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ARTICULO

AUDIOVISUAL TECHNOLOGIES IN EDUCATION

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AUDIOVISUAL TECHNOLOGIES IN EDUCATION

ABSTRACT

Most part of learning applications of modern Information and Communication Technologies (ICTs) are based on international standards for distribution of audiovisual contents. However not all professors and educational institutions have the necessary resources and knowledge for the right use of technologies for educational material production in audio and video, mainly due to formats diversity, transmission, storage and retrieval limitations and the specific student's capabilities to access the materials. This article reviews the main tools, both free and commercial; more used at institutions around the globe for content generation and sharing trough the most diverse communication media and also exposes trends of audiovisual communication technologies.

Keywords: Education Technology, Digital Video, Videoconference, Audioconference, Webcast.

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WHY TO USE AUDIOVISUAL COMMUNICATION IN EDUCATION?

Chalk and blackboard are still the major technologies for knowledge distribution inside the classroom (now could be considered as primitive ICTs). Jointly with books, projectors, slides and diverse printings, all of them share the main goal to give a graphic representation of knowledge, the same with characters, numbers, symbols as well as pictures, drawings or photographs. The communication media evolution thanks to the advance of digital technology have included, sometimes slower than technology itself, other media like audio, video, animations and voice – image virtual representations.

However, far away from knowledge that could be retrieved from the simple inspection of a blackboard or listening an audio in digital format, there are factors that "primitive media" barely record: the physical language from professor and the students themselves, even tone of voice and emphasis in lectures, items closely related with classroom's interactions. Recordings of moving pictures and "live" audio lectures enables to create educational materials more stylish and complete rather those remaining on thin sheets of tree's pulp.

In the Information Society the educational institutions can not been apart from using audiovisual ICTs. Everyday more sites appear on the Internet with audio and video substance, the same with commercial than educative goals. Mass media like television and radio are converging into a digital culture fashion, that not only reduces expenses compared to its analog sister, but edges new creation, storage, reproduction and delivery boundaries. In essence the institutions do not need to do more than they are already doing: to teach, but now technology supported, that is cheaper compared with what could be deduced at first sight. The solution is to use these technologies in common environments, trying not to convert the installations in something so inaccessible that, after all, it can not be used the same for operation than maintenance costs.

AUDIOVISUAL TRANSMISSION TECHNOLOGIES

Contemporary central processors, memory circuits, hard disks, optical devices and digital data networks have permitted the evolution of new communication technologies on education. Audio and video have been constantly on sight of educational institutions to share contents, but media like radio and television, which implies more than receivers, cameras and microphones, are not so close by its transmission requirements (antennas, satellite links, legal permissions, etc).

There are three families for audiovisual communication over digital data networks:

- Synchronous unidirectional
- Synchronous bidirectional
- Asynchronous unidirectional

Synchronous unidirectional audiovisual technologies

Described as audio or video broadcast in just one way and in the moment when is produced. There is only one source and could be more than one destination. In this family the most popular technologies are:

Audio

- Radio (AM, FM, Short Wave, UHF, Satellite Radio)
- Audio Webcast

Video

- Television (VHF, UHF, HDTV, DTH, Satellite)
- Video Webcast

Since regulations nearly in every country scheming the use of electromagnetic spectrum, is not insignificant for an institution to have the licenses for radio diffusion at any of the frequencies for that purpose (air radio or television). For this reason the alternative Internet broadcast, called Webcast, has become so popular in recent years, furthermore its lows maintenance and production costs.

An Internet radio station or television channel (notion a little confuse if we consider the term's roots, since there is no "air transmission" but "cable transmission"), includes three basic elements:

- Encoder
- Server
- Client

Encoder's hardware could be any computer with a sound card and line-in port for applications that requires only audio broadcast; even a video capture card if content is more robust.

