which can be used to store changes in the Milan-AVB output mapping allowing combinations of the 16 AES/EBU inputs to be routed to the P1. The corresponding configuration can then be loaded when switching between different consoles. Increased usability could be added by remotely loading the user configurations using either the LC16D GPI's or the HTTP API together with a programmable keypad such an Elgato Stream Deck for example.

The MADI in and out of LC16D enables the TV truck to become part of the Milan-AVB network. With the TV truck connected to the MADI Out, it is a simple task to send reference mixes and other stems from the FOH position. The MADI In of LC16D facilitates audio from the TV truck to enter the network and be distributed wherever needed. Many TV trucks have multichannel SRCs available so that they can retain their own clock domain while connected to other audio sources, or alternatively, as LC16D distributes the selected reference clock through its MADI output the TV truck could synchronize to the incoming connection as needed.
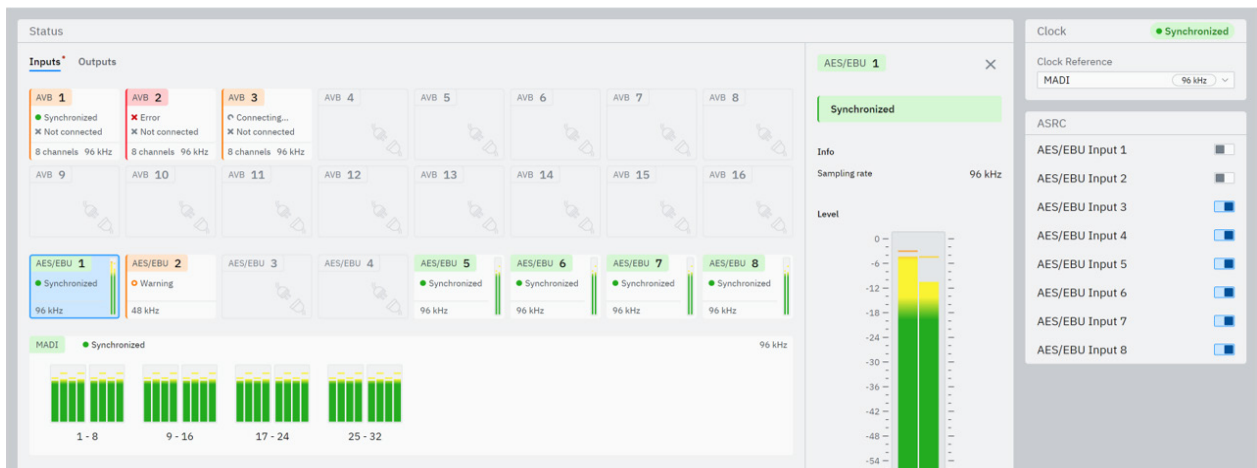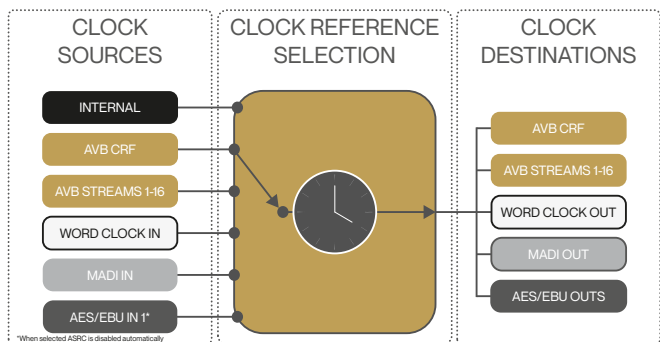

TECHNICAL NOTE: CLOCKING ARCHITECTURE

The internal clock of LC16D can act as the system reference for any connected devices. Alternatively, an input source connection can be selected as the clock reference for all output destinations, enabling LC16D to act as a distribution point for system synchronization. Should the selected clock source be temporarily lost, LC16D will 'freewheel' allowing audio to continue passing, until the clock connection is re-established.

Internally LC16D is a single clock domain device and operates at a base sampling rate of either 96 kHz or 48 kHz.

The AES/EBU inputs each offer an asynchronous sample rate converter (ASRC), which can be enabled or disabled on a per-pair basis. The ASRCs facilitate sources using multiple clock domains to be accommodated and interfaced with the Milan-AVB network. If AES/EBU input 1 is selected as the clock reference its ASRC will be disabled automatically.
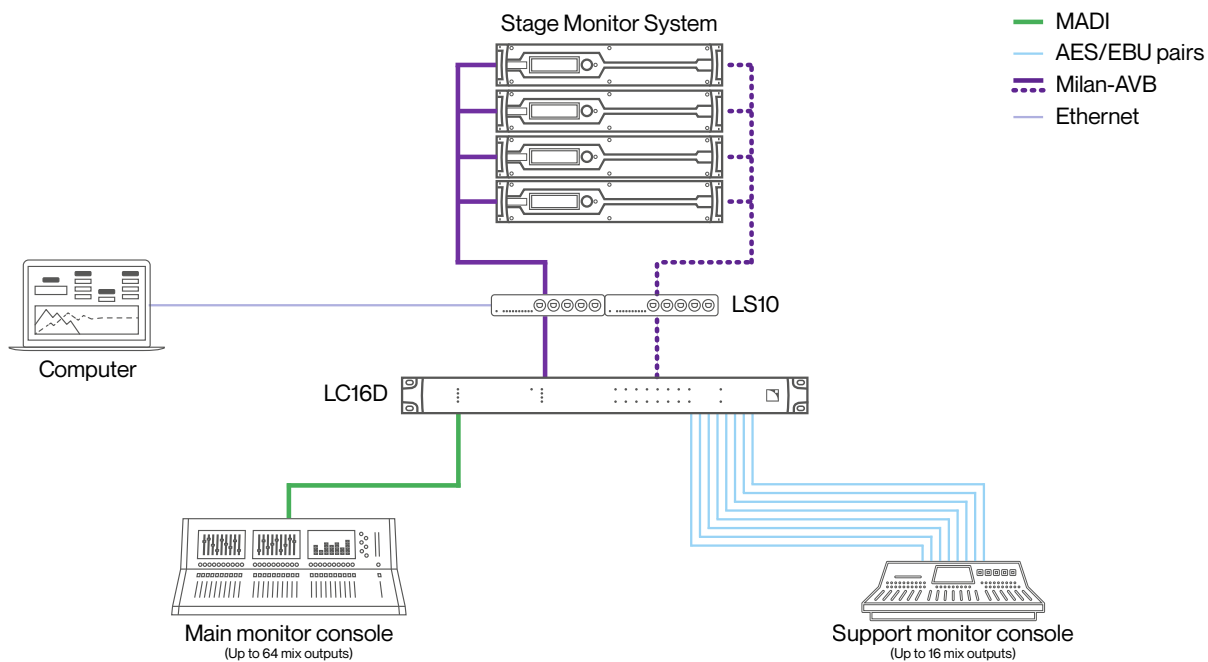
TOURING APPLICATIONS: STAGE MONITORS

