Basic Audio Networking – Ethernet Notes / Information

To stay current with Audio Equipment / Sound System technology – You need to understand how Networking is presently being utilized in the audio technical world. When we talk about Networking, it includes cable types, wireless connectivity, and protocols. This subject can get intense quickly, so the more you understand Wireless, Bluetooth, and essential Networking, the better off you'll be. We will provide you with a few basics and useful equipment options here but encourage further study, training, and research. This technology is growing rapidly and consistently changing – don't fall behind.

"Mini" Network Switch

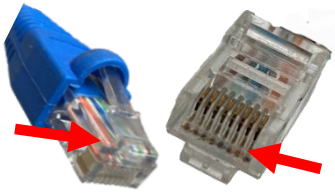
Cables / Connectors – Let's start with some basic info regarding Ethernet cables and connectors:

Ethernet Cable is widely used in "Ethernet-based" audio networks. (Referred to as Audio over Ethernet – AoE for short). Ethernet allows high-fidelity audio signals over longer distances while exhibiting low latency (delay). Cat6 or Cat6a shielded cables are recommended (for now). Ethernet cables consist of 4 individual twisted pairs. A specific "color code" is used for Ethernet connectors (see below), and the connectors are relatively easy to terminate. There is also a special tool that is used to assist with the connector termination process as well.

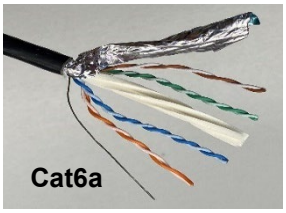
Cat 6 / Ethernet Connectors

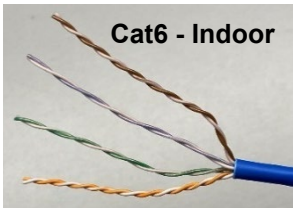
The Connectors are called RJ45 modular plugs (sometimes referred to as 8P8C connectors). Used for Networking and Digital Audio Systems.

Where is Pin 1?

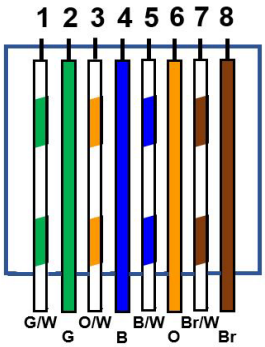


Ethernet Twisted Pair – Cat6 / Cat6a

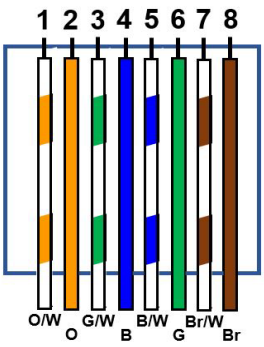




T-568A

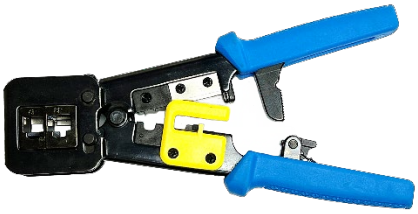


T-568B



Terminating RJ45 connectors is not as difficult as it is "tedious." The prep work to get the wires to stay true (in the correct order while trying to slide them into the connector) takes some getting used to. The crimping part is quick and easy.

How to Terminate Ethernet Connectors - Video Clip!



Ethernet Connector Tool

RJ45 Connectors – Pin Out (color code)

As an audio technician, you will need to be able to make and repair your own Ethernet cables. First, you must understand the color code, pin-out, and the two "accepted" standards – which are T568A and T568B. One slight difference in these standards is that the Green and Orange pairs are switched (with the Blue and Brown pairs staying the same). Which standard should you use? It depends on the Network you are using (your IT department provides that information). You can use either of the standards if you have your own personal Network. But, if you are working for a Theater, Theme Park, or any other business – you will need to find out which standard is preferred. You cannot mix and match the T568A and the T568B standards on the same Network.

Basic Ethernet Cable Tester

Networking and Audio Equipment

All new and current audio equipment will be set up with a way to connect to the Internet, Networks, or a Computer. Sometimes a Network connection is only needed so the equipment has a "path" to receive software or firmware changes. Audio technicians must be able to troubleshoot issues with ethernet cables and network cabling connected to audio equipment. Plenty of test equipment is available to assist you (one example shown left). Networking technology is now firmly engraved in the world of audio!

