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When deploying AV systems, it is important to know what type of connections your AV equipment requires, what type of cabling media is required and what the distance limitations might be for the specific application, type of signal and bandwidth.

The ABCs of AV

by Glenn Kierstead

Every enterprise environment today relies on audiovisual (AV) and multimedia technologies for a variety of applications, from video conferencing and training, to entertainment, digital signage, broadcasting and sound systems. With the need to access and view video content becoming as vital as the need to access email and the local area network (LAN), AV applications are now tightly embedded into everyday business activities in corporate, education, health care, hospitality, retail and entertainment market segments.

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Analog Audio	Digital Audio	Dolby Digital 5.1	Composite Video	Video Component
White – left channel Red – right channel	Multichannel bit stream (surround sound after decoding). Typically color coded orange.	Six-channel sound with left (white), right (red), surround left (white), surround right (red), center (black) and low-frequency effects (black).	Transmits video over one cable (480i and 480p). Typically color coded yellow.	Transmits video over three cables, including luminance (Y), red chrominance (Pr) and blue chrominance (Pb). Y is typically green, Pr red, and Pb blue.

Table 1: Common RCA connector types

Whether it is video conferencing equipment in the corporate office, projector systems and interactive SMART® Boards in the classroom, flat panel displays and medical AV equipment in a hospital, amplifiers and speaker systems in the auditorium or security and surveillance equipment at the mall, navigating the wide variety of AV applications, equipment and connections is no easy task for the information technology systems (ITS) professional. Identifying the wide variety of AV connectors and understanding key deployment considerations can help ease AV system deployment.

Know Your Connectivity

To the untrained eye, the number and types of AV connectors on the back of any AV equipment can be overwhelming. As technology advances, new digital connector types for better sound and picture quality are added to the mix. Those new to deploying AV systems may wonder which connectors should be used for which application. Whether for analog or digital, audio or video, knowing the use and application of each connector type can help you make the right decisions.

RCA connectors—Found on most consumer electronics (e.g., home theater equipment), audio equipment, computers and video recorders, the RCA connector is a standard analog, low-level connector that features a single cylindrical metal rod and an outer round metal belt. The connector gets its name from the RCA® Corporation, which first used the connection on radios and phonographs in the 1940s. Used for composite video, component video, line-level audio and Sony®/Philips® digital interconnect format (S/PDIF), RCA connections are unbalanced designs that do not maintain precise impedance for video. While common in older home theatre applications, they are rarely used in professional video applications. The various colors of RCA connections are related to their application, as shown in Table 1.

Speaker terminals—Used for surround sound speakers in home theater applications, speaker terminals are quick release spring-loaded push-button terminals for terminating bare speaker wire or pin connectors. Speaker terminals with bare wire do not provide as solid a connection or as much protection against short circuits as wires terminated with connectors.

480p, 720i, 1080p, What?

If you are not familiar with how picture quality is achieved, all of those numbers and the "p" or "i" listed for various display resolutions can be confusing. The display resolution indicates the number of pixels (i.e., smallest picture element) that can be displayed—the higher the number, the better the resolution. The "i" and "p" designate the type of video—interlaced or progressive.

Interlacing is a technique of rendering video by generating two fields of lines—a field of odd lines and a field of even lines. It was designed specifically for old cathode ray tube (CRT) TVs to improve quality (i.e., reduce flicker) without consuming extra bandwidth. When an interlaced image is transmitted, half of the lines of an image are displayed at one time, alternating between odd and even lines. The lines are refreshed at about 30 frames per second to allow the human eye to interpret them as a complete image.

Progressive, or noninterlaced, scanning renders video where all the lines of each frame are drawn from top to bottom, rather that divided into separate fields. Each line of the image is displayed one at a time in perfect sequence. While this provides a better quality picture, it requires more bandwidth.

