



Simplifying System Design with ARC and eARC Audio

Understanding audio return channels and their capabilities.



Audio system design is one of the most complex disciplines in audiovisual technology. The designer must account for the acoustic characteristics of the space and furnishings; the number and position of listeners in the space; ideal speaker positions and structural impediments; noise control and sound isolation; customer goals, and more. Usually, advancing technology only seems to add to the complexity. However, when it comes to audio distribution, the evolving HDMI specification now offers incredible simplicity for the right applications.

In this whitepaper, we'll explore the capabilities and applications for HDMI's Audio Return Channel (ARC) and enhanced Audio Return Channel (eARC) in professionally integrated audiovisual systems, including benefits, limitations, and equipment considerations.

The past fourteen years have produced a healthy ecosystem of ARC and eARC devices: with the right approach, integrators can leverage this technology to create extremely efficient designs that are easy to install and troubleshoot.

What are ARC and eARC?

ARC and eARC are bi-directional audio transmission protocols that are part of the HDMI specifications. They allow a simple daisy-chain setup: source(s), display, sound system, with a single HDMI link between the display and the sound system. This design can vastly simplify cabling, particularly for systems with multiple sources.

ARC Overview

ARC was introduced in 2009 as an optional part of the HDMI 1.4 specification. It has a maximum audio bandwidth of 1 Mbps, which is relatively lean: ARC cannot transmit uncompressed immersive audio formats. However, ARC does support the lossy format Dolby Digital Plus, which allows the transmission of compressed Dolby Atmos and Dolby 5.1 surround sound. If a system's primary audio source is streaming video, ARC is generally up to the task.

eARC Overview

HDMI introduced eARC in 2017, greatly increasing the maximum audio bitrate and number of supported formats for audio over HDMI. By dedicating the "data" channel of "HDMI with Ethernet" to audio transmission, HDMI was able to create a new bi-directional audio protocol with a maximum bandwidth of 37 Mbps. eARC can support uncompressed 5.1 and 7.1 surround sound, Dolby TrueHD, DTS-HD, and other audio formats intended for HiFi and theatrical applications. It includes other improvements as well: For example, lip sync correction, which was an optional feature for ARC, is mandatory for eARC.

There is full backwards compatibility between the old ARC protocol and newer eARC devices. If a link in the signal chain supports ARC but not eARC, the whole system defaults to ARC for "best effort" delivery. This is a handy lifecycle consideration, allowing system owners to upgrade components and cables over time without any interim loss of functionality or requirement for a complete system overhaul.

Professional Applications

ARC and eARC were developed primarily for residential systems to reduce the number of cables the system owner needs to hide. That said, after 14 years of ecosystem development, there is now a vast pool of commercial equipment that supports these protocols. ARC and eARC have become viable options for commercial applications: So, when should integrators consider them?

The main benefit of ARC/eARC technology is simplicity. When costs or other considerations constrain system complexity, these protocols can reduce cable infrastructure requirements. Examples of scenarios where an integrator may wish to consider leveraging ARC/eARC for audio distribution include:

Historical Sites

In historic buildings, it's often very important to limit impact on the original architecture and materials of the space. Using ARC or eARC can allow an entire system to be connected with a single unobtrusive cable.



Divisible Spaces

When using ARC/eARC, the sound system automatically plays the audio associated with whatever source is on screen. This feature is convenient for divisible rooms: When the space is combined, all speakers and screens display the same content. When it is divided, the speakers in each segment of the space automatically play the content associated with the screen(s) in that segment.



Rental and Staging

Simple cable infrastructure means fast setup and breakdown. ARC/eARC offers a single cable solution for rental and staging setups such as conference breakout rooms. It also simplifies setup for presentations with video or program audio.

Equipment Considerations for ARC and eARC Distribution

ARC and eARC are both optional features of the HDMI specification. As a result, HDMI certification does not guarantee support. Integrators wishing to leverage ARC and eARC must verify every link of the signal chain, including cables, devices, and ports.

Any device produced before 2009 will not be compatible with ARC or eARC. On more recent source and sink devices with multiple HDMI I/Os, it is common for only some ports to support ARC or eARC; compatible ports are usually labelled. ARC/eARC support is often less clearly indicated for distribution devices, cables, and other infrastructure equipment, however. Integrators are advised to read device specifications closely and maintain awareness of which devices support ARC/eARC audio distribution when an application calls for it.

Cables

Any HDMI cable labeled as "HDMI with Ethernet" should support ARC and eARC distribution. However, HDMI cable labelling can be unclear, and cable

vendor quality varies widely – and worse, issues relating to cable quality can be challenging to troubleshoot. Best practice calls for using the highest-quality and bandwidth cable infrastructure a project’s budget allows. High-bandwidth, redundant cable infrastructure makes systems easier to maintain, troubleshoot, repair and upgrade.



[UHD8K](#) Certified Ultra High Speed HDMI Cables

Certified UHD HDMI Cables

For high-demand applications, and to prepare for future requirements, integrators should employ cables that carry HDMI’s stringent Ultra High Speed HDMI Cable Certification. This certification ensures that the cable supports all HDMI 2.1b features, including eARC, as well as uncompressed UHD video up to 8K@60Hz. Certified UHD HDMI cables are also low-EMI, reducing any possibility of interference in noisy RF environments.

