english

MOVET

Modernisation of VET through
Collaboration with the Industry

Ivan Pravda

Audiovisual content

Erasmus+

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Explanatory Notes

$E=m\cdot c^2$	Definition
	Interesting
	Note
	Example
	Summary
+	Advantage
–	Disadvantage

ANNOTATION

The module deals with processing and distribution of audiovisual content. It defines a number of basic concepts, it contains description of basic components and concepts. Further attention is paid to projection and appropriate choice its techniques. The module contains, last but not least, a number of practical instructions and recommendations. The module's conclusion is dedicated to storage management systems and its content.

OBJECTIVES

By studying the module students will be able to get an overview of processing and distribution of audiovisual content. This topic is very current, as AV systems can be found in variety of branches of industries, public administration and education. Emphasis is placed not only on the clarification of the terminology in the field, but also on the explanation of specific instructions and recommendations used in the implementations. The final section clarifies the problem related to streaming and AV storage security issues.

LITERATURE

[1] Petr Hrubes. Zaklady AV techniky – projektory a displeje: *Skoleni pro nove zamestnance*. Praha: AV Media, a.s., 2018. Firemni prezentace.

[2] Antonin Ruzicka. Projekcni platna. Praha: AV Media, a.s., 2017. Firemni prezentace.

[3] Petr Smolík. Audio. Praha: AV Media, a.s., 2017. Firemní prezentace.

[4] David Jakubec. Ridici systrmy: *Uvod do produktu*. Praha: AV Media, a.s., 2017. Firemni prezentace.

[5] Petr Smolik. Audiokonferenční systémy. Praha: AV Media, a.s., 2017. Firemni prezentace.

[6] Marek Larisch. Informacni technologie. Praha: AV Media, a.s., 2017. Firemni prezentace.

[7] David Jakubec. Videotechnika: *Uvod do produktu*. Praha: AV Media, a.s., 2017. Firemni prezentace.

[8] Marek Larisch. Digital Signage. Praha: AV Media, a.s., 2017. Firemni prezentace.

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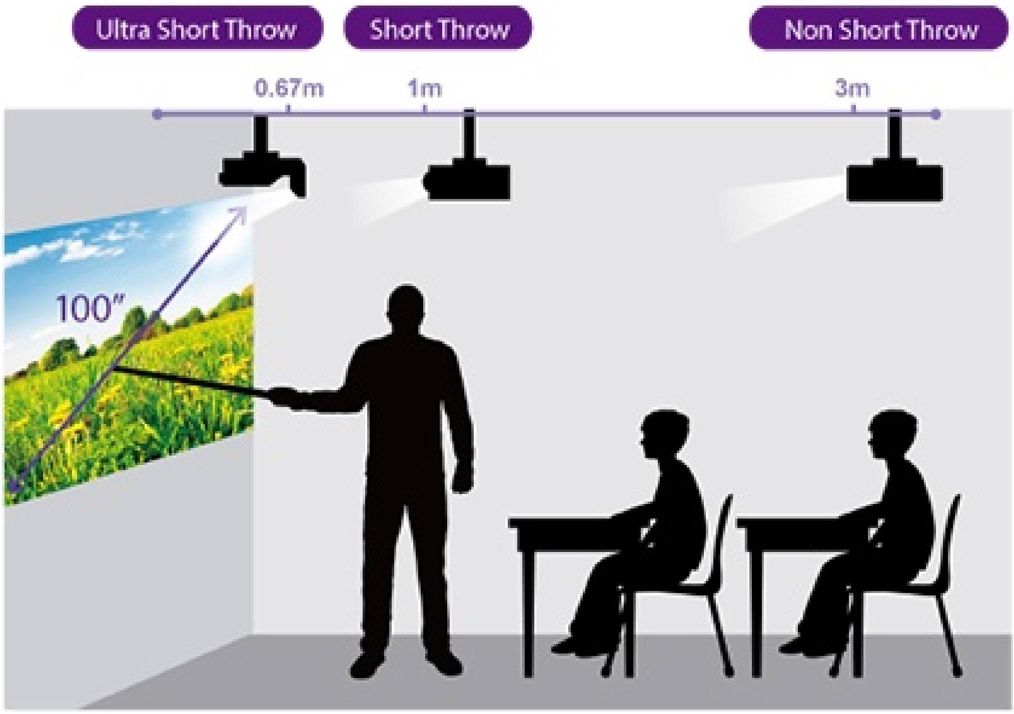
1 Projection and imaging systems

The most important parameter of the projected image is its contrast.

Contrast of a picture is influenced by three factors:

- **Projector** - its light output, contrast, resolution and projection distance
- **Screen** - its size, reflectivity, flatness and material structure
- **Room lightning** - the amount of light, direction and degree of light passing through the window



Examples of projection distances

ANSI (*American National Standards Institute*) and Infocom (currently **AVIXA** (*AudioVisual and Integrated eXperiance Association*) published a standard that specifies the optimal overall (system) contrast of the projected image for individual application. For the calculation purposes, the system contrast includes properties of a projector, projection screen, and room lighting.

Overview of recommended contrast values for individual applications

Category	Description	Minimal contrast	Examples
passive tracking	The viewer must be able to distinguish texts and images from the background of the image.	7:1	basic image viewing, simple presentation
basic decision making	The viewer must be able to make basic decisions based on the projected image, they do not depend on the minor details.	15:1	information displays, presentation with detailed pictures, school classes, meeting rooms, multi-purpose rooms.
analytical decision making	The viewer must be able to recognize all the details in the image.	50:1	detailed drawings, diagrams, surveillance centers
projected video	The viewer is fully involved in the content of the projected image	80:1	home cinema, viewing post-production video

1.1 Projectors and displays

Large-area imaging can be technically covered in two ways – in a projection and non-projection way.

Large-screen projection is the function of a data projector. Currently, **LCD** (*Liquid Crystal Display*) or **DLP** (*Digital Light Processing*) are used.

In the past, **CRT** (*Cathode Ray Tube*) projection was used. Projection systems can also include reflective **LCDs** and laser projection.

Non-projective large-scale imaging is done by so-called flat displays. Nowadays, **LCD** displays, or **OLED** (*Organic Light Emitting Diode*) are primarily used.

Plasma projections have been used in the past. Non-projective imaging systems can also include so-called **LED** (*Light Emitting Diode*) walls.

The basic feature of a data projector is to view images from a **PC** (*Personal Computer*) or **NTB** (*NoTeBook / NeTBook*), as well as viewing videos from other sources, such as TV, **DVD** (*Digital Video Disc*) or **BD** (*Blu-ray Disc*) etc.

The basic parameters are:

- **Resolution** - indicates the number of pixels in the image; the **PC/NTB** compatibility is important, strongly affecting image sharpness
- **Luminous efficiency** - they determine the image size or output light conditions/properties
- **Weight** - affects device mobility

Data projector resolution:

- 4:3 - older format, 1024x768 **XGA** (*eXtended Graphics Array*), 1400x1050 SXGA + (Super XGA +) and 1600x1200 **UXGA** (*Ultra XGA*)
- • 16:9 or 16:10 format - newer widescreen formats, 1280×800 **WXGA** (*Wide XGA*), 1920×1080 full **HDTV** (*High Density TeleVision*), 1920×1200 **WUXGA** (*Wide UXGA*), and 3840×2160 **UHD** (*Ultra HD*), often mistakenly referred to as 4K

Classification of data projectors:

- by weight - ultra light (up to 2 kg), personal (up to 4 kg), mobile (up to 6 kg) and conference (over 6 kg)

- by power - with LED light source (500 to 1500 ANSI lumens), with lamp or laser light source (3000 to 30000 ANSI lumens)
- by resolution - XGA, WXGA, FHD (1920 × 1080) and WUXGA (1920 × 1200), 2K and 4K digital cinema
- according to the technology used - LCD, DLP
- by destination - business, school, special applications (3D), for continuous operation (e.g. dispatching)