Encoder's software might be commercial (for no more than 30 dollars the more complete) or free of charge, with restricted conversion and compression capacities, but sufficient to generate a transmission sequence, or audiovisual stream that can be received on the server. The analog audio input possibly will come from a microphone, an audio mixer or any other device with base band output. Video's source output must be plugged into the video capture card. Cables interconnecting audio and video sources (RCA, S-Video, Miniplug and Plug) with the encoder's capture cards are easy to buy at any electronics store.

Some modern devices like portable digital audio recorders or digital video cameras have USB and FireWire interfaces, eliminating the analog to digital translation (task assigned to audio and video capture cards) improving signal's quality. The computer responsible of signal production should have the appropriate ports, compatibles with these digital devices.

The server is the most significant component, because of its Internet's access and processor/memory features depends the channel or radio station performance. This system receives the original sequence from encoder and, just as a radio or television repeater, relay the zero and ones stream to computers that have requested the signal. Its software could be of open and limited to system's capacity or restricted to use upon a license payment per simultaneous access. If the encoder is equivalent to a radio or television station, the server is the antenna at the top of the roof.

Clients are computers in a connection with the server and they requests, plainly, one copy of the live stream that comes from encoder. The minimum hardware includes a sound card and any audio-out appliance, such as speakers or a headset.

There is diversity of programs to access audio – video content, branded as media players, some cheaper than others, even of free use. Any of these programs employs coder – decoder libraries stored as part of the operating systems, one for each kind of media. However, some of these programs have proprietary

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formats or *codecs*, that can not be interpreted by others media players. For an educational organization is good to use standard formats, avoiding to force possible users to set up specific programs that might cause a charge of use or even an intricate installation, sinking the possibilities for content's delivery.

Synchronous bidirectional audiovisual technologies

Comparable to unidirectional ones, provides the advantage to enable a two-way communication between the origin and the destiny. Synchrony means that every participant must concur in time, no matter the space. Widespread technologies in this scope are:

Audio:

- Telephony
- Telephony over IP
- Audio conferencing
- Audio conferencing over IP

Video:

- Videoconference
- Videoconference over IP
- Interactive HDTV

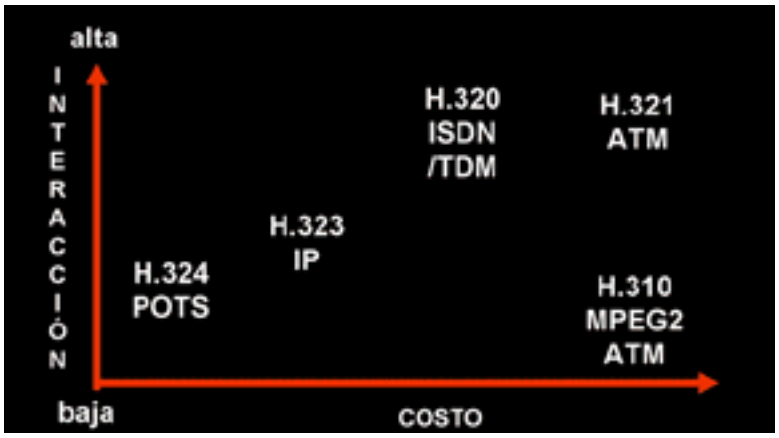
Telephony evolved in recent years from stationary and low quality devices to digital and portable services. Today, telephone service extend its capabilities to the Internet, a packet switched network, taking the name of Telephone or Voice over IP, to send and receive data packets with human voice encoded and compressed into a digital format. New routers with similar functions as on PBXs not only permits the use of computers or ad hoc devices for telephone services over local networks, but also have interfaces to public old telephone systems and networks.

In a usual way, a telephone link involves two endpoints (a point to point link). New switches and devices provide enough infrastructures to set up audio conferences: a connection of more than two sites at certain time. This technology was one of the firsts used in distance education, because it's low cost even in long distance calls, and the ubiquitous telephone services. For group interactions it is recommended to use mixers (microphones – input) and amplifiers (speakers – output) coupled to telephone devices.