Connection Diagram

- **——** MADI
- **——** AES/EBU pairs
- **┅┅** Milan-AVB
- **——** Ethernet

Stage Monitor System

LS10

Computer

LC16D

Main monitor console
(Up to 64 mix outputs)

Support monitor console
(Up to 16 mix outputs)

LC16D Solution

The connectivity of LC16D makes it the ideal interface between a digital mixing console and LA7.16 or LA7.16i amplified controllers. In this example, two monitor consoles are sharing amplified controller inputs simply and easily, while also increasing channel routing and setup flexibility.

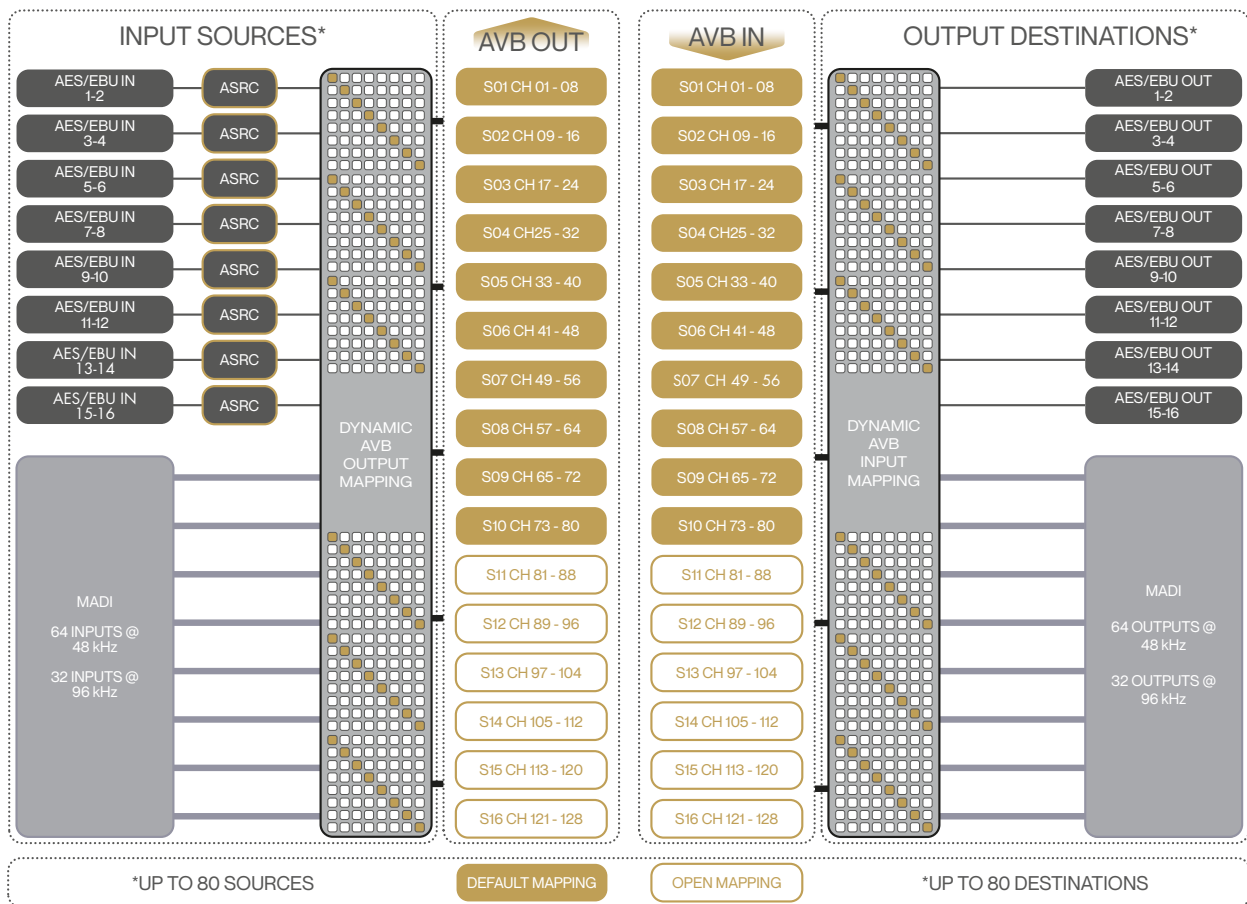# L-ACOUSTICS LC16D NETWORK AUDIO CONVERTER
FEATURE OVERVIEW

With a single BNC MADI connection from the main monitor console to the LC16D, up to 64 mix outputs can be converted, mapped to the redundant Milan-AVB outputs and routed to the inputs of the four LA7.16 amplifeid controllers. Simultaneously up to 16 AES/EBU mix outputs from the support artists' console can be connected to the AES/EBU inputs of LC16D. The ASRCs allow both consoles to remain on independent clock domains and the outputs from the support console can be mapped to the inputs of LA7.16 dynamically. The individual channel mappings could be stored and loaded using the user configuration memories of LC16D.