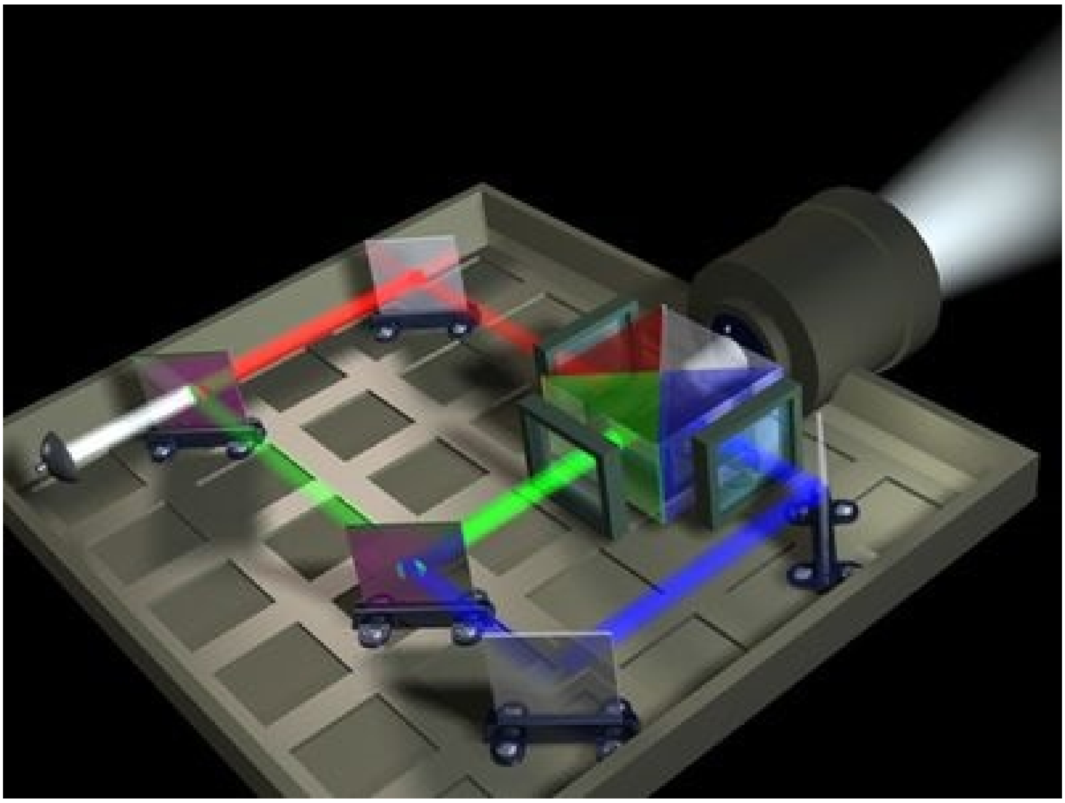
1.2 LCD projectors

E=m·c²

Basic principle of an LCD projector

Light leaving the device's lamp is incident on a system of dichroic mirrors (that is, semipermeable mirrors), which are generally used in optical prism to split the white light into the base colors of the **RGB** (*Red-Green-Blue*) model. The first dichroic mirror passes through the red light component, the others (i.e. the green component and the blue component) are reflected. The light in the complementary color (i.e., cyan color) goes on to the next dichroic mirror. There is a reflection of the green light on it, while the blue light passes forward. These mirrors are produced by depositing a thin reflective layer on a glass plate that reflects light of the given color only (i.e., the light of a specific wavelength).

The optic light-processing system from the projector's lamp goes on through the polarizing filters and the LCD panel. An electrical current (corresponding to the television signal) is carried to the LCD panel, which produces an image corresponding to this electrical current in the LCD panel. Then, the light of the three basic colors of the RGB model (carrying information about the generated image) is reflected on the dichroic prism in which they compose the resulting light (and the image). Finally, the light passes through the lens directly to the screen.



The LCD projector principle

One advantage of such projectors is that they create a stable image that is not shattered (in comparison with the DLP technology). The color of the entire projected scene can be adjusted with the throughput of each LCD panel. This allows for a fairly high contrast and true color display.

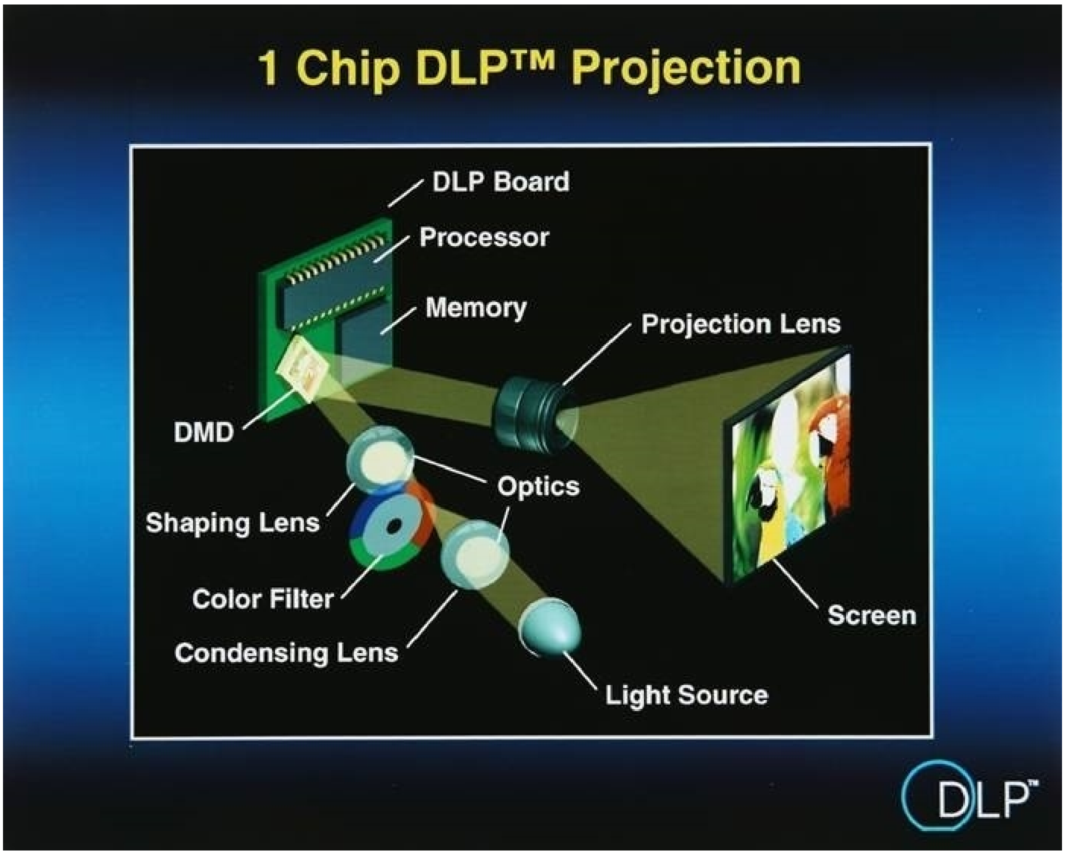
One disadvantage is that, in particular, the first models of these types of projectors displayed a visible grid on the screen as a result of the use of LCD panels. The individual display points that are to be displayed on the screen, are positioned side by side on the LCD panel, but they do not touch one another. It is necessary to bring the conductors with electric current to these display points controlling particular pixels. Newer models with better LCD panels no longer suffer from this defect; the production technology makes possible to bring individual pixels closer to each other. Another disadvantage is the so-called pixel aging. Transistors that control the brightness of individual pixels work at high temperature and are burning over time, and some of them stop working.

1.3 DLP projectors

E=m·c²

Basic principle of a DLP projector

White light from the projector's lamp goes through a rotating circular color filter. It is symmetrically divided into three color parts corresponding to individual base colors of the RGB model. The light of red, green, and blue color is gradually coming to the chip. The video signal we want to project is fed to the chip's controlling electronics. The processor connected to the chip, based on a digital signal in which the projected image is encoded, transmits pulses for individual mirrors of the **DMD** (*Digital Micromirror Device*) technology. Thus, flipping the DMD mirrors between their ON and OFF position is controlled by the video input to the chip with respect to the color that the given mirror has to produce on the screen (i.e., we need to assign a given pixel the desired color in a projected image). An important role here is played by the ratio of the times in which the mirrors are in ON and OFF state. This way, up to 16.7 million colors can be created on the screen from the RGB model base lights. The colors we see on the screen are created by additive mixing the lights of these three basic colors at the appropriate intensity and brightness.



The DLP projector principle

+

One advantage of the DLP technology is high contrast and image brightness. There is also no grid in the projected image (as in some models of LCD technology), because the individual DMD mirrors are located close to each other. It can also be mentioned that the DLP technology means a simpler design, higher dust and smoke resistance and longer life.

–

Image flicker and poor color rendering are shortcomings, compared to LCD. The light that cannot be modulated when it passes through a rotating color filter is incident on a mirror and, after reflection, it falls on the projection screen with full light intensity that is emitted by the projector’s lamp. Therefore, the brightness of individual pixels cannot be adjusted individually. On the contrary, in LCD it is possible to set the intensity for each point individually. In DLP technology, the image is slightly blurred and there is a so-called "rainbow effect". This is due to the rotation of the color filter.

1.4 Light sources for projectors

There are three types of light sources currently used in projectors - a conventional lam (tube), LED sources and lasers.

In the case of a classical lamp, it is a system, where an electric arc burns between two electrodes and this arc is the source of light.

+ Long-time proven technology and high intensity output are the advantages.