However audio conference is not a media with an endlessly number of participant terminals. The lack of visual expressions as part of the human communication protocol, regardless language, makes hard to maintain under control a session with more than seven or eight sites, close to a "walkie-talkie" environment, so far from natural communication in a classroom or a face-to-face meeting.

Probably one of the most used tools for content based on video is videoconference: audio and video transmission and reception in real time. At present any computer with a sound card and sufficient media processing power can be a videoconference terminal with a microphone and a webcam. More advanced devices, like the Videoconference *CODECS*, are dedicated software and hardware appliances oriented to this purpose with better audio and video quality.

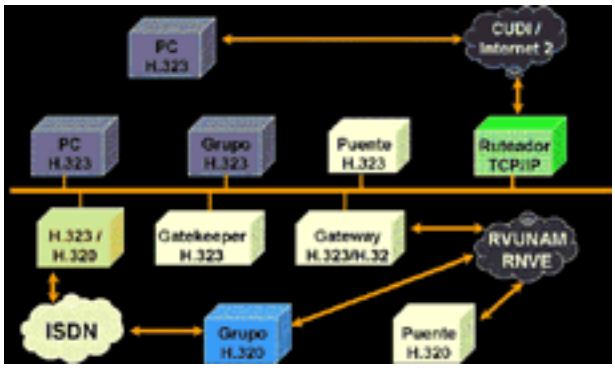
Not so many years ago the few available transmission technologies for videoconference were dedicated networks and ISDN. But in the process of digital convergence, new audiovisual codification standards allowed the introduction of videoconference over IP networks, with the Internet as the ideal test bed. *CODECS* changed from complex and expensive systems to a huge service based on software installed in personal



computers. Even so, robust/group systems at custom-made videoconference rooms are still in use and they are compatible with software and webcam based versions on personal computers, only if all of them are sharing the same communication network, almost better if is the Internet or high performance networks like Internet 2.

PC-based *CODECS*, also known as Desktop Systems, are very convenient to associate individuals or small groups into a larger session with group systems, using one of the most effective videoconference layouts: multipoint sessions.

Every videoconference system (personal or group use) can recognize only one remote endpoint. When communication with more than one site is required, is indispensable to use a Multipoint Control Unit (MCU), which acts like a codec's array, one for each of the remote sites in the conference, taking care of audio mixing and video switching.



More complex MCU's can interconnect systems belong to different protocols and types of links: a personal computer with webcam and microphone could be connected to a group system already signed into the MCU by ISDN or a dedicated link. Other special features, not mandatory by international standards, are continuous presence (split screens on observer's side, each quadrant with the signal from other site) and simultaneous Video Webcast.

Recently have appeared new technologies in the market (and as result of academic community's efforts), incorporating the advanced features of HDTV and the hottest videoconference developments. Such are MPEG-2 Videoconference, the Virtual Rooms Videoconference System (VRVS) and the Access Grid, these two last mostly used on networks like Internet 2, because their capacities for transmission, interaction and multimedia–multisource audiovisual content aggregation outlays the traditional available capacity of conventional Internet.

Asynchronous unidirectional audiovisual technologies

Different to previous tools, these not requires sender – receiver coincidence. Also known as Audio or Video on Demand, because only a user request to the server gives access to one or more files. There is only needed to place audio files into a server's directory and with help of a HTML interface, indicate users which materials are accessible. Client's browsers will do the rest, calling the appropriate media player settled as default or the one preferred by user.

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MEDIA SERVERS

Both synchronous and asynchronous unidirectional technologies (Webcast and Audio or Video On Demand, respectively) uses a system that distributes the information to more than a client at the same time. There are two media server types: the specific purpose designed ones, working under the RTSP standard (Real Time Streaming Protocol) and traditional servers based on Internet protocols, like HTTP or FTP.