Similar benefits apply to fixed installations, where the high channel density and multi-format conversion of LC16D enable versatile and adaptable interfacing within a large Milan-AVB-based network and drive system.
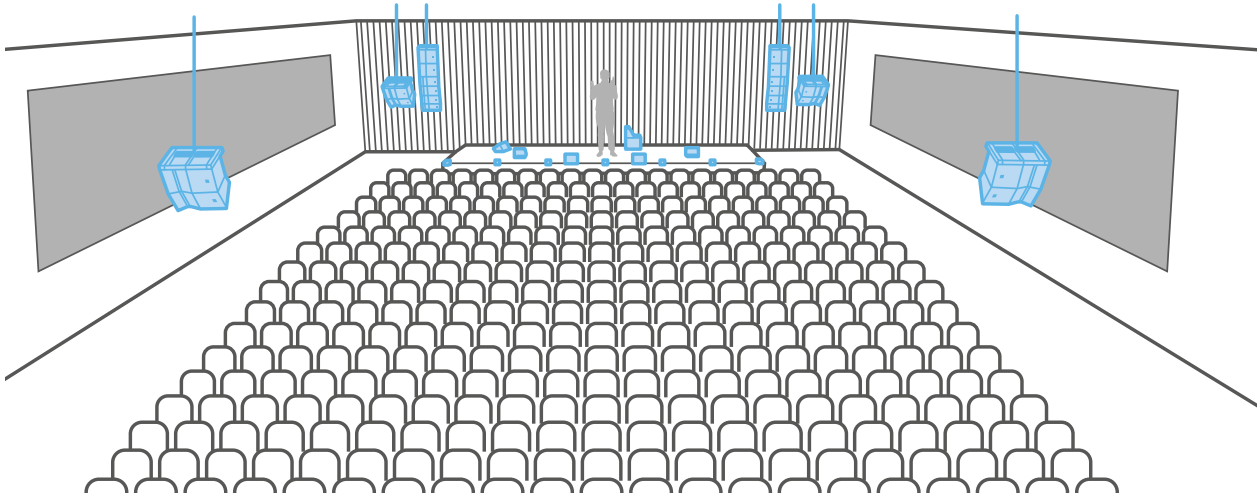
TECHNICAL NOTE: DYNAMIC MAPPING

Out of the box, the default channel mapping of LC16D uses a logical one-to-one layout, allowing devices to be connected and used immediately in most situations. This mapping positions the AES/EBU channels on the first two Milan-AVB streams and MADI is mapped from the third Milan-AVB stream, up to stream 10, if operating at a 48 kHz sampling rate, using 80 channels in total for the legacy ins and outs. The remaining Milan-AVB inputs and outputs are open for added routing flexibility.
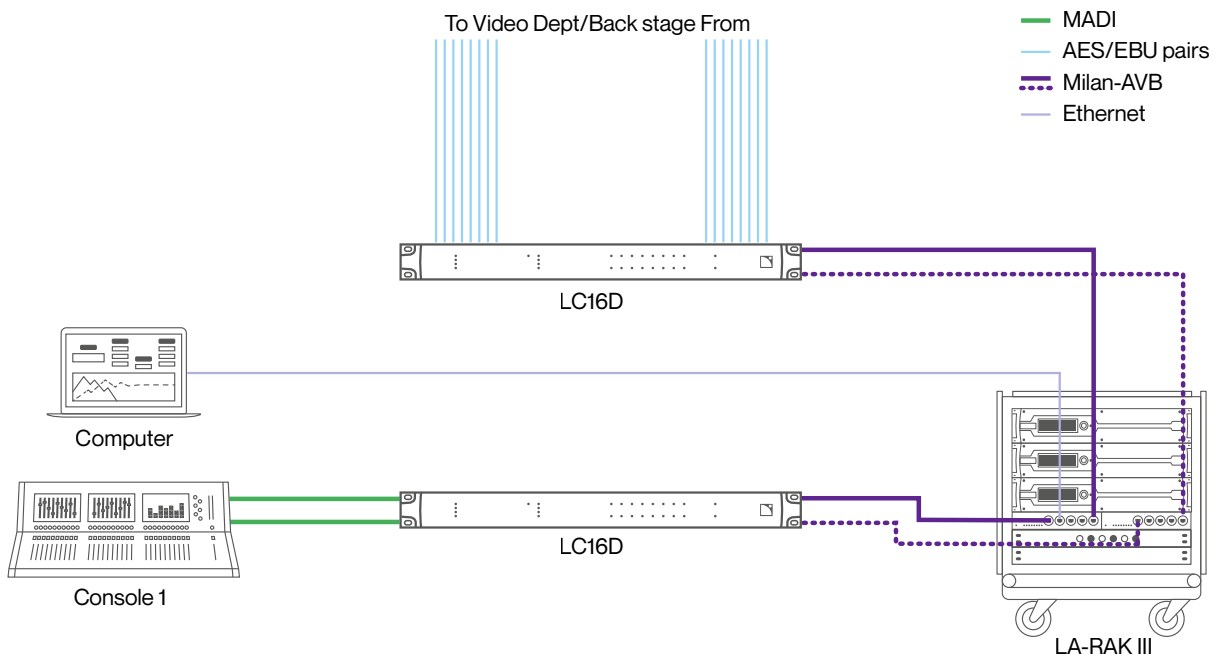
Dynamic mapping is accessed through a practical crosshair matrix layout, making the process of creating complex routing schemes and tracing channel sources and destinations straightforward. The mapping view can conveniently be expanded or condensed, accommodating diverse screen resolutions and display needs.

INPUT SOURCES*	AVB OUT	AVB IN	OUTPUT DESTINATIONS*
AES/EBU IN 1-2 → ASRC	S01 CH 01 - 08	S01 CH 01 - 08	AES/EBU OUT 1-2
AES/EBU IN 3-4 → ASRC	S02 CH 09 - 16	S02 CH 09 - 16	AES/EBU OUT 3-4
AES/EBU IN 5-6 → ASRC	S03 CH 17 - 24	S03 CH 17 - 24	AES/EBU OUT 5-6
AES/EBU IN 7-8 → ASRC	S04 CH 25 - 32	S04 CH 25 - 32	AES/EBU OUT 7-8
AES/EBU IN 9-10 → ASRC	S05 CH 33 - 40	S05 CH 33 - 40	AES/EBU OUT 9-10
AES/EBU IN 11-12 → ASRC	S06 CH 41 - 48	S06 CH 41 - 48	AES/EBU OUT 11-12
AES/EBU IN 13-14 → ASRC	S07 CH 49 - 56	S07 CH 49 - 56	AES/EBU OUT 13-14
AES/EBU IN 15-16 → ASRC	S08 CH 57 - 64	S08 CH 57 - 64	AES/EBU OUT 15-16
DYNAMIC AVB OUTPUT MAPPING	S09 CH 65 - 72	S09 CH 65 - 72	DYNAMIC AVB INPUT MAPPING
	S10 CH 73 - 80	S10 CH 73 - 80	
	S11 CH 81 - 88	S11 CH 81 - 88	
MADI	S12 CH 89 - 96	S12 CH 89 - 96	MADI
64 INPUTS @ 48 kHz	S13 CH 97 - 104	S13 CH 97 - 104	64 OUTPUTS @ 48 kHz
32 INPUTS @ 96 kHz	S14 CH 105 - 112	S14 CH 105 - 112	32 OUTPUTS @ 96 kHz
	S15 CH 113 - 120	S15 CH 113 - 120	
	S16 CH 121 - 128	S16 CH 121 - 128	
*UP TO 80 SOURCES	DEFAULT MAPPING	OPEN MAPPING	*UP TO 80 DESTINATIONS