– One disadvantage is a limited lifetime (2000 to 8000 hours), slow start (about 1 minute to full output light intensity).

In projectors that use LEDs as light sources, three LEDs are present for red, green and blue color.

+ Among advantages are a quick start and long-life operation (20000 hours or more).

– The disadvantage is the limitation of the projector's output light intensity to a maximum of 1500 ANSI lm.

Projectors working with laser light incorporate several tens of blue lasers that light up on a rotating disc with a luminophore that emits white light. It is further processed as ordinary light from a lamp. Therefore, conventional light, not a laser beam, comes out of the projector’s lens.

+ Among advantages, there is a quick start and long-life operation (20000 hours or more). There is no performance limitation of the light output as it is in the case of LEDs.

1.5 Projection area (screen)

The correct placement, the position of the projection plane, in relation to viewers, is conceptually based on several of the following recommendations:

1. Image height - conceptually based on the dimension of the distance x to the most distant spectator

- for an overview – $\frac{x}{8}$
- for reading – $\frac{x}{6}$
- for details – $\frac{x}{4}$

2. Distance to the nearest spectator

- Infocomm - distance = 1 × image width
- Projecta - distance = 1.5 × image height

3. Bottom edge of the projection screen from the floor – at least 110 cm

Basic distribution of projection screens:

- Front Projection - The projector is on the same side as viewers
- Rear projection - The projector is on the opposite side to the viewer

It is also possible to classify projection screens according to the design: with a roller shutter (operated manually or electrically), with the frame-to-wall, with mobile frame, with tripod and with the cinema screen.

The format of the screen is specified by two dimensions - width and height (W × H). Taking these two dimensions into consideration, the projection surfaces can be divided into:

- universal - 1:1
- widescreen - 16:9 or 16:10
- conventional - 4: 3 (now less used)
- cinema - 2.35:1

Why is the widescreen format now preferred?

There are two reasons. The first one is that the maximum screen size is often limited by the height of the room, the second one is that at the same height of the screen as compared to the conventional screen more information is displayed.

Each screen has its own specific surface, which we choose with regard to the type of projection:

- Diffusion surface for front projection - reflects image in all directions in the same way (parameter gain = 1.0 - 1.1, viewing angle 100° - 120°)
- Diffuse surface for rear projection - directs the image in all directions equally (gain = 0.9 - 1.3, viewing angle 60° - 130°)
- Progressive HD Surface for Front Projection - specially designed for Full HD, 4K or higher, reflects the picture in all directions in the same way (gain = 0.6 or 0.9 or 1.1 or 1.3, viewing angle 150° - 170°)
- Optical front projection - reflects the image in all directions equally (gain = 0.8 or 2.3, viewing angle 46° or 170°)

2 Electroacoustic sound system

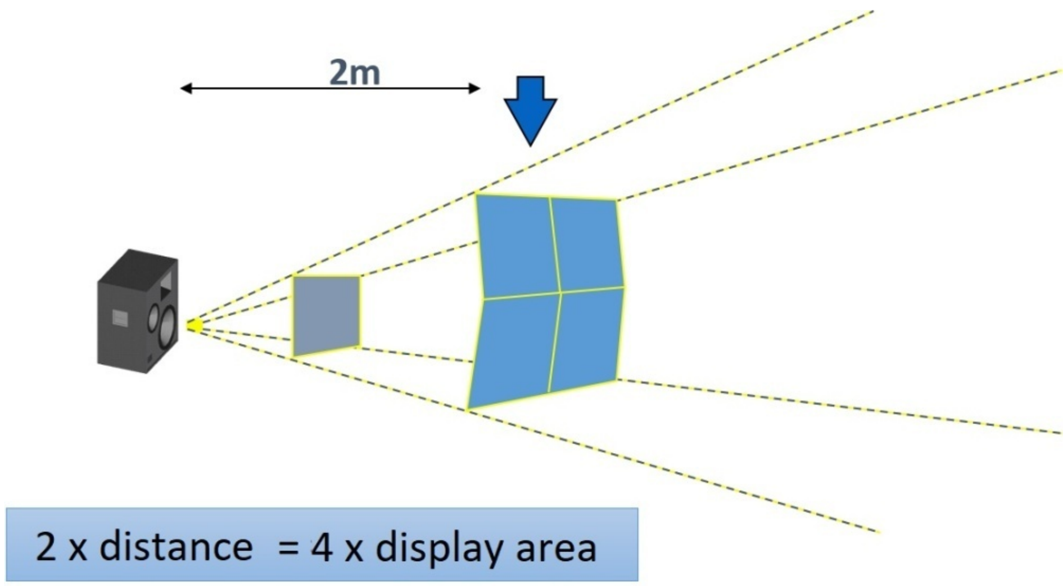
Sound is a mechanical movement of particles that is capable of inducing hearing sensation.

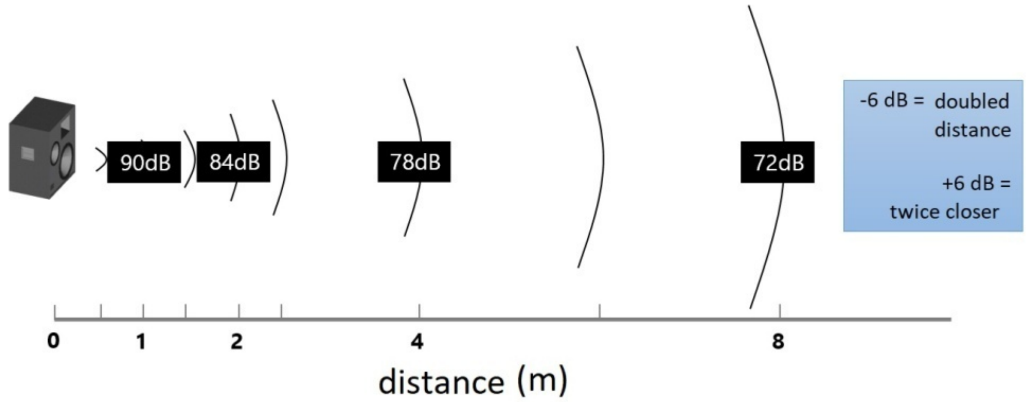
For interest, let's take a look at the sound propagation speeds for common types of materials (at normal pressure and temperature). In the air, it is 344 m/s, 1454 m/s in water, 3232 m/s in ice, 3837 m/s in marble, 5100 m/s in steel, and 6059 m/s in glass.

The frequency range of the sound that most people perceive starts at around 20 Hz and reaches up to about 20 kHz (the area of audibility is theoretically 16 Hz to 20 kHz). With the increasing human age, the upper limit significantly decreases. The most significant range is between 2 and 4 kHz, which is the most important for speech intelligibility and the human ear is the most sensitive in this range. The highest information value of speech is transmitted in the band from 0.5 through 2 kHz.

Inverse Square Rule:

When the listening distance is doubled, the volume decreases to 25 % of the original value; doubling the listening distance increases the listening area four times. In other words, doubled distance means that the acoustic pressure is reduced to a quarter, i.e. 25 %, and the radius of the sphere is doubled, the area multiplied by four.



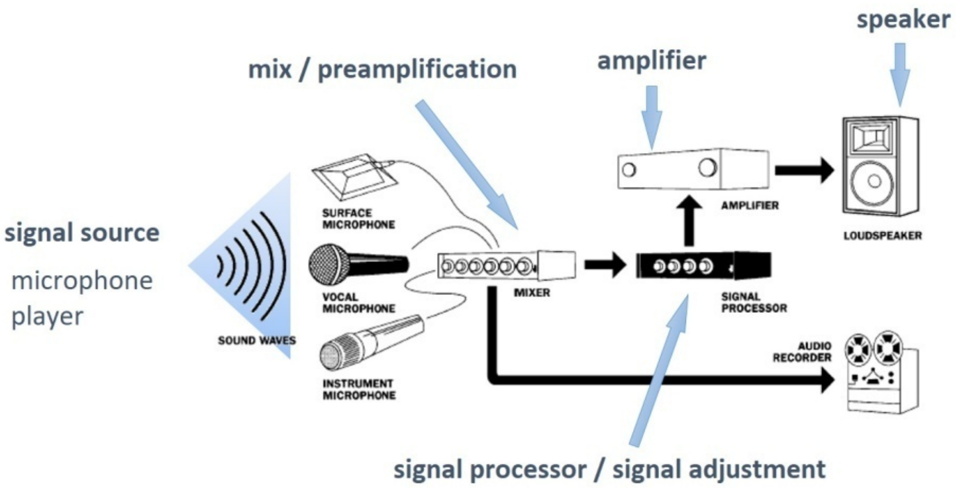


Inverse square rule

Decibel is a physical unit used to measure the sound intensity level. In general, however, it is a measure of the proportion of two values used in many fields. It is a dimensionless measure, like a percentage, but unlike it, decibel is a logarithmic unit. The human body perceives the impulses logarithmically by their intensity (the great changes to the great impulses can be caused only by small changes of counts) - Fechner-Weber's law. The rate specified in 1923 by Bell Laboratories engineers originally served to indicate attenuation of telephone lines. For example, a 3dB decrease in attenuation means half of the power, while achieving the 3dB gain means doubling the power.

