Communication Signals & Infrastructure

What’s the Signal?

Once one has determined the equipment to be controlled and the methods to control it, one can take a closer look at the actual control signals and infrastructure required to get those signals from the control processor to the device being controlled.

Some methods are pretty simple. Contact closures require two conductors to make contact and complete a circuit. Some methods, including Ethernet Control, require additional hardware and coordination with the client’s IT department. Both have their place in today’s AV control system, but one needs to be aware of each of the requirements and their impact on the project.

Control Systems Communications, Signals & Infrastructure

We know how we need to control the AV equipment in our system. But what limitations do we need to consider in getting the control signals to the AV equipment that we are controlling? What do we need to consider when specifying the cable to carry that signal? What can be done to accommodate these parameters?

Here’s a list of common control systems signals and the strategies used to accommodate them.

Ethernet

Today’s Ethernet networks use Unshielded Twisted Pair cable - UTP. UTP is inexpensive, easily obtained, and easy to install. UTP is categorized by the number of wire pairs, and its rated speed. Most current installations use Category – Cat 5e, Cat 6, or Cat 7 wire. Ethernet is terminated using RJ45 connectors of the same rating as the cable. It is important to coordinate the type of cable used for a project with the client’s IT department, as using a lower grade cable and/or connectors can de-rate a segment of the network and reduce overall network performance.

Most products on a AV network communicate using telnet which is a network protocol used either on local area networks or on the internet to provide a bidirectional communications using a virtual terminal connection. Once a telnet connection is established to the remote host your client becomes a virtual terminal that allows you to communicate to the remote host from your computer.

All Ethernet devices have dedicated cable runs to an Ethernet hub or switch. The connection of Ethernet endpoints to a series of hubs, switches, routers, and bridges makes up the network. The layout and design of the network should be done by a network certified professional.

IT managers tend to regard AV systems with caution. In a typical scenario, IT departments beta test systems on their networks to determine the network impact and to prevent any adverse impacts on corporate network performance. Understandably, the idea of just connecting a number of network-dependent AV boxes to their network can be unnerving.

In the AV world, Ethernet communications can be equally unnerving. AV installers are typically responsible for the installation and operations of all facets of the AV system and are responsible for the design and specification of all equipment in the system. Having another group to answer to and gain approval from can be added stress on already tight deadlines. Subnets, managed switches and routers, firewalls, equipment, and protocols outside the AV installer’s control add another layer of complexity to an already complex system where traditional diagnostic techniques may not help.
Power over Ethernet - PoE

Power over Ethernet - PoE is an IEEE specification for powering Ethernet devices over their standard Category cabling. PoE devices are typically smaller Ethernet appliances that do not consume much power. PoE devices outside the AV industry might include Wireless Access Points - WAPs or Voice over IP - VoIP phones. However, the number of PoE devices within the AV Industry is growing. Several Extron touchpanels, such as the TLP 350MV, and the TLP 710 and TLP 1000 Series feature PoE capability. All of these touchpanels can either be powered using an external power supply or PoE.

PoE currently has two specifications IEEE 802.3af and IEEE 802.3at. Extron devices use the 802.3af standard. 802.3af provides up to 15.4 W of DC power to each device. 802.3at provides up to 25.5 W of power.

Some newer Ethernet switches are 802.3af-enabled and deliver data and power over the same cable, but many Ethernet switchers do not carry power. PoE systems require power to be injected into the Ethernet network. Power is typically injected using a PoE hub or a PoE injector. The PoE hub or injector sits between the Ethernet network’s hub or switch and the Ethernet endpoint or node that requires PoE. You cannot inject and distribute Power over Ethernet into a standard hub or switch and expect the power to be distributed from the hub or switch’s ports.

PoE allows power to be distributed to devices where mounting a power supply would be difficult or impossible, or that would require running a separate power cable. PoE uses that same Category UTP cable used for Ethernet data and the same RJ-45 cable termination, saving time and money.

Wireless Ethernet

Wireless Ethernet devices are becoming more common in today’s AV systems. Wireless Ethernet allows Ethernet networks to be extended to locations where it may not be easy to pull the necessary cables or to give Ethernet-enabled devices a degree of portability.

Like wired Ethernet devices, wireless Ethernet devices have a level of physical or hardware compatibility, and a logical or software compatibility.

There are four major wireless Ethernet standards: IEEE 802.11a, 802.11b, 802.11g, and 802.11n. Many times, wireless Ethernet devices will support multiple standards, for example, 802.11a/b/g. The wireless device that you are adding to your system must be linked to a Wireless Access Point - WAP that has a compatible wireless standard. For example, a wireless device that supports 802.11a/b/g must be linked to WAP that supports all or one of the 802.11a, 802.11b, or 802.11g standards.

Because of the range that a Wireless Access Point can have, it is critical to work with, and coordinate with, your client’s IT department. Poorly placed WAPs can interfere with the communications of corporate WAPs and cause communications problems for both the AV Ethernet network and the corporate IT Ethernet network.

The logical side of the wireless network has many similarities to the wired Ethernet network, plus a whole new level of security. The IT department will govern the security protocols used in the wireless network, the naming of WAPs, and the IP addressing of all the Ethernet devices associated with the network.