TOURING APPLICATIONS continued

BROADCAST AND CORPORATE APPLICATIONS: CONFERENCE

Connection Diagram

To Video Dept/Back stage From

— MADI
— AES/EBU pairs
--- Milan-AVB
— Ethernet

LC16D

Computer

Console 1

LC16D

LA-RAK III

LC16D Solution

In this corporate application, the capabilities of the redundant Milan-AVB network are being fully utilized with the presence of two LC16D. The first LC16D at the console position is primarily acting as the interface between the console and the LA-RAK III, converting a MADI output and mapping these channels across the network to the inputs of the LA7.16 amplified controllers.

However, the network is not only being used to connect to the LA-RAK III and drive the loudspeakers, it is also able to distribute audio that is not directly related to the PA system. With up to 64 outputs from the console being accessible with the system operating at 48 kHz sampling rate, some of the console outputs are mapped to drive the loudspeaker systems, while other outputs are mapped to the second LC16D which is placed backstage with the video department. They can receive audio through the AES/EBU outputs from FOH and send audio back to FOH using the AES/EBU inputs of the same device, which then maps to MADI inputs at the console position. Allowing the Milan-AVB infrastructure to act like an extended stagebox system for the digital mixer.

Inline PoE injectors can be added at the LA-RAK III position for LC16D in the video department position, removing the need for a mains power outlet to be found close to the same area.

This versatility shows how LC16D can be used as a problem-solving utility product, adding further value.
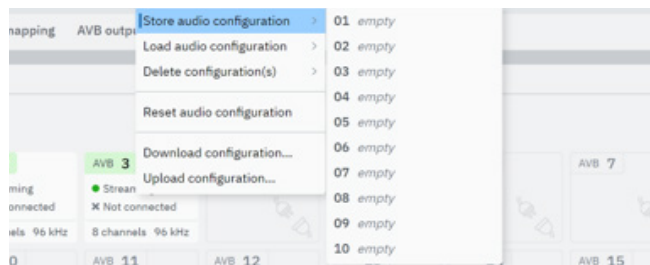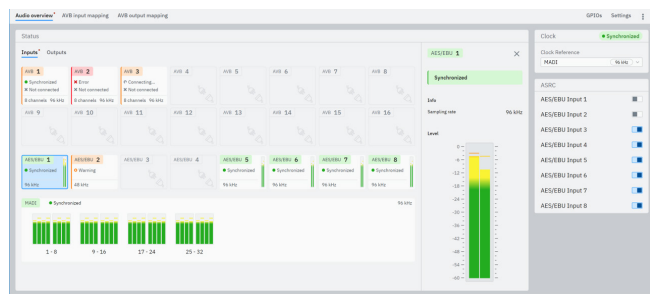
TECHNICAL NOTE: CONTROL AND SOFTWARE

Configured, controlled, and monitored through an embedded web server, LC16D is accessible from any device with a web browser and an Ethernet network connection by simply typing the IP address of the unit into the search bar.

The web server's intuitive user interface enables the configuration of general settings, selection of the clock reference, channel mapping management, and setup of GPIOs. The status of AES/EBU, MADI, and clock source connections can be monitored in real-time.

Configurations can be stored in one of 10 internal memory positions and loaded when required. These can also be saved to the control device for backup and transfer to other LC16D units.

AVDECC control software, such as Milan Manager, can be used to create and configure streams between LC16D and other devices on the Milan-AVB network.