2.1 Electroacoustic chain

The following figure shows an electroacoustic string with all important components (components):



Electroacoustic Chain Diagram

Microphone is a device at the beginning of the electroacoustic chain. It converts an acoustic signal into an electrical signal, which is further processed by other devices. Its quality fundamentally affects further processing of the sound.

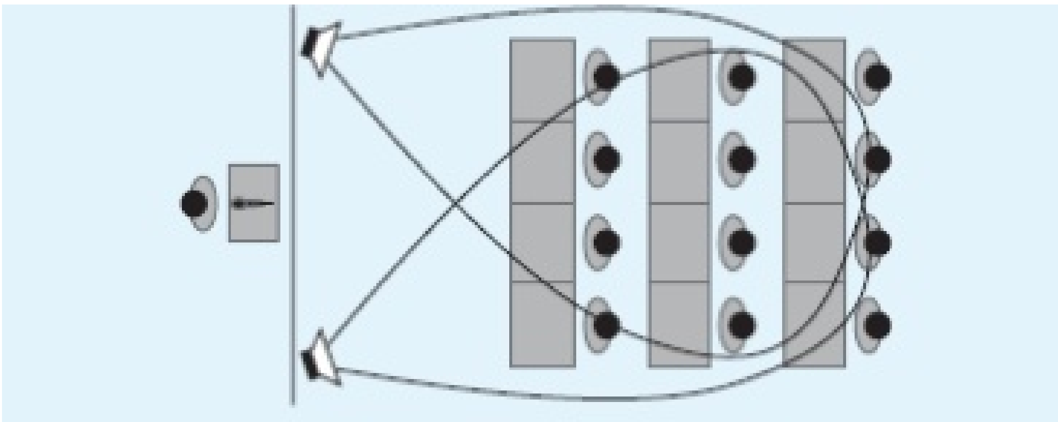
Microphone types:

- manual
- headset
- on the goose neck
- lapel microphone
- desktop
- special (e.g. for musicians)

Wireless microphone (microport) is a microphone assembly with a connected transmitter and receiver. The transmitters are part of the microphone or are connected to the microphone by a short cable. The receiver receives a signal from the microphone-transmitter. Transmitters are powered by batteries; the receivers usually use a conventional power supply.

Although there are many recommendations on where to place speakers based on the type of use and acoustic environment, in practice two basic sound systems are the most commonly used:

1. **The central sound system** (single source assembly) can be a single speaker or a central set of several speakers. The central sound system is usually located in front of the presentation. Since the listener tends to turn towards the signal source, optimal position of speakers is next to the stage, screen or other points that are to get attention.



Central sound system

2. **Decentralized sound system** should be used in the case of insufficient ceiling height required for proper functioning of the central sound system, or when there is no need for a connection between the source of the signal and its reproduction. That is a set of more loudspeakers that are optimally distributed, mostly in suspended ceilings or hanging from the ceiling. Distribution systems are mostly used to amplify the spoken word or as calling systems (queue management systems).

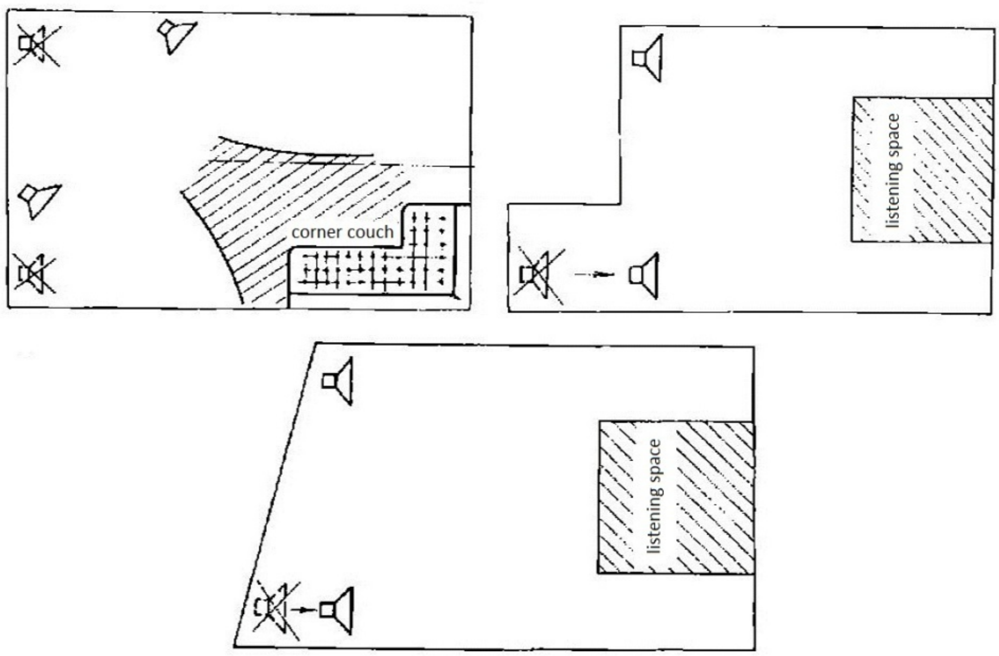
Decentralized sound system

2.2 Installation of electroacoustic sound system

Recommendations for perfect installation of electroacoustic sound are, as follows:

1. Always place the speakers in a plane perpendicular to the axis from the center of the listening position ⇒ it helps avoid the signal delay between the two signal sources.

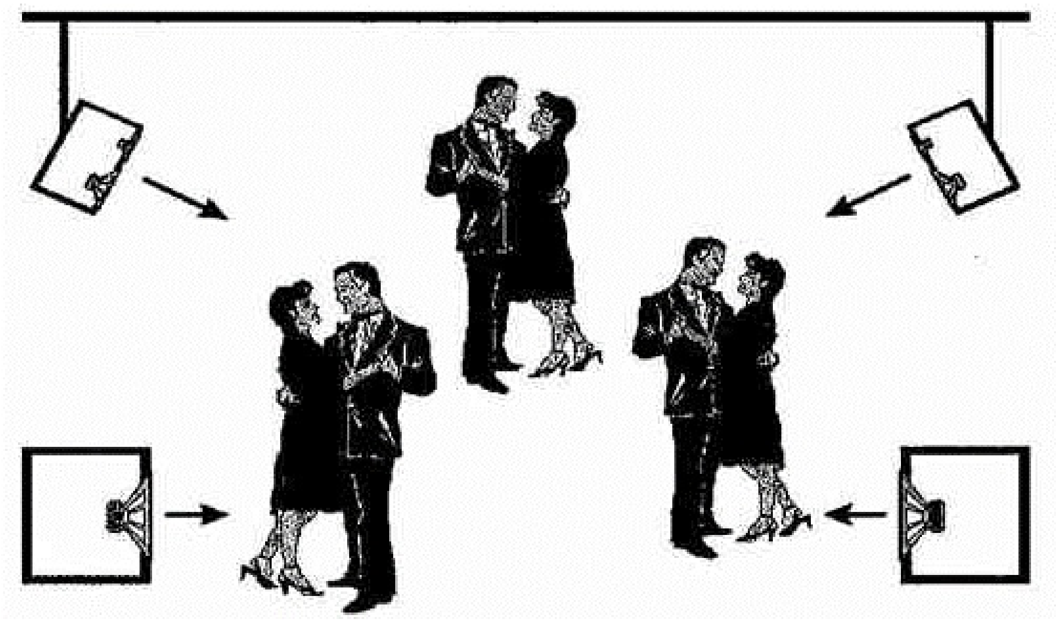
The delay can be observed mainly at higher frequencies. The low frequencies are spread evenly (it is the property of a wavelength).



