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Audio Visual Inputs and Outputs

Welcome to the TANDBERG University prerequisite Audio Visual Inputs and Outputs lesson.

Lesson: TANDBERG Audio Visual Connectors

Learning Objectives
On completion of this lesson you will be able to:

At the end of the 30 minute lesson students will be able to explain the terms Conductor, Connector, Shielding and Insulation
At the end of the 30 minute lesson students will be able to describe the difference between a balanced and an unbalanced cables
At the end of the 30 minute lesson students will be able to describe the difference between analogue and digital signals
At the end of the 30 minute lesson students will be able to explain the terms frequency and distance and how they impact signals
At the end of the 30 minute lesson students will be able to describe RCA, XLR and stereo jack connectors for audio and their uses
At the end of the 30 minute lesson students will be able to describe different connector types for composite video including RCA and BNC
At the end of the 30 minute lesson students will be able to describe component video cables including s-video, RGB and YPrPb cabling
At the end of the 30 minute lesson students will be able to describe DVI and HDMI cable types and their use with high definition video.

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Cabling fundamentals

- Conductor, connector, shielding and insulation
- Balanced vs unbalanced
- Analogue vs digital
- Frequency and distance
- Quality vs cost
- Male vs female

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Conductor, connector, shielding and insulation - Every cable is made up of four possible components:

Conductor - The conductor is the material used to transmit a signal,

Shielding - Shielding is used to prevent the conductor from picking up any interference. Shielding is connected to the ground through the device the cable is connected to. Shielding is necessary to keep all the cables clean from interference by channelling (shunting) unwanted signals and noise (interference) to 'ground'.

Insulation - Insulation is a non-conductive material around the conductors and shielding preventing the conductors and shielding coming into direct contact with each other and holds all the components together as well as protecting the cable from the elements.

Connector - The connector is used to connect the cable to a device or another cable.

Balanced vs unbalanced - Balanced cables are made with pairs of conductors that are separately insulated then combined with shielding. The conductors are twisted together in a specific twist in the cable is a specific twist ratio that cancels out induced electrical noise and reduces interference. Balanced and shielded cables can be run over longer distance and provide better quality signals for a given distance.

Analogue vs digital - An analogue signal changes state gradually – usually a SINE or mix of SINE waves. A digital signal is made of square wave pulses that can represent the equivalent analogue signal and are derived from it by fast sampling techniques.

Frequency and distance - Frequency is the number of changes to a signal per second. The higher the frequency the quicker the signal degrades and hence the shorter your cable run can be without loss of quality.

Quality vs cost - When buying cables and deciding on the quality to purchase you need to consider the length the cable has to run. Generally speaking the thicker the conductor and the shielding and the higher quality the connector and insulation the better quality and the more it costs. Generally a longer cable run will require a better quality cable to reduce the risk of the signal degrading too much or picking up too much interference.

Digital signals can degrade further and pick up more interference before it becomes a problem than analogue signals. This is because digital signals are fixed states so the signal can be easily regenerated as long as the fixed states are still distinguishable. Analogue signals consists of many states and signal degradation can cause these many states to become indistinguishable although the brain is also analogue so can distinguish the noise from the message.

An amplifier (analogue) and regenerator (digital) can be used to extend cable lengths. Amplification of an analogue signal needs to be done at greater intervals than regenerating a digital signal. Amplification also amplifies the interference as well as the original signal which is why digital transmission is always better over distances because the original, clean signal is regenerated.

Male vs female - All cables have a male (usually the plug) and a female (usually the socket) end. This is important when buying cables to ensure you get the correct connector at each end of the cable.

Analogue audio connectors

XLR Connector

RCA connector

3.5mm stereo and mono jack connectors

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Mic and Line audio – are distinguished by their typical impedance (measurement of resistance on an AC circuit) and voltage levels. Mic input impedance is designed to match that of the microphone, thereby transferring the maximum signal. Depending on the design of microphone this can be high or low. It can be a balanced or unbalanced input. Balanced lines allow greater length of cable. A Line level input has, typically, a higher impedance and a fixed (standardised) power level – typically this is -10dBV. (approx 0.5v).

XLR connectors are available in various sizes and pin numbers. The 3 pin XLR3 is the most common and used almost universally for balanced audio from microphones and links between audio equipment. There are 2 conductor cables twisted together carrying the analogue audio and power. The third pin is for ground. The power carried by the cable is used to power the microphone itself (known as Phantom power). XLR cables carry analogue signals only.

The other most common analogue audio connector is an RCA or phone connector. The RCA connector is a single conductor carrying a single channel of audio and are grounded. Most come in pairs carrying left and right audio separately. Red connectors denote the right channel and black or white denotes the left channel. Cables have a single pin carrying the audio signal and shielding connected around the outside.

'Jack' connectors are also used for audio cables and are available in 3.5mm and 6.3mm and can be stereo or mono (two or one channel). Stereo cables can be easily identified by the 2 lines on the connector as each part of the connector pin carries each channel and grounding while a mono connector has 2 line splitting grounding from a single channel.