Ethernet Jacks

AVCSS Tech World
Basic Audio & Technical Information

avcsstechworld.com

Other Options for Using Ethernet / Networks with Audio

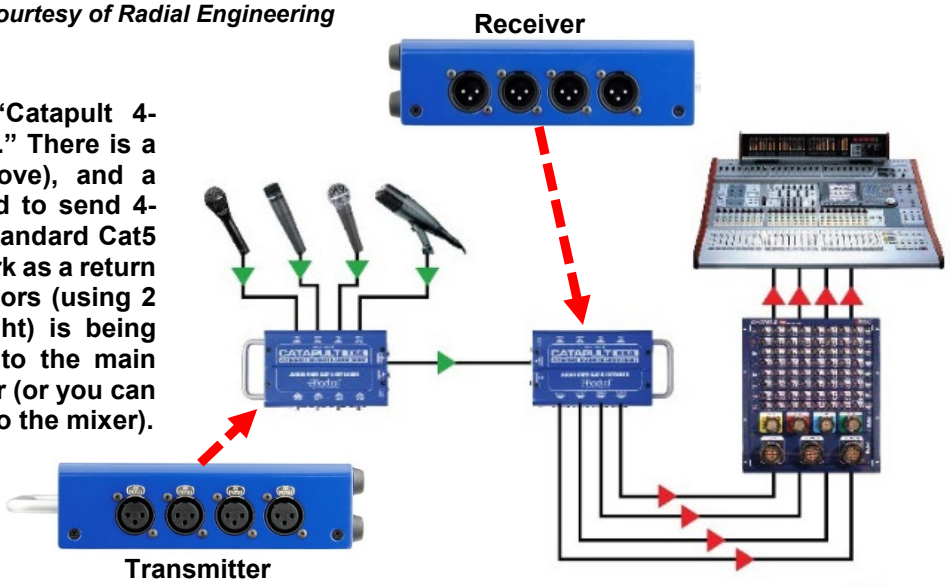
What about smaller Networked audio system installations? What if you are setting up a small stage and want to keep it simple and don't want to run a large mic snake for a system this small? There are plenty of equipment options that are smaller in size and less expensive – here are a few for you to consider.

The devices below are called "Audio Over Cat5 Extenders." They are "plug and play" and can be used in many different configurations. Very easy to set up, and can be used with either Cat5 or Cat6 cable types.

Courtesy of Radial Engineering

This is the Radial Engineering "Catapult 4-Channel Cat5 Passive Audio Snake." There is a Transmitter unit #TX4 (shown above), and a Receiver unit #RX4 that are needed to send 4-Channels of Analog audio over a standard Cat5 or Cat 6 cable. This unit can also work as a return snake to feed a couple stage monitors (using 2 Cat cables). The configuration (right) is being used as a microphone sub-snake to the main stage snake that is feeding the mixer (or you can skip the sub-snake and go directly to the mixer).

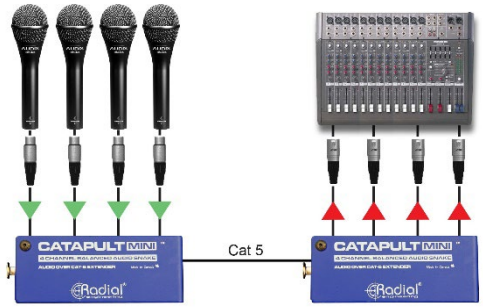
Note: These Catapult modules do not require power to operate due to their "Passive" operation.



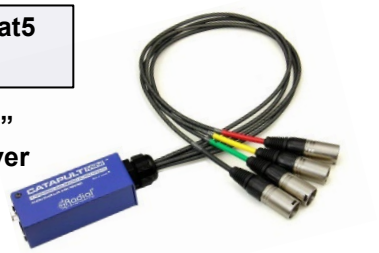
The devices below are "Mini" versions of the Radial Engineering "Audio Over Cat5 Extenders." These units can deliver "balanced" signals over long distances.

"Mini" Transmitter

The audio passes through without distortion or any coloration to the signal.



"Mini" Receiver



Send Line or Mic levels without signal loss, noise, or interference. There is also a TRS version of the Mini Catapult as well.

Courtesy of Radial Engineering

Networking – Other Important Notes

There are a few essential aspects of Network Connections that audio technicians will need to be familiar with. They are IP addresses and MAC addresses. Let's take a look at a brief description of each.

MAC Address – This is a unique hardware ID number assigned to a Network Interface Card (NIC) and every device on a network. A MAC address (Media Access Control) helps identify all the devices on the same Network. Example of a MAC Address (Physical Address): 4A:45:92:68:D8:C3

IP Address – Stands for "Internet Protocol" is a unique string of numbers that identifies each computer (Laptops, iPads, PCs) and computer-based audio equipment (Digital Mixers, Amplifiers, Wireless Equipment) over a network (large or small networks). Examples of IP Addresses: 192.158.0.2 and 192.168.100.1

Most Networked Audio Equipment you will encounter as an audio technician will already have an assigned MAC Address. Technicians need to be able to "locate" MAC addresses (IT departments may ask for it so they can set up a Network connection for your equipment). With IP Addresses, technicians need to be able to "locate and program" IP Addresses on any Network based audio equipment (and attached iPads, PCs, and Laptops) when applicable. This is a relatively straightforward process requiring a little training and hands-on experience.