A separate Windows and macOS software utility, LA Device Scanner, is available to facilitate the discovery of and connection to LC16D with a single click through the computer's default web browser. However, this practical utility is not exclusively for use with LC16D; LS10, P1, and all amplified controllers can benefit from its extended feature set. These include the scanning and identification of individual units on the network, the naming of devices, and the management of IP addresses, including the resolution of IP conflicts. MAC addresses and serial numbers are also displayed and a table of information from the discovered devices can be exported as a CSV file. This can all be achieved remotely, helping to streamline the setup and configuration of any L-Acoustics system.
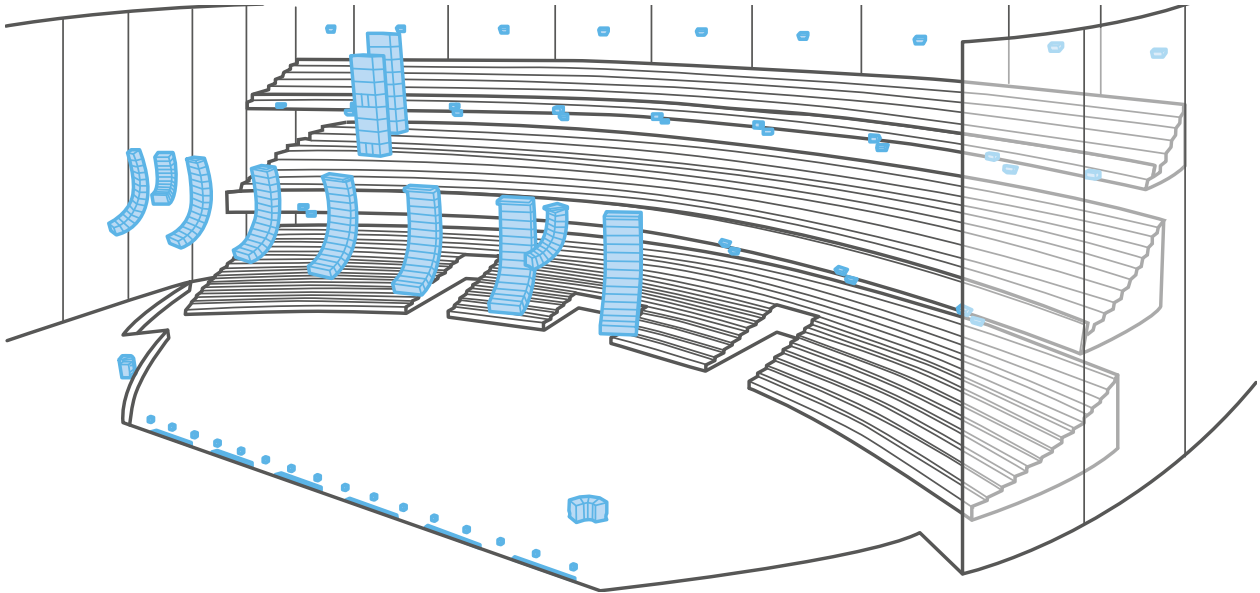
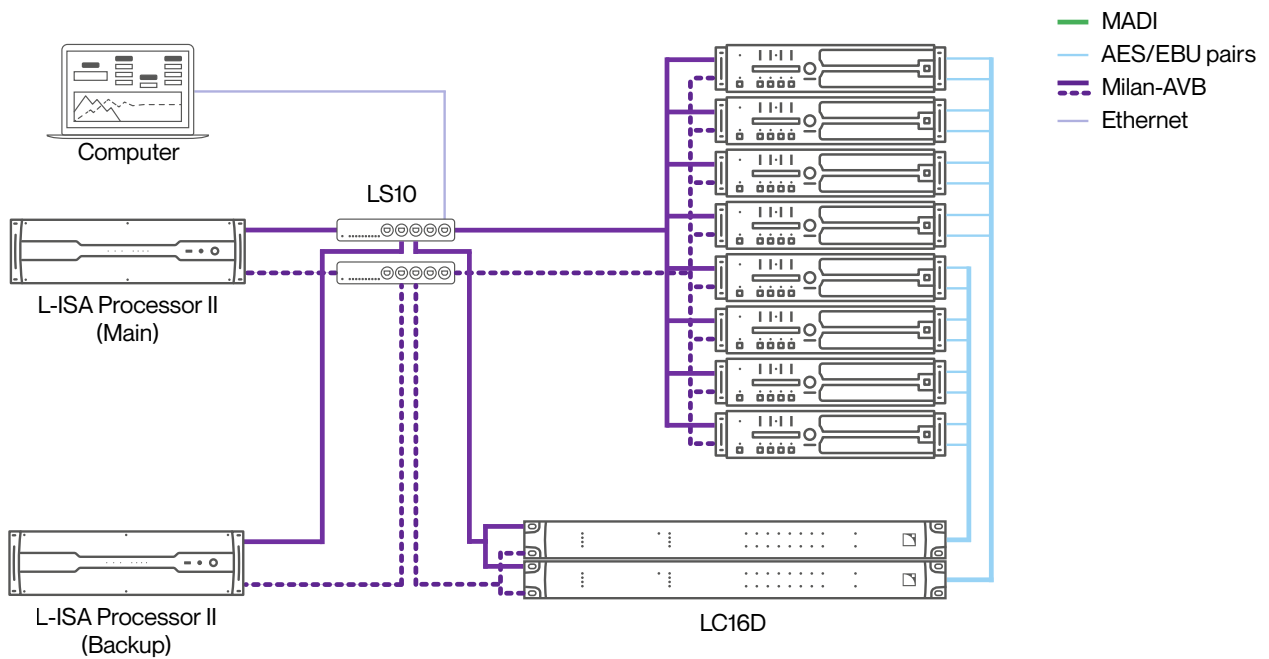## VENUES AND FIXED INSTALLATION APPLICATIONS: L-ISA PROCESSOR II

Connection Diagram

Legend:
— MADI
— AES/EBU pairs
- - Milan-AVB
— Ethernet

Computer

LS10

L-ISA Processor II (Main)

L-ISA Processor II (Backup)

LC16D

LC16D Solution

In this example, the system uses 4-channel amplified controllers, with the primary and backup L-ISA Processor IIs connected via a standard redundant Milan-AVB network. The primary processor is routed to the amplified controllers over the redundant network, while the backup L-ISA Processor II feeds the LC16Ds.

Integrating this second processor can be achieved by utilizing the existing fallback capabilities of the amplified controllers, together with LC16D. By employing the AES/EBU outputs of the LC16D and connecting them to the AES/EBU inputs of the 4-channel amplified controllers the fallback system can be used to switch between the two L-ISA Processors IIs. The backup L-ISA Processor II can be integrated into the system effortlessly, keeping it isolated from the primary processor and the main Milan-AVB network infrastructure. Allowing the creation of a backup immersive mixing system with smooth input source switching. In this illustration up to 32 L-ISA outputs can be managed using two LC16D and this number can be adapted to the output requirements of the design by adding more units.

The innovative redundant power scheme of the LC16D enables up to three separate sources to supply the unit, and each has the capacity to power it individually. Allowing the LC16D to continue to pass audio in almost any scenario should one or more power sources or phases fail, giving peace of mind.

The LC16D enables additional layers of redundancy to be integrated into this type of setup, without adding significant cost or complexity.
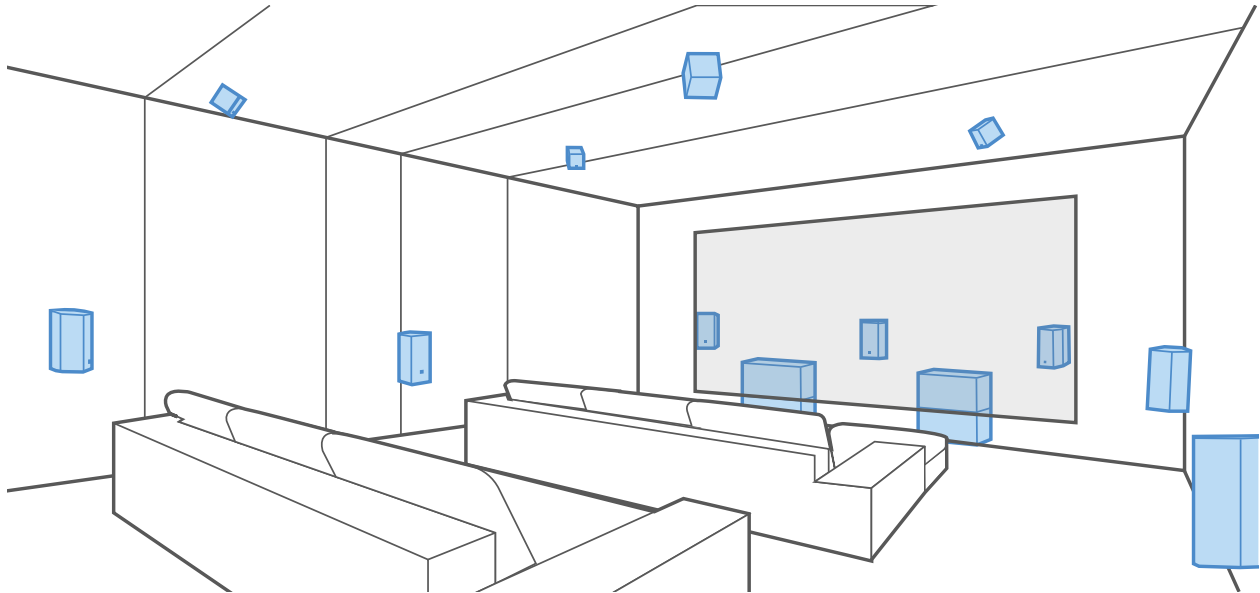
TECHNICAL NOTE: USER INTERFACE