Correct position of speakers in relation to the listener's position

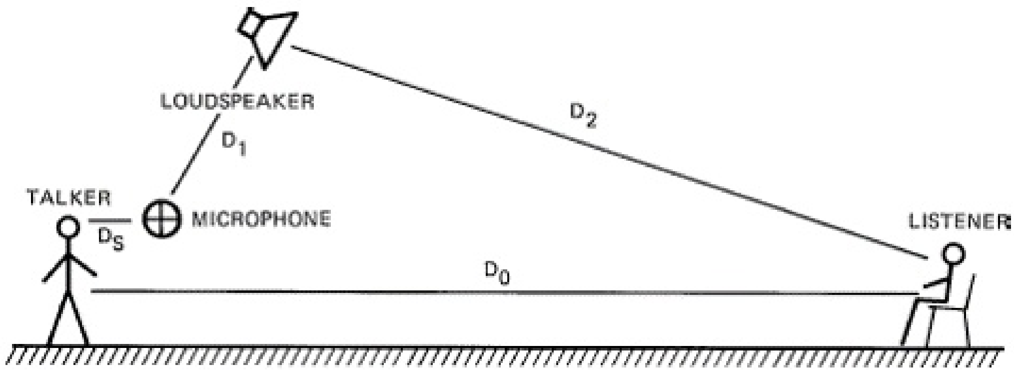
2. Height and center speakers should be placed at the height of the ears

Higher frequencies have narrow directional characteristic, low frequencies spread in every direction.



Correct positioning of high and center speakers in relation to the listener position

3. Place the microphones beyond the direct reach of the speakers.



Correct position of a microphone with respect to the position of the speakers

3 Control systems

A control system is a hardware and software set that enables users to easily and intuitively use AV/IT in the rooms and throughout the building without technical knowledge and guidance.

Control systems allow you to control the entire AV system using a simple user interface. The entire AV/IT system is composed of many individual components that ultimately work as one system. However, in order to control of such an AV system, deep knowledge on each individual device is required. Control systems can make control more accessible because no technical knowledge is required from the user about these AV devices. The control systems simplify many individual functions and steps needed for specific tasks. In addition, the control systems are able to activate with a certain event, for example, by pressing a button or reaching a certain temperature. The system initiates the subsequent response automatically in a preset way.

An advantage for users is controlling AV technology and other technologies from a single control panel, simplification and convenience of operation, automation, combining multiple functions in a single button or adapting to other individual user requirements.

At present, control systems are used for heating and cooling control, air conditioning, outdoor and indoor lighting, shading techniques, relaxation zones, security and fire protection systems, and audio and video equipment.

3.1 Components of control systems

A control system consists of the following components:

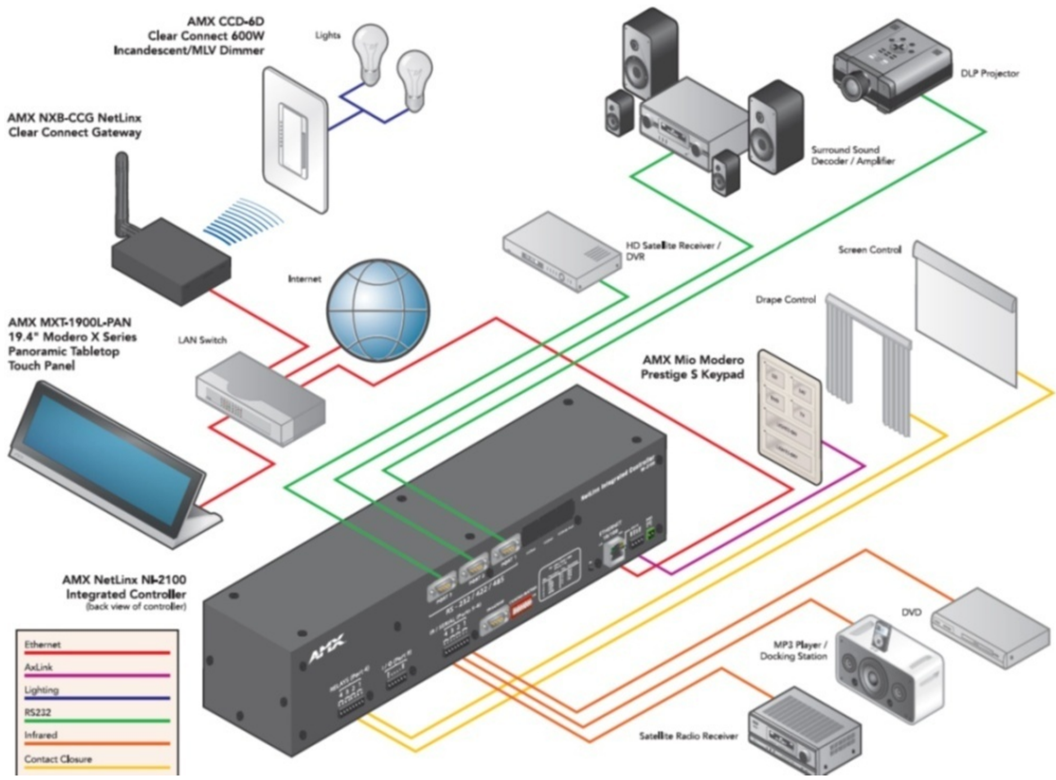
- Central controller - industrial computer with control program and control ports
- User interface - touch panels, remote controls, button panels, virtual UIs (tablets, smart phones, etc.)
- Communication gateways - modules for technology management (lighting, heating, air conditioning, VZT, etc.)
- Environmental detectors - door switches, access systems, presence sensors
- Software and applications – e.g. remote administration, reservation systems, monitoring, help desk

Current control systems include a wide range of hardware and software. The key features include the user's interface and the controller. In addition, the control system includes a variety of communication gateways, detectors, software and applications that open other features to the system while opening these functions outward. In practice, it is possible to connect control systems in individual rooms and connect them to remote management or to other technologies in the building, e.g. lighting control, heating, air conditioning, blinds, etc. With the software, the AV/IT administrator manages, monitors and analyzes all available systems throughout the building in one central location.

Central controller

The central component in the control system is the central controller. It is the "brain" of the entire control system. The controller runs a specific program that receives inputs or control requests from the user and controls individual devices as required by the program. The control system programmer modifies software so that the controller performs the correct functions. It may be required to operate the devices in several rooms across the university campus or even at the other end of the world. There may be a need for multiple linked controllers in this advanced configuration.

A controller and attached devices must be able to communicate to make the required commands. Available types of communication or control signals vary based on the capabilities of the controller and the devices. Communication between devices may be one way or two-way. In a bidirectional communication system, the controller sends instructions to the device (on the Ethernet interface). The device executes the instruction and sends back an acknowledgment (OK response) to the controller. This is called feedback and allows the user to see device status at any time. Communication can also be conducted in just one direction. It is known as one-way communication (relay contacts are one way). Unidirectional (one way) communication is often the only available type of communication between the controller and the device. The command is sent to or from the device and does not follow any confirmation that the command has been executed.



Central controller and its role in AV set

Controllers in a control system may be equipped with various types of peripherals for direct control of components of an AV system. These peripherals are used by the software drivers within the program stored in the controller to invoke certain functions and activities. For example, turning on/off the projector, rolling up or down the screen, turning the light on/off. Control system manufacturers offer many different types of controllers that have different types and numbers of peripherals. The AV system designer chooses the type of controller that meets the requirements of the solution. Some manufacturers offer the option of additional extension of standard peripherals via expansion modules.

Peripherals can process commands unidirectionally (simplex), i.e. either in or out of the device. Some peripherals process the data bidirectionally (duplex) by transmitting commands to the device on the same communication cable, and on the other hand they receive information from the device whether or not the command has been executed. Bidirectional communication can also be used to actively retrieve state information that is stored in the device's memory, such as information on operating temperature, number of hours in operation, error states, etc.

User's Interface

An important, if not the most important, component of the control system is the user's interface. It is made either in a form of a simple button driver or by a graphical touch environment on the control panel display. User needs determine the right type of user interface. In a small room, a wall-mounted keyboard is usually enough, but a large meeting room cannot do without clear graphical control. To simplify the control, the functions can be put together into preferences or scenarios. It is not necessary, therefore, to have one button for each AV/IT system. In addition to AV/IT, it is possible to integrate lighting control, pulling blind, comfort temperature setting and other technology into the user's interface.

Peripherals of the user's interface

The peripherals that are part of the user interface are:

1. Touch panels

- different diagonals from 3.5 - 21"
- wired or wireless
- table or wall

2. Keyboard / Remote Controls

- different sizes and number of buttons
- table or wall

3. Tablets and smartphone

- Connection to a Wi-Fi control system and an application that emulates a virtual touch panel

A specific part of the user's interface is the **GUI** (*Graphic User Interface*).

The graphical concept of the interface is purely on its creator; however, he/she has to respect the relatively strict rules of user ergonomics. In general, users rate the quality of the entire AV/IT system according to the quality of control, especially reliability, simplicity, intuitiveness and clarity. "Less" can be "more" in this respect. The **GUI** designer has to carefully evaluate user requirements, habits and standards, AV/IT installed techniques, and other aspects. The result has to be a **GUI**; in which the user can easily find everything you need without a thick instruction manual.