While interlaced scanning consumes less bandwidth than progressive and interlaced devices are typically less complex and less expensive, the images are prone to anomalies, especially video of a fast-moving object. To counter the problem, interlaced images are sometimes blurred, which results in a reduced picture quality. On large displays, interlaced scanning also can cause flicker. Progressive scanning produces no anomalies or blurring for a much clearer picture. While it required too much bandwidth for traditional analog signals, the shift digital has made progressive scanning more popular. Progressive scanning is also ideal for advanced video surveillance because it enables more detailed viewing of moving objects.

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Binding posts and banana connections—These connectors are typically found on loudspeakers, amplifiers, home theater equipment and electronic test equipment. Binding posts are a high-quality connector that can accept several types of speaker wire and connections, including banana plugs. They contain a threaded metal rod and a cap that screws down on the rod. Banana plugs consist of a single fat shaft that bulges on the sides, hence the name. Banana terminations provide the most contact area of any speaker wire termination for maximum signal and power transmission.


Stereo jacks (TRS connectors)—Originally invented for telephone switchboards, tip, ring, sleeve (TRS) connectors are commonly known as stereo jacks. They are the most common audio interfaces and come in three sizes. The 3.5 millimeter (mm [0.138 inch (in)]) jack is used for speakers, microphones and headphones found on computers, portable devices and other consumer electronics. Typically mounted in panels, the 6.3 mm (0.25 in) jack is used for broadcasting and recording equipment, intercom and public address (PA) systems, switchboards, medical testing equipment and industrial and military communications equipment. The miniature 2.5 mm (0.10 in) version was originally designed for transistor radios and still can be found on inexpensive audio players.

Three-pin XLR—Found on PA and intercom equipment, amplifiers, component units and microphones in professional broadcasting and auditorium applications, the three-pin XLR connector is the standard connector for digital and analog balanced interconnections between audio equipment. These durable, balanced connections use three conductors (positive, negative and ground) for impedance-balanced lines with resistance to electromagnetic interference (EMI), resulting in low distortion.

SpeakON® connections—Intended solely for high-current audio applications, such as for connecting loudspeakers to amplifiers in entertainment and PA systems, SpeakON connectors are an alternative to 6.3 mm (0.25 in) stereo jacks and XLR connectors. Designed with a locking system for either soldered or screw-type connections, these connectors are less prone to disconnection and are fully shielded to prevent risk of electric shock and short circuits.

F-type connectors—Used with coaxial cable, the F-type connector is widely used for cable and satellite TV, closed-circuit TV (CCTV) in surveillance applications, broadband applications and video entertainment systems. Typically machined as threaded to be screwed into place, the connector is round and features a single thin metal shaft in the center. F-type connectors transmit both audio and video.

S-video connectors—Used for standard definition (480i or 576i) analog video distribution in home theater and entertainment systems like DVD players and game boxes, as well as for video cameras, projectors and surveillance systems, the S-video connector is a keyed four-pin mini-DIN connector. The connector carries luminance (brightness) and chrominance (color), with each signal pin paired with its own ground pin. By separating the color from the brightness, distortions can be eliminated and a better picture quality produced.

BNC connectors—A professional coaxial cable termination used primarily in professional studios as an interconnect, the BNC connector has a thin central pin and an outer rounded metal belt. The connector pushes onto its jack and twists to the side to lock in place. Primarily used for entertainment, surveillance systems, wireless systems and test equipment, BNC plugs have good impedance characteristics.

High-density 15-pin D subconnectors—The standard connector used to connect a computer to a viewing device, the 15-pin D subconnector transmits high-quality video. It can be found in display signage applications that use flat screen displays, projectors and interactive white boards. The analog signal is transmitted as red, green and blue (RGB) and vertical and horizontal synchronization (HV), resulting in a high-quality signal with low distortion.