| 1 | Mains, PoE, Control and Status LEDs | 3 | AES/EBU input / output Status, Signal, and Clip LEDs |
| 2 | Clock Reference LEDs | 4 | MADI input / output Status, Signal, and Clip LEDs |
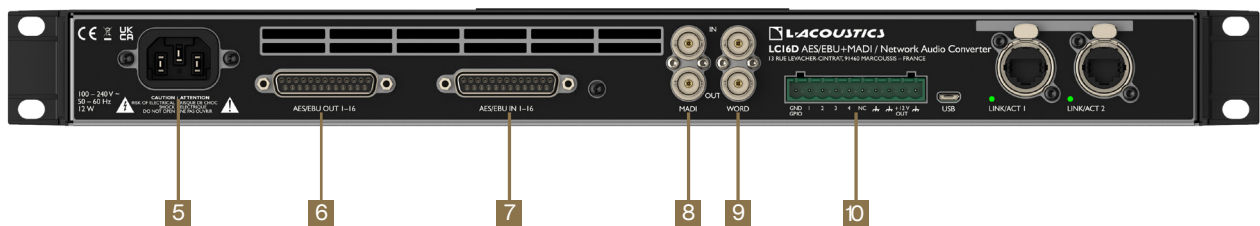
5	IEC V-Lock™ compatible power supply inlet	9	Word clock input and output (BNC connectors)
6	AES/EBU outputs (25-pin D-SUB connector, AES59 8-way compatible)	10	10-point terminal block connector (with General Purpose I/O)
7	AES/EBU inputs (25-pin D-SUB connector, AES59 8-way compatible)	11	USB port for IP address configuration and initial setup
8	MADI input and output (BNC connectors)	12	etherCON™ 1 Gb/s Ethernet connectors (with PoE)

VENUES AND FIXED INSTALLATION APPLICATIONS continued

RESIDENTIAL APPLICATIONS: HOME CINEMA

Connection Diagram

LA7.16i

LS10

Computer

LC16D

AV Processor
with AES/EBU outputs

AV Control System

— MADI
— AES/EBU pairs
- - Milan-AVB
— Ethernet
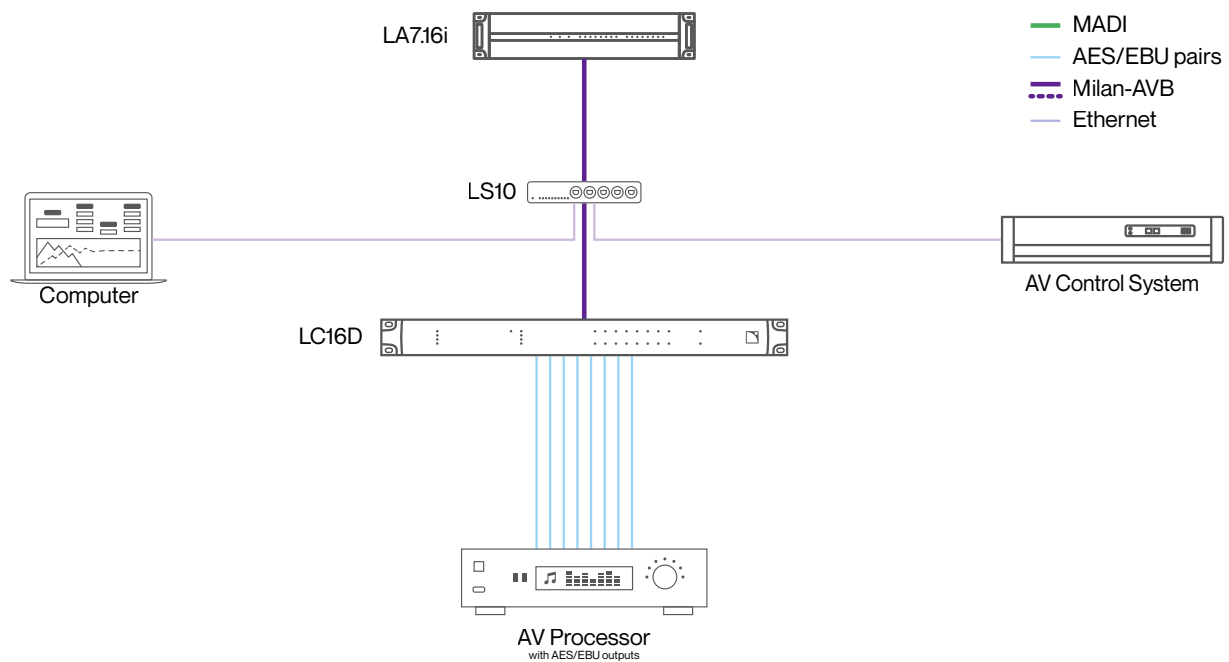
LC16D Solution

The AV processor used in this example can deliver up to 16 discrete AES/EBU output channels as standard, making a 9.1.6 configuration possible. LC16D converts the AES/EBU outputs from the AV processor to Milan-AVB network audio. Making the audio interfacing between the AV processor and amplified controllers simple and efficient, with a single Ethernet cable. LA7.16i, with its 16 amplifier channels, offers a high-density and powerful solution capable of driving the entire loudspeaker system, using just two rack spaces.

The AV processor is upgradable and can deliver up to 32 AES/EBU outputs. In this case, multiple LC16D can be used, and the number of amplified controllers increased, all connected using the same Milan-AVB network architecture.

Managing the Milan-AVB output channel mapping through LC16D simplifies the signal flow and increases system flexibility. The AV control system can interface with LC16D using the HTTP API, or through the GPIs, allowing it to load user configurations that change channel mapping as needed for each decoding format. This approach has the added benefit of not affecting the DSP utilized within the LA7.16i amplified controller during the loudspeaker system calibration process.