HTTP and FTP servers shares the content without notice its format, so user's player controls like fast forward and rewind in an audio track or video clip are not enabled, because content treatment is the same as with any other text or picture file. In the other hand, RTSP servers can do fast forward and rewind directly on command from user's controls, without long time waiting the server to play in its memory the entire file.

Additionally, RTSP servers can be configured in Unicast or Multicast modes. HTTP and FTP servers work only in Unicast mode.

Unicast and Multicast

Multimedia content transmission over the Internet could be a mayor challenge for local network administrators. In the same way as a computer to computer connection, audiovisual content retrieval implies to use a fraction of available bandwidth, multiplied in a proportional scale as client's requests to server grows.

This type of connection, point to point, where client makes a link with the server and receives or sends a data stream independent from other clients is called Unicast. Several on-live services such as videoconference, audioconference and webcast are distributed in this fashion. Asynchronous services, as audio – video on demand, only can be provided under this mode. In other words: the client creates an exclusive channel with server, a separate lane, adding bandwidth utilization as many users goes into the service at the same time.

When low bandwidth is an issue or the predictable number of clients supersedes local network or corporate Internet's capacity of implicated servers, is healthier to deploy Multicast: just one copy of multimedia stream is sent to a specific address (Multicast Address), belonged to a router on the Internet with sufficient capacity to repeat the data stream, without relevant bandwidth consumption.

For example: If an audio broadcast is made at 56Kbps on the Unicast model, every user's connection will take up 56 kbps from available bandwidth. If server has a 10 Mbps NIC, then will accept roughly 150 simultaneous clients. As an alternative, a Multicast service will take only 56 Kbps of server's capacity, giving out data to as many users as the bandwidth at Multicast's router allows it.

That is why looks more effective to use Multicast. However this technology is not full compatible yet with the security measures and tools implemented into the most important and well managed networks. A data packet sequence on Multicast mode is commonly detected by routers and firewalls as an attack, keeping it out the local network, thus users behind these protections can not access the content in this approach. In the same way, Multicast connections uses another packet protocol, UDP, which one do not requires to verify destination's address (quite different from TCP, which in fact validates destination of packets). Those content's distributors whom desires control over every access and user's registration to their services must employ, without doubt, Unicast instead Multicast.

AUDIO AND VIDEO DIGITAL FORMATS

Fundamental elements on any kind of audiovisual technology are the digital codification and compression formats. For a long time the only ways to storage and share out audible and visible information were analog media and resources: long play discs, tapes, videotapes, AM/FM radio and air television. These resources, with the purpose of simulate a process or information, the same arranging magnetized particles over tape's plastic surface or by waves emitted from a radio station, are widely known, but incompatible with modern media like the Internet or Direct to Home Television.

Digital formats are a set of recommendations, standards and proprietary initiatives that provides some kind of equivalence to the analog information in terms of zeroes and ones, discrete binary representations or, in a simpler explanation, digital content. Most of the higher education institutions around the globe have adopted standards validated by world wide recognized entities, like the International Telecommunications Union (ITU) or the International Organization for Standardization (ISO), assuring compatibility of programs, equipments and products with the resources at hand of their students or professors, or other users in the rest of the institutions.

For audio webcast and on demand, a renowned format is MP3, product of the first MPEG implementation for audio/video compression. MP3 is the audio layer of MPEG-1, best known as the digital audiovisual format into VCD's. MP3 facilitates audio compression up to a tenth part of the original size of a PCM/CDA audio file, the ones stored on Audio CD's. Part of MP3's success comes from the free use of decoders, and a very inexpensive license for encoders, many of them already present in the media players software. Although there are more digital formats for Audio Webcast or On Demand, MP3 and its recent version MP3Pro are pointing to be the *de facto* standard for this type of services.