Communication Gateways

Communication gateways provide the control system with one-way or two-way communication from and to neighboring systems. They can be embedded in large complex technologies, such as lighting control or ventilation systems. On the other hand, gateways can be used to access from the outside for remote management and technical maintenance. Because there are many of different communication platforms available on the market, the AV/IT system designer needs to know the specific requirements and choose the right interface type. At present, Ethernet communication across all standards is enforced, allowing for integration into existing structured cabling and thus better interconnection with existing technologies.

Examples of other communication protocols/interfaces/standards/technologies:

- **EIB** (*European Installation Bus*)
- LonWorks protocol
- DALI (*Digital Addressable Lighting Interface*)
- Modbus protocol
- **DMX** (*Digital MultipleX*)
- **KNX** standard (*KoNneX*) - EN 50090, ISO / IEC 14543
- EnOcean technology
- Z-Wave protocol

Examples of communication gates

Environmental detectors

Environmental detectors are the “eyes and ears” of the control system. Through various types of sensors and gauges, the controller receives information about the environment or situation in a room or building. Based on the program, it is then able to respond to the various values, changes, and suggestions that detectors bring.

For example: a room with a movable sliding wall can be used for two small groups or for one large group. For this purpose, it is possible to divide space using a sliding wall. There is a switch reacts to the position of the sliding wall and thus sets appropriate AV/IT to operate either as two separate systems or one large.

Another example is the motion sensor. The sensor may, if the user enters the room, switch on the light or the light panel with information on occupancy (red - busy, green - vacant).

Thanks to **IoT** (*Internet of Things*) technologies, today's modern detectors have their own logic and they are smart. They can communicate directly through different networks (**LAN** (*Local Area Network*), **WAN** (*Wide Area Network*), **LTE** (*Long Term Evolution*), proprietary **IoT**) and transfer data for further processing and analysis. Therefore, the controller of the control system may not have a direct connection with a cable, but it only needs to be connected to the local computer network. The detector can even activate itself, in other words, without the controller's direct command.

Sample detectors

Software and applications

Software and applications bring users a great added value to the control system and to develop a relationship with customer, for potential for resale. There are either:

- particular applications for a specific area,
- or complex software that combines several areas together.

An interesting area is the use of personal equipment such as tablets and smartphones not only to manipulate with the equipment, but also as a personal assistant for planning work hours and resources (room, catering, technology, object navigation, etc.). A great issue in the corporate environment is remote administration, monitoring and analytics. Software of this kind provides administrators with comprehensive resource information and offers online support for users regardless of the geographical location of the office or branch of the company. Another extensive area is room reservation, building navigation and resource allocation (e.g. catering, AV equipment rental, cleaning services, etc.).

Some manufacturers offer both apps and cloud-based services. The customer can pre-pay the scope of the service according to the individual request regularly in monthly or annual payments. The advantage is that they do not have to purchase expensive infrastructure and servers for running "On Premises". Because control systems and their components use network communications over local or global networks, there are no limitations. Some components have their own intelligence (**IoT**) and communicate directly with the cloud service, i.e. without a dedicated controller.

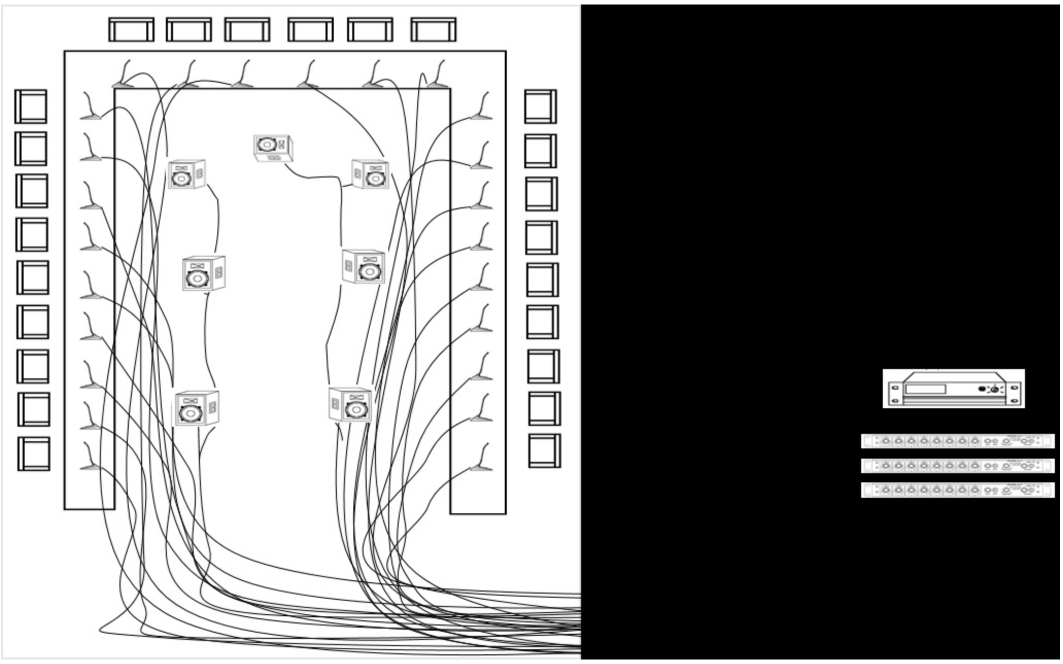
4 Audioconferencing systems

Audioconferencing systems are assemblies of delegate units designed for quality discussion within a meeting room or auditorium.

Each unit has its own microphone and loudspeaker, ensuring trouble-free amplification of the discussion of each participant and excellent clarity of the whole discussion.

Thus, audioconferencing systems provide features such as hearing and being heard, discussion management, recording capabilities and other additional features.

Non-system installation

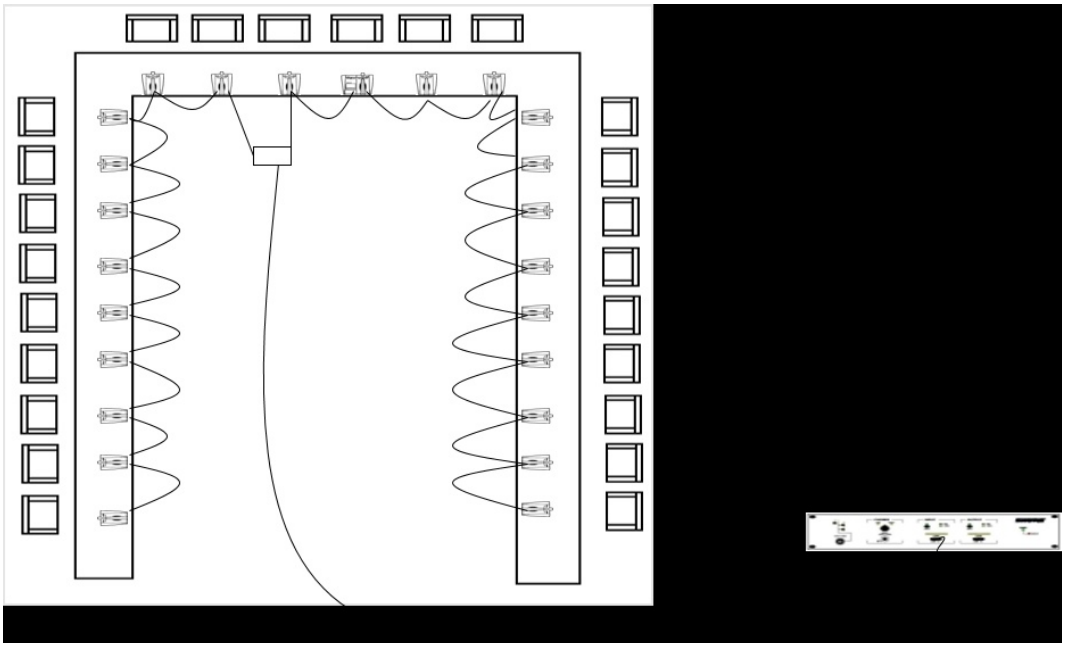


An example of a non-system installation of an audioconferencing system

This type of installation, putting it into operation, and uninstallation process are time-consuming. At the same time, the presence of at least one of the technicians as a system operator throughout the meeting is necessary.

The solution with classical microphones and speakers would be challenging and not very handy.

Conference (discussion) system



An example of system installation of an audio conferencing system

This type of installation, putting it into operation and uninstalling is time-consuming. At the same time, there is no need for any technician to attend the system for the duration of the meeting.

Discussion and conference systems are therefore easily interconnected and easy to use. Discussion and switching on and off the microphones can be handled by the chairman, it is as well possible to set the maximum number of talking people.