LC16D can also report potential fault states to the AV control system via its GPO connections, enabling remote status monitoring through the central AV control system. These can include loss of AES/EBU inputs, Milan-AVB network connections, and general health states for example. Allowing closer integration with the larger AV system.
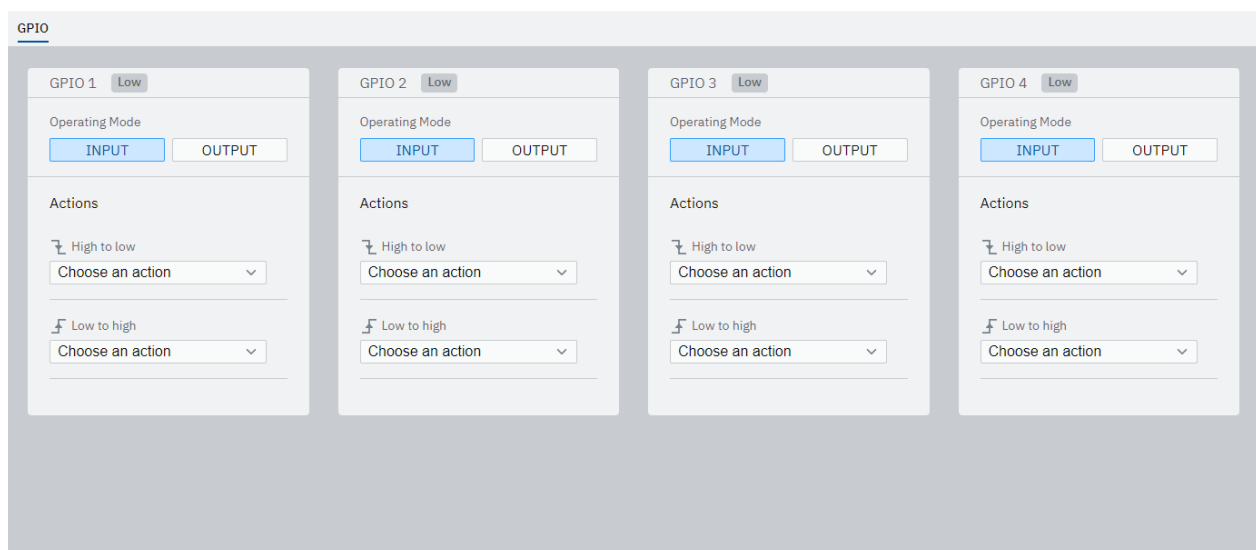
TECHNICAL NOTE: MILAN-AVB AND MILAN MANAGER

AVB is the only protocol that guarantees deterministic and synchronous network behavior, ensuring on-time delivery of time-sensitive data. Milan is the applications layer on top of AVB, independent from any private entity, that ensures seamless interoperability between any Milan-certified device. The Milan initiative developed agreed-upon standards for media stream format, media clocking, seamless redundancy, and more so that no IT expertise is required to set up a reliable and deterministic AVB network with Milan-certified devices.

Milan-AVB is an evolving, long-term, viable and durable network developed by the industry for the industry.

Milan Manager is a free-to-use application for the configuration, management and monitoring of any Milan-AVB network.

Compatible with Windows and MacOS, Milan Managers' user-centric workflow simplifies and streamlines the deployment of the network, regardless of its complexity. Its clean and intuitive tab-based interface provides fast and efficient access to all essential functions while delivering clear, real-time network status reporting for peace of mind.

MULTI-POINT DISTRIBUTION APPLICATIONS: SPORTS ARENA
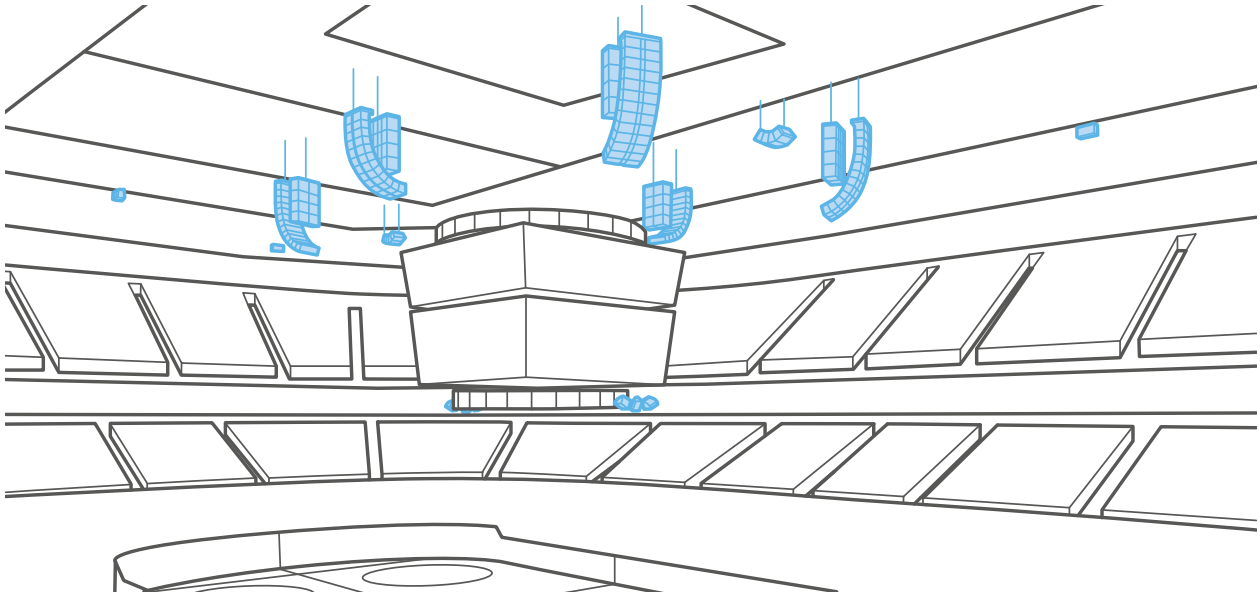
Connection Diagram
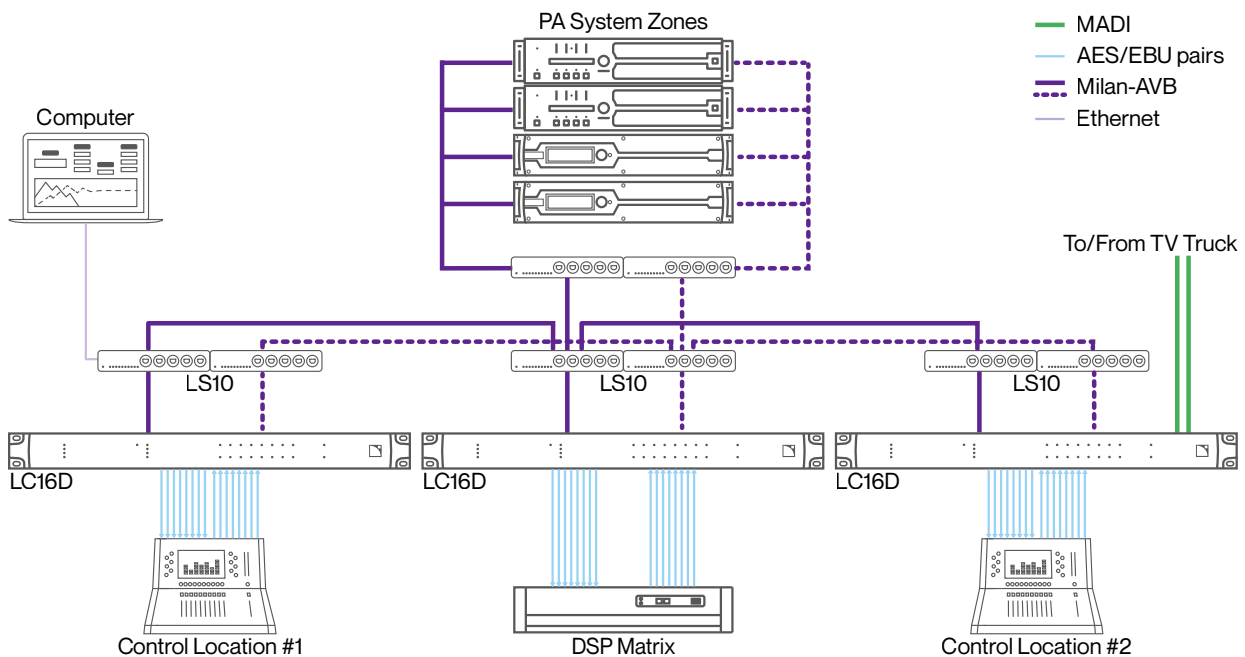
LC16D Solution