For video webcast and on demand the format diversity is bigger, specially the proprietary ones. Corporations like RealNetworks, Apple and Microsoft, creators of the most popular media players (Real Player, Quicktime and Windows Media Player, accordingly) have developed coders – decoders that only its own media player can understand. If an institution decides to use a proprietary format implies that assumes to restrict, in some sort, their community's access possibilities, since not all personnel and students have identical operating systems, computers or media players.

This is why MPEG-4 takes relevance. Resulting from MPEG-1 and MPEG-2 (the DVD and DTH audiovisual standard) MPEG-4 was designed for multimedia delivery over the Internet, with some levels of scalability from low bandwidth services up to good quality interactive sessions. Currently almost all media players and RTSP servers are MPEG-4 compliant.

Formats for interactive audiovisual technologies are more related between them. Telephony and IP audio conference uses same standards for audio codification as videoconference. These standards are designed in such manner that optimizes as much as they can the communication quality at low bandwidth and provides superior performance as network resources also increase. G.711 and G.723, Voice over IP standards (point to point or multipoint) are the same employed by videoconference systems operating under H.320 (ISDN and dedicated lines) and H.323 (sessions over IP networks) standards. From another perspective: an IP audio terminal works like an IP videoconference terminal, without the video component, of course.

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PERIPHERALS AND TRANSMISSION TECHNOLOGIES

For any audiovisual service, the educational institutions already have most of the required peripherals, understanding these as devices that provides the source signals or shows the content transported over digital networks to user's senses, in other words, input and output devices.

The most easy to get are video cameras and microphones, as well as speakers, amplifiers and monitors. Among these resources must be analog to digital converters (encoders) and digital to analog converters (decoders), being these customized computers for that purpose or specially designed systems, like the group videoconference devices.

Whereas connection between input and output devices to their respective encoders or decoders is generally analog with copper wires (coax, RCA, etc) the transmission link that belongs encoders and decoders could be simple or complex.

The simple transmission links are identical in the whole operation path connecting two or more digital devices. Twisted pair cables, fiber optic, coaxial, microwaves, satellite links, radiofrequency emissions, 802.11 wireless networks, among others, are the most popular technologies for simple media networks.

Complex networks mix more than one transmission technology. The clearest example is the Internet itself: meanwhile a local access might be over twisted pair, as long as the data packets goes to their target, media changes, as undersea fiber optic cables or regional microwave links, returning at the end to twisted pair in the last segment, just to quote an example.

An interesting thing from a user's point of view is that they don't have to know how all these transmission technologies operates or how many are present in a certain service, because the continuing operation of routers, gateways, switches and network hubs guarantees them a smooth connectivity

CONCLUSIONS

One technology, by itself, is not the solution to educational contents delivery challenges. In the same way, technology without contents is useless. Educational institutions have made significant efforts in recent years to encourage teachers and students to exploit ICT's at the classroom and beyond university grounds. However, materials storage has not followed the same path. Many instructional resources that could be included into on line education sites are hand writings or disperse documents, even thoughts at teacher's minds.

Adequate technology integration comes from media and methods oriented to collect contents, and in this scope, to record traditional lectures on audio and video saves time and effort investments by professors to create on line materials. Right selected courses and its didactic elements will enable the production of resources such as learning objects, on line audio and video repositories or the creation of new instructional materials, assuring better and effective initial content storage.

Is clear that a sole institution will need more time for publishing materials about one or more courses if is compared with pairs collaboration. Thanks to telecommunications technologies and advanced networks now is possible to share audiovisual archives beyond local buildings, reaching more interest groups, not only of users, but collaboration and production ones, in the other side of the planet. That is why is very important to exploit at its maximum capacity collaborative tools such as discussion forums, e-mail distribution lists or the CMS portals oriented to support workgroups and related communities.