Audio-conferencing systems are often implemented in combination with other systems:

- voting systems
    - enable unmistakable identification of participants
    - enable transparent voting management
    - enable adjustable weights for individual voices
    - enable discussion management, including technical notes
    - enable camera and audio recording of the discussion
- interpreting systems - multichannel audio transmission systems
    - infrared wireless systems are used for professional interpretation purposes, congress delegates or meetings have wireless receivers where they can hear an interpreter on the headphones; the interpreters translate in separate cabins, and the signal is distributed to the transmitters

- guiding systems - a microphone guide
    - a mobile guide system is an appropriate solution for the implementation of a visitor group in a noisy or acoustically inappropriate environment, such as exhibitions, production halls, etc., the system enables a quick simultaneous translation, e.g. at press conferences
- Exposition Guides - Multimedia Interpreter (Audioguide)
    - a voice or multimedia exposition guide, guide for an interesting interior, or even a city; a visitor can play interpreting himself/herself or interpreting it automatically started if the user approaches a location, which is to be commented on, (e.g. in electromagnetic-triggered museums and in cities by the GPS position)

5 Signal lines, access points

In terms of the focus of this chapter, the concept of network infrastructure is a key concept.

Network Infrastructure:

- provides communication and data exchange between two communicating systems
- allows sharing of resources/network devices on a large scale
- provides single service sharing for multiple devices/clients such as file server, database software, client authentication
- connects hardware products and their software to one local area network (LAN)
- allows you to connect multiple local LANs across geographically large WANs, such as the Internet

Signal lines are essential for data exchange / communication:

- optical
  - data is transmitted through optical fibers arranged in optical cables
  - an advantage is the high resistance to electromagnetic interference
  - they are mainly used in backbone networks
  - the individual fibers are terminated by optical connectors - **LC** (*Lucent Connector*), **SC** (*Standard/Subscriber Connector*), **ST** (*Straight Tip*), **FC** (*Fiber-optic/Ferrule Connector*) and many others
  - active element ports are mostly often **SFP** (*Small Form-factor Pluggable*) or **SFP+**
- metallic
  - data is transmitted by metallic pairs arranged within a cable - such as **UTP** (*Unshielded Twisted Pair*), **STP** (*Shielded Twisted Pair*)
  - categories of cables are CAT5e, CAT6/6a (most common), CAT 7/7a, CAT8
  - typically, the **RJ-45** (*Registered Jack-45*) is used as termination, also referred to as **8P8C** (*8 Position 8 Contact*)
  - active element ports differ according to data bandwidth (FastEthernet/Gbit/5Gbit/10Gbit)

- wireless
    - data is transferred in an open space (air)
    - these connections exhibit lower data throughput and are very sensitive to interference
    - they are mainly used in access networks (according to IEEE 802.11)
    - operating bands are in the order of GHz units

The network infrastructure can be further subdivided into individual elements:

1. **passive elements** - cables, racks, patch panels, optical tubs and other installation material
2. **active elements**
    1. Switch - allows you to create individual segments of the local area network, optionally also enables **PoE** / **PoE+** (*Power over Ethernet*) local power management, L2/L3 management, cloud management
    2. Router - connects multiple LANs or interconnects two or more geographically distant networks, provides routing between these networks using a static or dynamic routing table, creating secure communication tunnels (e.g. **IPsec VPN** (*Internet Protocol Security Virtual Private Network*)), allows filtering of traffic (antispam, antivirus, firewall)
    3. Access Point - suitable for building access networks or for connecting client devices to the local LAN, it can operate in Access Point/Client/Repeater mode; implementation of **MIMO** (*Multiple Input Multiple Output*) and **MU-MIMO** (*Multi User MIMO*) versions of 2×2:2, 3×3:3 and 4×4:3, in order to achieve maximum throughput, the same standards must support both the access point and the client

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Current forms of solutions for network infrastructure connection:

- On-Premise - all network infrastructure assets are physically managed by the company
- Cloud - all network infrastructure assets are managed by a service provider, the company only uses services from the offer
- Hybrid - some parts of network infrastructure assets are under company management, some parts of network infrastructure resources are under the management of a provider

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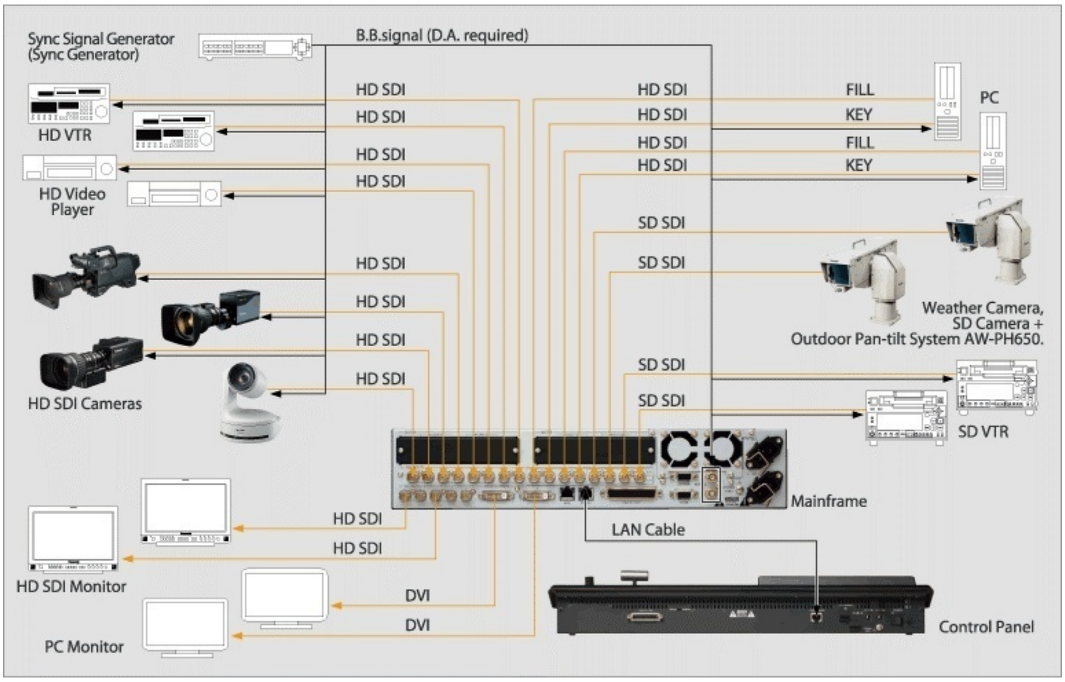
6 Video technology

Video devices include cameras and camera systems, consumer electronics, video recorders, streaming, and systems for recording and sharing content. They addressed in the following chapter.



Schematic of the CCTV system in a TV studio

Cameras and camera systems form one large area of video technology. The basic division includes three main categories:

1. installation cameras

- Rotating **PTZ** (*Pan, Tilt, Zoom*) - this type of camera is equipped with motor or manual rotation in the horizontal and vertical axis. In addition, it is possible to modify the so-called zoom lens. It is perfect for rooms where flexible image capturing is required in varying conditions such as person tracking, detail shots, overview, etc. The camera can be controlled from a console, a computer, or the control system. If the camera is part of, for example, a videoconferencing system, its motion can be controlled by an intelligent processor that detects faces and human voice. The camera then focuses on the speaking person.

- Cameras with the fixed mount - cameras of this type are designed for situations where you need to scan a specific place in a room or a wide view of the whole area is needed. They are used when conditions in the room are fixed and people in front of the camera do not move. These cameras can be equipped with a fixed lens or a zoom lens.

- Webcams – they are used to be connected to a computer or a conference system using the **USB** (*Universal Serial Bus*) interface. The purpose is to capture an individual or a limited number of people in an image and transfer it to further processing. Typically for Skype conferences, WebEX, etc. They can also serve to capture static images, i.e. photos.

Examples of installation cameras

2. portable cameras

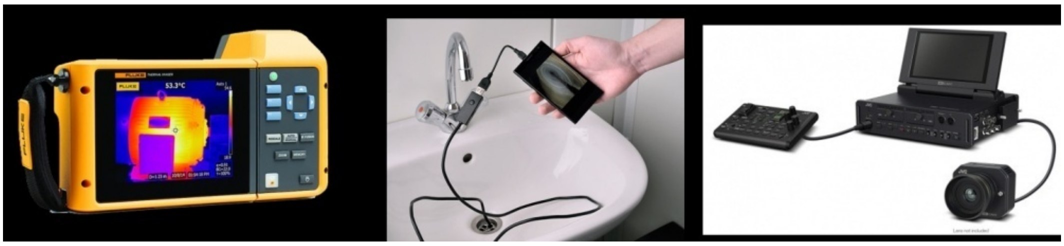
- professional - they are used mainly in television and film industry. They can also be used in regional or corporate studies where a user requires high image quality. The price range of these cameras starts roughly at 100,000,-. The best cinematography cameras are very expensive that the film producer usually leases them for a specific project.