DVI connectors—The digital visual interface (DVI) connector is designed to maximize the visual quality of display devices such as flat panel displays, monitors, digital projectors and high-end home theater systems. Designed to transmit uncompressed digital video, this single connection also supports analog video to encompass both digital and legacy video graphic array interfaces. It provides enough bandwidth to support widescreen ultra extended graphics array (WUXGA) and super extended graphics array (SXGA) for high-definition TV (HDTV). The DVI connector comes in three different styles—DVI-D (digital only), DVI-A (analog only) and DVI-I (digital and analog). DVI connectors cannot be field terminated and have a distance limitation of 4.6 meters (m [15 feet (ft)]) for 1920 x 1200 resolution (WUXGA) and 15 m (50 ft) for 1280 x 1024 resolution (SXGA).

Ceiling enclosures designed specifically for AV applications are an excellent option for hiding AV equipment and cables in the classroom ceiling, as shown in this before and after photo.

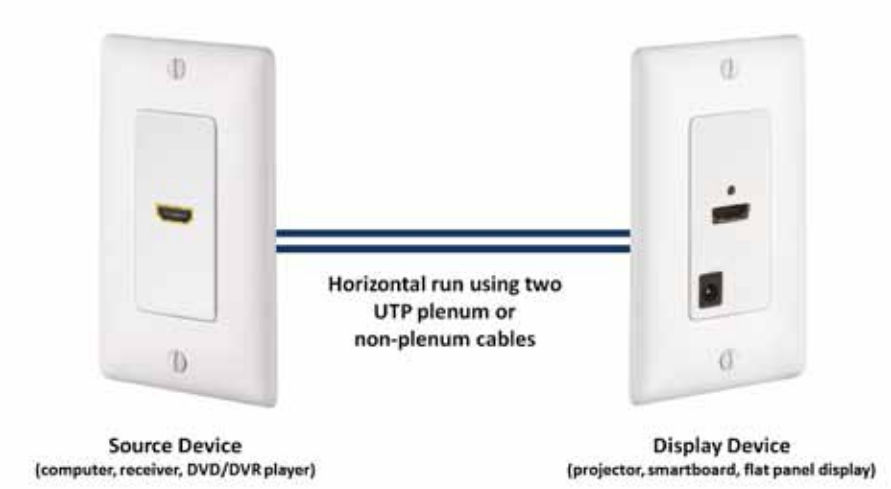
HDMI connectors—This high-definition multimedia interface (HDMI) is an all-digital AV interface capable of transmitting uncompressed streams for HDTV, digital signage, high-end home theater systems, flat screen displays, monitors, computers, laptops and portable multimedia devices. There are four types of HDMI connectors—a 19-pin connector (Type A) for single link, a 29-pin connector (Type B) for high resolution, a mini 19-pin connector (Type C) for portable devices and a smaller 19-pin connector (Type D) for small electronics (e.g., mobile phones). HDMI connectors are capable of transmitting 480i, 480p, 576i, 576p, 720p, 1080i and 1080p video signals up to 5 m (16.4 ft) using 28 American Wire Gauge (AWG) [0.32 mm (0.013 in)] cable assemblies and up to 12 m (39 ft) using 24 AWG [0.51 mm (0.020 in)] cable assemblies.

DisplayPort—Developed by the Video Electronics Standards Association (VESA), the DisplayPort interface is primarily used for connecting a computer to a display, monitor or other viewing device. Unlike HDMI interfaces, the DisplayPort interface is nonproprietary, which makes it less expensive to implement. Apple® Inc. developed a mini DisplayPort connector for use with laptop computers and other small devices.

USB connectors—The universal serial bus (USB) connector is a standard interface, which transmits both power and data. It was originally designed to simplify the connection between computers and peripheral devices. Because of its low cost and ease of use, it has become commonplace for scanners, printers, handheld devices (e.g., video cameras

Some vendors offer customized plug-and-play AV connectivity solutions with several available connector types and cable assemblies to support a variety of applications.