PoE (Power Over Ethernet)

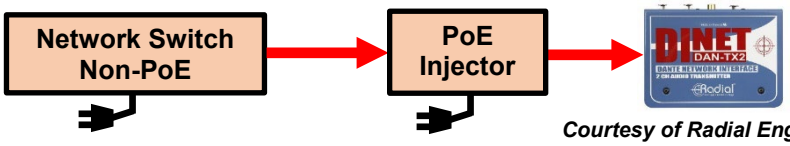
PoE (Power over Ethernet) delivers DC power to PoE-compatible devices over Ethernet cabling. This eliminates the need for separate power adapters and electrical outlets. For example: Let's say you need to install a Dante device (see below) at a remote location over a network, but there is no power available to use at that location. This would be an excellent opportunity to use PoE to power the device. It's pretty simple, as long as the network switch you are using has PoE capabilities and the device is PoE compatible, it should just be "plug and play." Audio technicians will eventually encounter PoE Technology in the field at some point.

Network Switches and PoE

Not all Network switches will come standard with PoE capability. If you are working with devices that require PoE, you will need to verify whether the Switch you will be using is a PoE Network Switch.

PoE Injectors

If you are working with a Non PoE Network Switch, but have a device that requires PoE – You can use a PoE Injector. The PoE Injector plugs into a port on the Network Switch, then plugs into your PoE compatible device. The injector not only provides power to the device, but also to the Data Connection.



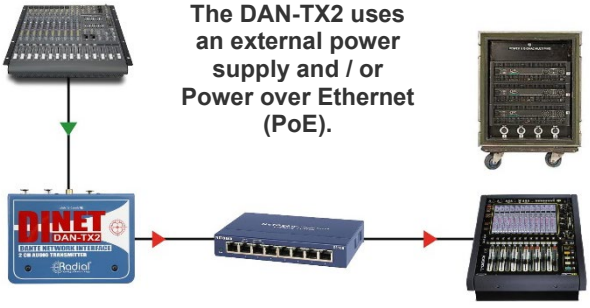
Radial #DAN-TX2 Dante Network Interface

Courtesy of Radial Engineering

What is Dante?

Dante is an Ethernet-based network system, just one of several "Digital Audio Transfer Protocols." Dante is a very popular protocol that can replace hundreds of audio cables using just a few Ethernet cables. And best of all – without losing speed and fidelity. Analog audio quality can quickly deteriorate as distances get longer and longer, but with Dante, this problem has been solved. All the devices on a Dante network share the same network. The signals can be sent between devices regardless of location. Dante has resolved the age-old problem of running audio over long distances without using expensive multi-channel cables. The Dante protocol exhibits low latency (delays) and works great for live performances, churches, large stadiums, etc. With this being said, Dante is also used in studios and smaller installations. Analog audio equipment can also work "digitally" on a Dante network when used with a Dante interface device (see example below).

For this example, let's say that you have a Digital Mixing Board already living on a Dante network, but you need to add the line-level output of an Analog Mixer located in another room in the venue. Radial Engineering makes it easy – connect the Analog Mixer to the Dante Network Interface unit and connect the Interface to the closest Network Switch. Some Network Switch configurations will need to occur, but it's a relatively easy set-up. That's it, and the Digital Mixing Board can now utilize any outputs from the Analog Mixer.



Courtesy of Radial Engineering

The Radial Engineering #DAN-TX2 Dante Network Interface is a 2-Channel Analog-to-Digital Converter.

Digital Mixing Boards (like the one shown above) will come standard with a Dante Interface installed or with "expansion" slots in the back of the mixing board that allows for external audio protocols (such as Dante) to be installed, configured, and functioning very quickly.

Dante Networks use Cat 5 / Cat 6 cabling and connect to a Network Switch and Computer using the "Free" Dante (Audinate) software to complete the set-up of a basic "Dante System." This software provides a way to configure and discover devices, event logging, a routing matrix, etc. Also, when using a Dante Virtual Soundcard, you can interface with your computer and DAW (Digital Audio Workstation). Many Dante expandable option cards are available to plug into the expansion ports on your Digital Mixing Board. The Dante protocol is here to stay and not going away anytime soon. There's also a good chance that most of the audio equipment you currently use has a built-in Dante card or "optional" expansion card slots.

Dante Certification! Audinate (creator of the Dante protocol) offers "In-Depth" AV Network training. Training is provided in three levels (Level 1, Level 2, and Level 3). This training offers valuable insights on Audio Networking and is a great way to assist with building a "Technicians" resume. Dante's training is highly recommended. Go to the Audinate Website for more info!