In many sports arena and stadia, multiple mix positions or control locations connect to a central DSP matrix. At each location an LC16D can be integrated, enabling mixing consoles or other equipment to connect to the audio network through the eight AES/EBU pairs, or 16, inputs and outputs. Using Milan-AVB as the primary system connection brings peace of mind, with the capability to deploy the audio network with seamless redundancy as standard, and its robust plug-and-play connectivity. With LC16D each location also offers MADI connectivity, enabling an outside broadcast truck to interface with the building's Milan-AVB network architecture simply and easily. This flexible solution makes it possible to accommodate almost any connection requirement across the system.

Audio can be sent and received at all locations, with the central DSP managing the overall signal flow and distribution around the building where needed. Our plug-ins and modules give access from 3rd party platforms, such as Q-SYS and Crestron, enabling remote monitoring, and control, of the L-Acoustics ecosystem via these control systems. For integration into a PAVA system, the AES/EBU or analog connections of the amplified controllers can be configured via LA Network Manager and used as fallback inputs for the main system or voice evacuation messages, additional LC16D could be used for this purpose.

TECHNICAL NOTE: THIRD-PARTY INTEROPERABILITY

L-Acoustics has developed several modules and plug-ins that facilitate integration with many popular media control systems, allowing interoperability between the L-Acoustics ecosystem and third-party platforms. They permit centralized monitoring and management, via a customized interface, of L-Acoustics electronics products alongside other types of devices. This includes continuous monitoring where voice alarm integration is a requirement.

* Supported AV control solutions:

Q-SYS TECHNOLOGY PARTNER

HTTP

CERTIFIED CRESTRON Integrated Partner

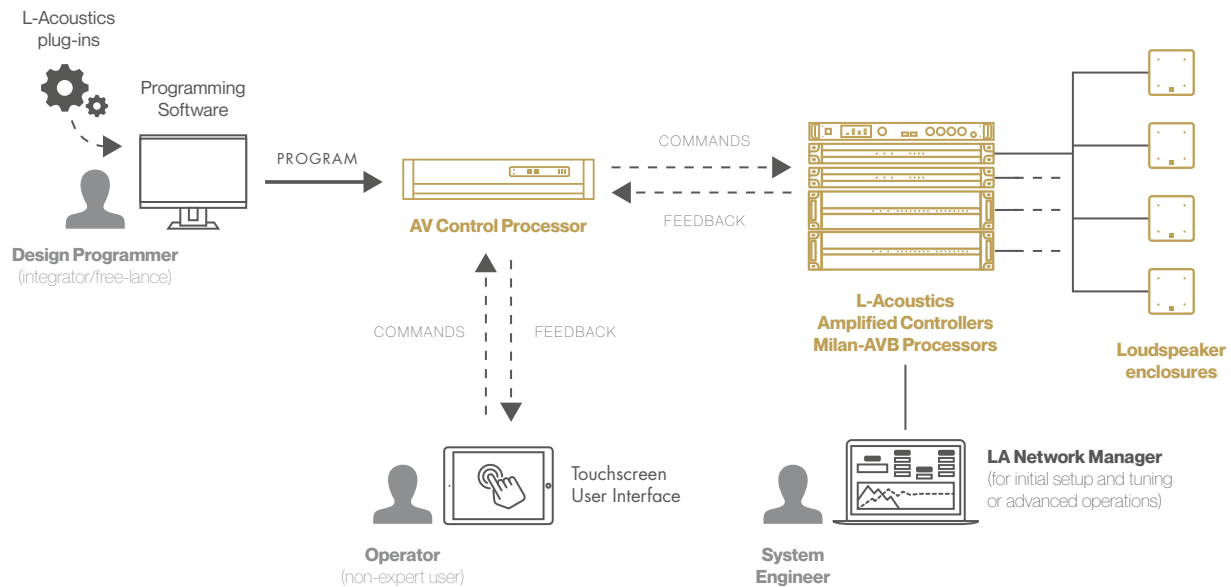** Additional solutions are supported by other L-Acoustics electronics products. Refer to individual product webpages or system spec sheets for details.*

Connection Diagram