HDMI extenders allow 1080p signals to be transmitted up to 45.8 m (150 ft) over two category 6A UTP cables or up to 40 m (131 ft) over two category 6 cables from the source device to the display.



and control devices), keyboards, video game consoles, portable media players and other peripherals. There are many types of USB connectors. The most common types include Type A, which is a flattened rectangle connector, and Type B, which has a square shape with beveled exterior corners. Various mini and micro USB connectors also have been developed for connecting to small devices (e.g., smartphones and digital cameras).

Deployment Considerations

When deploying AV systems, it is important to know what type of connections your AV equipment requires, what type of cabling media is required and what the distance limitations might be for the specific application, type of signal and bandwidth. Whether you are deploying a projector system in a classroom or a large flat panel display for digital signage, how and where you deploy the connections to support the AV equipment should also be considered.

For example, projector systems that are becoming commonplace in K-12 education environments are often installed in the ceiling alongside AV equipment that connects to the projector and back to desktop equipment (e.g., computer). When the AV equipment and the cables that connect to the projector are visible and unsecure, they can be inadvertently or intentionally damaged, not to mention unsightly. Ceiling enclosures designed specifically for AV applications are an excellent option for hiding the AV equipment and the cables in the plenum space. These enclosures fit into the drop ceiling and include space for the AV equipment and other necessary equipment (e.g., mounted connections), as well as power receptacles and appropriate knockouts for power and AV cables. Other types of enclosures to consider when mounting AV connectivity include furniture boxes for boardroom tables, desktops or podiums.

When mounting a flat panel display for digital signage applications, your customers do not want hanging cables or displays that are not flush against the wall. Instead of traditional wall outlets placed at standard height, consider a recessed enclosure mounted directly behind the display. Make sure enclosures offer enough space to house both power and AV connections behind the display while also accommodating the larger bend radii associated with today's AV cables (e.g., HDMI, DVI, coaxial cable).

AV displays and equipment often require more than just a power and video connection. Some might require multiple connector types for multiple displays, sound systems or connection to the LAN. It is also wise to future-proof the connections. While the current equipment might use composite video or DVI connections, including an HDMI connection will enable your customers to support advanced AV equipment in the future. Some vendors offer customized plug-

and-play AV connectivity solutions that allow you to specify a variety of connector types and associated cable assemblies for easily swapping applications without changing horizontal cable runs.

As previously stated, distance limitation associated with various AV applications is also a consideration. The HDBaseT standard, which was released in June 2010, allows HDTV signals to travel over unshielded twisted-pair (UTP) cabling up to 100 m (328 ft). HDBaseT uses an 8-position, 8-contact (8P8C) modular connection (i.e., RJ45). To date, HDBaseT adoption has been slow, with few supporting devices available.

While HDBaseT may be the wave of the future, many existing AV devices still use HDMI. Thankfully, video extenders are available with adapters that convert an HDMI connection to an 8P8C modular connection (i.e., RJ45) or 110 insulation displacement contacts (IDCs), allowing display devices to be located farther away from the source. These solutions allow the 1080p signal to be transmitted up to 45.8 m (150 ft) over two category 6A UTP cables or up to 40 m (131 ft) over two category 6 cables. Some extender solutions also have the ability to indicate that both power and the signal are working properly.

Closing Thoughts

With so many AV connector types, resolution options and mounting considerations, it is best to partner with vendors who have demonstrated experience with deploying integrated AV and data systems and who offer a variety of AV connector types, enclosures and solutions designed for AV applications. Modularity with faceplates and enclosures that offer keystone openings to fit any connector type also can facilitate changes and upgrades in AV equipment.

While knowing your connector types, cabling media and distance limitations is vital, there are several other factors to consider when deploying AV systems—from display size and placement height to room lighting and acoustics. It is wise to work closely with facility managers and architects when deploying AV systems because wall colors, windows, reflective surfaces, carpeting and upholstery can have an impact on how well a space supports video viewing and equipment placement.

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