- consumer - commonly available cameras for the widest range of users. They typically find use in households and in low-cost projects where the low price plays a role. Most features are fully automatic and a user needn't have any deep knowledge on image processing. However, even in the category of consumer cameras, there are models for demanding users, which can be classified as semi-professional. They provide a variety of features to set the parameters manually, resulting in high quality image quality.

Examples of portable cameras

3. special cameras

- purpose - cameras in this category are made for specific purposes. E.g. for thermal analysis, sensory detection (motion sensors, keying, ...), slow motion
- inspection - different types of cameras for medicine and other technical fields. They are used to transmit images from difficult-to-access or life-threatening places
- industrial - this category includes cameras used in various areas of industry



Examples of special cameras

In addition, cameras and camera systems can be divided by Interface to Digital (**HDMI** (*High-Definition Multimedia Interface*), **DVI** (*Digital Visual Interface*), **SDI** (*Serial Digital Interface*)), **IP** (*Internet Protocol*) for Ethernet Streaming, USB and combined (may have different interface combinations from the mentioned above).

Consumer video products include **DVB** (*Digital Video Broadcast*) receivers, TVs and DVD/Blu-ray players and recorders. These products are used in AV/IT installations as complementary to the system, not as the main solution. Consumer electronics is characterized by a low service life (i.e. no 24/7 operation), limited functionality for integration with other AV components, limited support by the manufacturer or distributor, often changing assortment.

Video recorders are video recording equipment for conventional recording, they can be divided into single channel and multichannel recorders, or similarly to cameras, according to the type of available interfaces.

Nowadays, a very interesting and popular application area is Streaming.

Streaming is a continuous audiovisual technology for transfer between the source and the end user. At present, streaming is mainly used for transmission of audiovisual material over the Internet (Webcasting). Webcasting can take place in real-time (Internet TV or radio) or as **VoD** (*Video on Demand*) – e.g. YouTube. To stream video to multiple users at the same time, the operator must have a stream server (in addition to the content) that communicates with target computers and streaming data.

For the transmission of audiovisual material over the Internet, codecs are used to reduce the volume of transmitted data. Flash codecs, **MPEG-4** (*Moving Picture Experts Group-4*), Windows Media, Real Time and QuickTime are the mostly used codecs. Even so, transmission of the TV resolution video (720×576) is very demanding. Therefore, streaming at 320x240 pixels at 256 to 512 kbps was the most popular. Nowadays, we can quite commonly encounter extremes such as 4K streaming, offered for example by YouTube or Netflix.

Streaming audio primarily uses **WMA** (*Windows Media Audio*), MP3, OGG, and **AAC+** (*Advanced Audio Coding+*) codecs in data streams, typically from 16 to 256 kbps. Audio can be streamed as singlebitrate, i.e. either a constant bitrate or multibitrate, which is a number of constant data streams transmitted together in one data stream between the encoder and the server. A player that can play multibitrate stream from the server can then automatically change the sound quality if the Internet connection deteriorates/improves.

The distribution of AV stream to the viewer is basically possible with three basic methods:

- **Unicast** - the transfer takes place in a closed circuit between two points, i.e. a source and a viewer. This method is suitable for transfer over backbone paths or between clearly defined products. Only one viewer can be connected to each source at a time. Multiple unicast on the network must be arithmetically aggregated and define the overall data stream of the system.

- **Multicast** - in this method, it is possible for multiple viewers that more users can join one stream at a time. The stream is started by a demand from the viewer towards the signal source. Viewers whose stream is turned can capture it based on the connection with the source. On the contrary to unicast, multicast streams do not accumulate, there is just one stream in the network. However, multicast traffic is only available on a controlled network with active Layer 3 Switch activation constraints

- **Broadcast** - is methodically similar to multicast, with the difference that the stream source actively transmits to all endpoints in the network. It is the least used of the three methods, since it cannot be controlled and thus the network can potentially encounter huge data overload

Apart from the above-mentioned video and audio distribution to the Internet, Streaming is also used in AV systems. In this case, bitrate is not a critical issue - it can use the full bandwidth offered within the local LAN, which can be up to 1 Gbps. However, one of the codecs must be used here as well, which compresses the signal and reduces the data stream. The uncompressed 1080p signal can easily reach up to 10 Gbps.

The most common codecs are in H.264 and JPEG2000. However, manufacturers produce a number of custom codecs, which are, however, mostly compatible with only one brand of products. Codecs can either be in the form of hardware or they are installed as software on a dedicated computer. In addition to image and sound, the selected codecs can also transmit other data, such as data for keyboard, mouse, USB peripherals, **IR** (*InfraRed*) and **RS232** (*Recommended Standard 232*) signals, etc. It is therefore possible to transmit complex data over a single UTP cable within a computer network for data processing in the AV system. Some peripherals can also be powered on the same cable (PoE technology).

In association with AV content streaming, it is also worth mentioning the concept of **CDN** (*Content Delivery Network*). It is a network that provides broadcasting of an AV content by broadcasting to public or private networks. In essence, this is similar to **DVB-T** (*Digital Video Broadcast - Terrestrial*) or **DVB-S** (*DVB-Sattelite*), but takes place in an IP network environment. Providers are paid. Availability, capacity and archives are guaranteed for a fee. Custom CDNs are often run by large organizations.

– Their traffic is expensive (for example, Mediasite **EVP Server** (*Event Visualization Platform Server*)).

7 Storage and content management system

In general, success in today's society is based on the speed at which information and data are distributed to users. A successful organization, which has to face the pressure of competition, addresses the need to make training, presentations and a knowledge base available to its employees and managers as quickly as possible. Only timely published content is up to date.

The above implies that an optimal system integrates four basic activities that the lecturer, presenter and viewer perform with the presentation: recording, sharing, viewing and organization.

There are a number of available solutions on the market that more or less comfortably provide the users with tools for recording, publishing, and archiving presentations through the web interface. The benefit of a live presentation does not stay behind the closed door for a limited number of viewers, but it can be shared among an unlimited number of viewers anytime, anywhere via a local network or the Internet. In addition, you can also synchronize video, sound, and slideshow to an intuitive player that can be started by using a Web browser.

You can see a live demo of a system at http://mediasite.avmedia.cz.

Systems for digital content management, distribution and display provide information within a predefined time schedule. They can display digital content in the form of, for example, advertising messages, internal marketing communication, navigation, etc. The content can be the compilation of images, videos, HTML, RSS feeds, etc.

Potential users, therefore, offer the possibility of displaying more information on a single viewer, viewing digitized content with the possibility of immediate changes, engaging dynamic content through visual effects, and monitoring the device's management.

At present, storage management systems are used across the corporate segment, retail, cultural projects, public administration, and schools. So it can be stated that it's everywhere where they want to replace the analog content by the digital one.

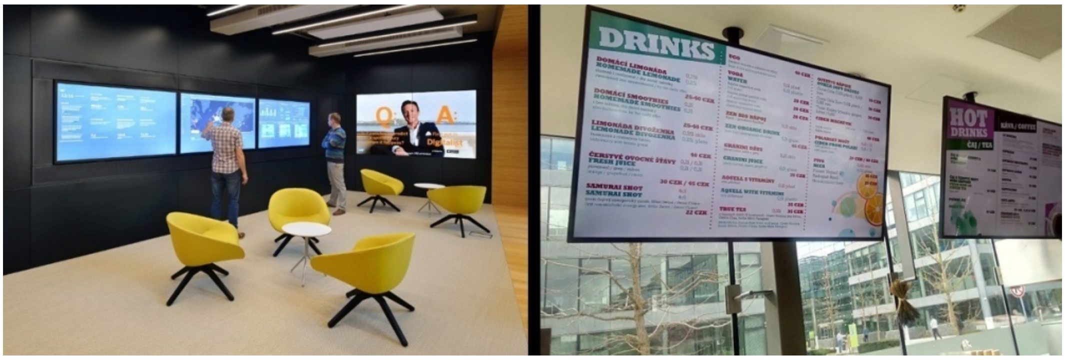
The structure of a storage management system includes:

1. system for management and distribution of multimedia - software part
2. network infrastructure
3. Content Players
4. display/kiosks
5. interactivity (i.e. controls) and sound reproduction

There are several possibilities to distribute content. One of the conventional solution is so-called Standalone, i.e. a local solution. Nowadays, however, it is possible to take advantage of the options offered by the available network connectivity. This means that multimedia content can be distributed through a local data network (LAN), or they can be solved by remote cloud access or by a Server-Client approach, i.e. On-Premise.

A server is a central computer with the service software; a client is a multimedia player often installed on a PC.

A very important part is to secure the distribution of content. The transmission is done in an encrypted form directly to the player's storage. The player can also be secured with a login and password. The proxy server support is also important. Some solutions can be integrated into **AD** (*Active Directory*).



Sample storage usage and distribution of content