Vanco was among the first to market with Certified UHD HDMI cables. Their traditional copper UHD 8K cables are available in lengths from 1 – 16 feet (0.3 – 4.8m). Vanco also offers active optical Certified UHD HDMI cables in lengths up to 66 feet (20m). These cables can support up to 32 audio channels, with support for the most demanding immersive audio formats on the market. They also support HDMI 2.1b features designed for gaming and interactivity, including Variable Refresh Rate (VRR), Auto-Low Latency Mode (ALLM), and Quick-Frame Transport (QFT), making them ideal for applications such as eSports or real-time production.

HDMI Switches

ARC and eARC are an extremely convenient solution for spaces with multiple BYOD HDMI sources, such as conference spaces or huddle rooms. An HDMI switch with ARC or eARC support ensures plug-and-play audio and video for all participants. For example, Vanco’s EVSW1042 Evolution 4K 4X1 HDMI Switch supports 4 HDMI inputs with ARC for a single display. It has both automatic and manual switching modes, and digital and analog audio outputs for extraction.



[EVSW1042](#) 4K 4x1 HDMI Switch with ARC and HDR

HDMI Extenders

Professional applications often call for cable runs that exceed the maximum length of even active optical HDMI cables. Fortunately, HDMI signals can be extended over Cat cable with full ARC or eARC support.

HDBaseT 3.0 Extension

HDBaseT 3.0 can support ARC or eARC. In fact, a fully-featured HDBaseT 3.0 extender can simplify signal distribution for a wide range of systems, accommodating and extending not just audio and video, but control, data, USB signals, power over a single cable.



[EVEXHDB3](#) 4K HDBaseT Extender with eARC, KVM, PoH and Ethernet

Vanco’s award-winning EVEXHDB3 Evolution HDBaseT 3.0 Extender delivers uncompressed 4K@60Hz video up to 330 feet (100m) over Cat6a/7 cable, with ARC and eARC compatibility. It features the ability to embed a separate audio source, or de-embed/extract audio from the source or display end. The EVEXHDB3 also includes an HDMI loop-out for local signal monitoring or audio de-embedding. This extender supports multiple audio formats, including LPCM, Dolby Digital/Plus/EX, Dolby True HD, Dolby Atmos, DTS, DTS-EX, DTS-96/24, DTS High Res, DTS-HD Master Audio, and more.



[EVMX88PRO](#) 4K HDBaseT 8x8 Matrix with ARC, IR, IP and RS-232

Matrices

Applications with multiple sources, sinks, and even zoned audio can still leverage ARC for audio distribution using an HDBaseT matrix switch. For example, Vanco’s award-winning EVMX88PRO HDBaseT 8X8 Matrix Switch has 8 HDMI inputs and 8 HDBaseT outputs. Every output supports ARC when paired with a compatible receiver. The EVMX88PRO has a built-in audio matrix with digital and analog outputs for 8 zones. Each of the eight HDBaseT outputs also has a mirrored HDMI output for local monitoring, audio de-embedding, or distribution.



[PAEXARC1](#) ARC Digital Audio Extender

ARC Extenders

It is also possible to extend just the ARC signal beyond the limitations of HDMI cabling. An ARC extender allows digital audio to be routed from a display to a remote location or amplifier. Such devices can also serve as a “back-up” plan for extending audio using SPDIF if a display lacks ARC capability, or ARC is not functioning properly.

The Vanco PulseAudio PAEXARC1 is a ARC digital Audio Extender that can transmit ARC signals over a single Cat5e/6 cable up to 492 feet (150m). It supports Dolby / DTS 5.1 channel surround sound and PCM two-channel audio, as well as CEC pass-through,

Audio Extractors

Sometimes, it is not possible to guarantee in advance that every component will support ARC or eARC – particularly in room update or rental and staging applications that employ a mix of new and legacy equipment. Fortunately, there are failsafe devices that allow integrators to essentially add ARC or eARC breakout to any HDMI source.



[PA-EARCX](#) HDMI Audio Extractor with eARC and ARC

An audio extractor is designed to de-embed audio from an HDMI source for breakout to a soundbar, AV receiver, or amplifier without affecting the video output to the main display. For example, The Vanco PAEARCX HDMI Audio Extractor supports both ARC and eARC, with Dolby and DTS format pass-through such as Dolby TrueHD, Dolby Digital Plus, Dolby Atmos and DTS-HD Master Audio. This device features two HDMI outputs: one for video, and one for dedicated audio breakout. The video output passes 18 Gbps video at 4K@60Hz resolution with 4:4:4 sampling and advanced EDID management.

Conclusion

ARC and eARC are simple options that leverage standard cables to vastly simplify system infrastructure. Supported by a growing ecosystem of endpoints and distribution devices, ARC and eARC can handle audio distribution for a surprisingly large range of professional applications. Verifying compatibility is critical, but with the right components, integrators can use ARC and eARC to create streamlined systems with superb audio quality.

Contact your local Vanco distributor for support and check out our new project registration form on our website.

Visit www.vanco1.com to learn more about ARC and eARC in the Vanco ecosystem.

Additional Resources
[Project Registration Form](#)
[Find a Distributor Map](#)