Video cables

RCA or phono connector

BNC connector

4 pin connector

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The most common analogue video cable is the composite cable. Unlike audio signals, video signals are made up of several types of signals including color (chrominance), brightness (luminance) and synchronization. A composite cable is called composite because it combines all these signals in a single conductor. This type of cable is common in domestic installations.

A standard composite cable usually uses an RCA/phono connector but can also used with a BNC connector. The BNC connector is more robust as it twists to lock and is less likely to become detached and is often used in professional installations.

Composite cables also exist for high definition digital transmissions. An example is the HD-SDI (high-definition serial digital interface) cable. The cable type is a higher quality allowing the amount of data needed for high definition pictures to be supported on a composite cable. Connector types can vary but commonly use a BNC connector.

Component video signals have been split into two or more signals and include S-video, RGB and YPrPb cabling. Generally speaking the more a signal is split up the better the quality of the signal.

S-Video cables are a step up from composite cables as they split up color (chrominance) information from brightness (luminance) information to produce a crisper image. S-Video cables carry standard definition video only. S-Video is also referred to as Y/C Y is the standard symbol for luminance and C for chrominance.

The most common S-Video connector is the 4 pin (mini-DIN) connector shown above which has two pins for the video signal (1 for color and 1 for luminance) and two for grounding. Like the composite signal it is possible to use the more robust BNC connectors for S-Video – two connectors are needed for each S-Video signal.

The RGB (Red, Green, Blue) standard sends three separate color signals each with it's own luminance signal. As a result there is a lot of redundant information in an RGB signal and a lot of bandwidth is required. Connector types are commonly RCA/phono or BNC connectors.

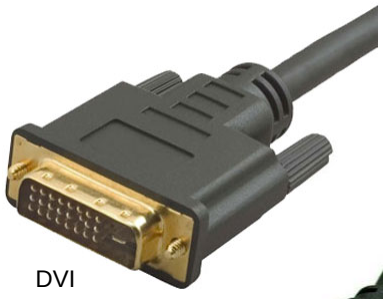
The YPrPb standard which splits the signal across 3 conductors. Y – luminance, Pr – Progressive Red, Pb – Progressive blue (green is derived mathematically) YPrPb video is capable of carrying both standard and high definition analogue video.

The YPrPbHV standard uses 5 conductors which splits out the synchronisation of the signals into separate cables H – Horizontal synchronisation and V – vertical synchronisation.

RGBHV standard also splits out the synchronisation of signals from the RGB into separate cables H – horizontal synchronisation and V – vertical synchronisation.

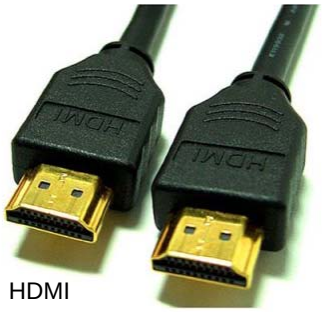
The connector types commonly used with RGB, YPrPb, RGBHV and YPrPbHV include separate BNC or RCA connectors for each channel or a VGA connector or scart connector.

Video cables



DVI

VGA



HDMI

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DVI (Digital Video Interface) cables split the video signal up the same way composite cables do and is format often used for computers and high end digital video devices such as DVD players. In addition to the video signal itself the cable and connector transmit HDCP (High-bandwidth Digital Copy Protection) copy protection which basically stops signals being copied as they travel across DVI cables. DVI cables come in 5 separate types:

DVI-D for digital to digital only (dual and single)

DVI-A for analogue to analogue only

DVI–I for digital or analogue or a mix between the two (dual and single)

Dual vs single. Dual DVI cables have two transmitters rather than a single transmitter so signals can be sent over the cable faster and at a higher quality. Different types of DVI cables are not interchangeable and have different pin outs however DVI-I sockets allow use of DVI-D or DVI-A cables as long as these are supported by the onboard circuitry.


DVI-D Single


DVI-A


DVI-I Single


DVI-D Dual


DVI-I Dual

VGA (Video Graphics Array) – the VGA standard actually covers more than the actual cable and connector specification and includes the specification of the computer graphics capability as well. VGA is very much a base standard which has been superseded with a number of video formats such as XGA which provide higher resolutions than the standard VGA format. The cable and connector type associated with all associated VGA resolutions is often referred to as a VGA cable. VGA signals are analogue.

HDMI (High Definition Multimedia Interface) – A similar standard connector as DVI cables but in a much smaller connector type. Despite its size there are 19 pins inside the HDMI connector. An HDMI cable can also carry audio and power if needed.

Where to find more information

- http://www.howstuffworks.com
- http://www.wikipedia.org
- http://www.whirlwindusa.com/
- http://www.pcmag.com/encyclopedia/
- http://www.datapro.net/techinfo/dvi_info.html

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This concludes the TANDBERG Audio Visual Inputs and Outputs lesson. You are now advised to proceed to the next pre-requisite lesson that is available as part of your remote learning syllabus accessible through the TANDBERG University portal. Thank you.