Wireless Ethernet devices can be a great asset to AV control systems, but they do require an extra measure of coordination with the client’s IT department.
RS-232/422

RS-232 and RS-422 are generally point-to-point communications signals. While some devices may allow the RS-232 signal to be daisy-chained, we mostly assign one RS-232/422 controlled device per port on the Extron controller.

As a rule of thumb, RS-232 has a maximum cable length of about 50 ft. (15 m). That length can vary based upon the cable and the baud rates being used. The destination device will specify pins and the type of connector used for the RS-232 communications. The most common is a three-conductor - Tx, Rx, and Ground cable terminated with a DB-9 connector. Up to seven pins can be used, and connectors range from DB-25 connectors, mini-DIN connectors, or captive screw terminals. It is very important to consult the destination devices manual to see the device’s requirements.

Cables are wired as straight-through or null. Straight-through cables generally are terminated with a female DB-9 on one end of the cable and a male DB-9 on the other end. Pins 2, 3, and 5 on the female end are connected to pins 2, 3, and 5 respectively on the male end. Null cables are generally terminated with a female DB-9 on both ends. Pins 2 and 3 are connected on each end and pin 5 is connected to pin 5 on each end.

RS-422 uses a balanced signal for transmit and receive and can transmit data up to 4000 ft. (1200 m). RS 422 requires 5 conductors - Tx+, Tx-, Rx+, Rx-, and Ground. RS-422 may be terminated using a DB-9, DB-25, or captive screw connector.

Infrared

Infrared control is most commonly seen when controlling AV devices using an IR remote. IR remotes are typically designed to control a single device, not an entire AV system. AV control systems seek to simplify the user experience and provide for a single point of control rather than requiring the user to use multiple handheld IR remotes. An additional drawback to IR remotes is that they are easily lost and often stolen.

IR is still used, however. AV control systems can still control IR devices using infrared emitters. An IR emitter should be connected to an IR port and placed on one IR controlled device. Controlling multiple IR devices from a single IR port may seem cost effective, but it may cause larger, more costly problems when the system requires maintenance or upgrades.

The IR emitters are attached to the front of the AV device using double stick tape or silicon adhesive, and wired to the IR port on the AV controller. IR emitters can generally be run 110 ft. (33 m) depending upon the wire used to extend the emitter.

Flex I/Os

Flex Inputs and Outputs are very similar to relays and contact closures with regard to their wiring and infrastructure. Each I/O has a signal wire and a ground. Ground wires are shared by multiple I/Os on the same device.

In a system with two motion sensors connected to an IPL T SFI244’s Flex I/O port, one would use two 2-conductor cables with one conductor connected to the signal terminal for each I/O and the ground conductor for both motion sensors connected to the Flex I/O’s ground terminal.

Flex I/Os do not pass data, so wire pairs do not need to be twisted or shielded. It is important to consider the amount of voltage required across the cable, and select a wire gauge that will accommodate the voltage drop between the relays and the contact closures.
Relays and Contact Closures
In control systems, relays and contact closures can be very effective means of control. A device that can be controlled using contact closures, such as an Extron SW 2 VGA DA2 A, will be wired to a control processor’s relays. The low voltage relays on the control processor creates the contact closure.

Relays and contact closures use two wires or conductors: signal and ground. Devices with more than one contact closure will typically share ground wires. For example, the SW 2 VGA DA2 A has two contact closures to switch between inputs 1 and 2. The SW 2 VGA DA2 A uses a three-wire captive screw terminal; a conductor for Input 1, a second for Input 2 and a third for the Ground. A projection screen may use four conductors; 1 for Screen Up, 1 for Screen Down, 1 for Screen Stop, and 1 for Ground.

If the contact closures on a controlled device share a common ground, then the relays on the control processor will need to share a common ground. For example, each relay on the IPCP 505 has a signal and ground terminal. If one is controlling the SW 2 VGA DA2 A and using a three-conductor cable, one would run the signal for Input 1 to the signal on Relay 1, the signal on Input 2 to the signal on Relay 2, and the Ground to the Ground on Relay 1, and jumper the Ground on Relay 1 to the Ground on Relay 2. If one were also using Relays 3, 4, and 5 to control a projection screen, one would run the signal wires to Relays 3, 4, and 5, and connect the Ground to Relay 3, and jumper the Grounds for Relays 3, 4, and 5.

Since relays and contact closures do not pass data, one does not need the wire pairs to be twisted or shielded. It is important to consider the amount of voltage required across the cable, and select a wire gauge that will accommodate the voltage drop between the relays and the contact closures.

Low and High Voltage Power Control
Intelligent power management solutions allow operations and facilities managers as well as IT administrators to use their energy resources more efficiently. Low voltage and high voltage power controllers provide easy power management to AV systems. When power is restored following an outage, the power controllers will power up devices in a specific sequence rather than all at once to avoid tripping breakers due to high inrush current.

Many Extron controllers and control processors are equipped with relays. These relays are capable of making and breaking circuits of up to 24 V and 1 amp rating. For higher power circuits, Extron offers power controllers from within our IP Link category. These power controllers offer centralized management of AC outlets and are rated at 120 VAC and 10 amp. Many of these power controllers can be programmed to send out e-mail notifications as each scheduled on/off event is performed. When these controllers restart following an outage, outlets are powered up sequentially with a user-configurable delay between each one. The internal memory of these units will ensure that only those devices that were on before the outage will be restarted.