Technological change is a continuum, and whereas some entities at last are doing some kind of on

line and interactive education, others are using already tools to share materials over wireless networks directly to student's digital assistants (PDA's), migrating from those plain old telephone systems to rich convergent networks in voice, video and date, unidirectional or interactive. But any resource is limited and bandwidth is still a caution issue when multimedia communications are involved. Certain applications such as videoconferences over IP or High Definition ones are few tolerant to transmission delays or failures, due its interactive nature and real time communication. Less severe services, such as asynchronous audio and video on demand, can work with relative success even in poor bandwidth conditions.

Is easy to deduce that moreover selecting those contents which permits a rapid institutional positioning in the spotlight of on line education, define which technology or technologies will be used for every application is mandatory. Is a temptation hard to refuse to think that videoconference in every classroom would be an enormous competitive advantage, the reality is that only a few educational, scientific or administrative applications requires videoconference over IP or ISDN, and more less needs Access Grid or Interactive HDTV. Is enough to identify the available resources, the mean technology at hand of teachers and students, to determine if priority will be given to on demand contents production and delivery (in the lower level of cost and investments) or is better to develop wide interactive and multimedia networks (assuming the cost). There is no direct and proportional cost – benefit relationship. Afterwards, the right combination of technologies, networks, resources and standards will provide the best possible solution to every need.

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GLOSSARY

802.11

A family of specifications developed by the IEEE for wireless LAN technology. 802.11 specifies an over-the-air interface between a wireless client and a base station or between two wireless clients. The IEEE accepted the specification in 1997.
There are several specifications in the 802.11 family:

- **802.11** -- applies to wireless LANs and provides 1 or 2 Mbps transmission in the 2.4 GHz band using either frequency hopping spread spectrum (FHSS) or direct sequence spread spectrum (DSSS).
- **802.11a** -- an extension to 802.11 that applies to wireless LANs and provides up to 54 Mbps in the 5GHz band. 802.11a uses an orthogonal frequency division multiplexing encoding scheme rather than FHSS or DSSS.
- **802.11b** (also referred to as 802.11 High Rate or Wi-Fi) -- an extension to 802.11 that applies to wireless LANS and provides 11 Mbps transmission (with a fallback to 5.5, 2 and 1 Mbps) in the 2.4 GHz band. 802.11b uses only DSSS. 802.11b was a 1999 ratification to the original 802.11 standard, allowing wireless functionality comparable to Ethernet.
- **802.11g** -- applies to wireless LANs and provides 20+ Mbps in the 2.4 GHz band.

http://www.webopedia.com/TERM/8/802_11.html
http://www.enterate.unam.mx/Articulos/2004/Abril/redes.htm

Access Grid

Analogic

Also spelled analogue, describes a device or system that represents changing values as continuously variable physical quantities. A typical analog device is a clock in which the hands move continuously around the face. Such a clock is capable of indicating every possible time of day. In contrast, a digital clock is capable of representing only a finite number of times (every tenth of a second, for example). In general, humans experience the world analogically. Vision, for example, is an analog experience because we perceive infinitely smooth gradations of shapes and colors.

When used in reference to data storage and transmission, analog format is that in which information is transmitted by modulating a continuous transmission signal, such as amplifying a signal's strength or varying its frequency to add or take away data. For example, telephones take sound vibrations and turn them into electrical vibrations of the same shape before they are transmitted over traditional telephone lines. Radio wave transmissions work in the same way. Computers, which handle data in digital form, require modems to turn signals from digital to analog before transmitting those signals over communication lines such as telephone lines that carry only analog signals. The signals are turned back into digital form (demodulated) at the receiving end so that the computer can process the data in its digital format.

http://www.webopedia.com/TERM/a/analog.html

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Bandwidth

(1) A range within a band of frequencies or wavelengths.
(2) The amount of data that can be transmitted in a fixed amount of time. For digital devices, the bandwidth is usually expressed in bits per second (bps) or bytes per second. For analog devices, the bandwidth is expressed in cycles per second, or Hertz (Hz).

The bandwidth is particularly important for I/O devices. For example, a fast disk drive can be hampered by a bus with a low bandwidth. This is the main reason that new buses, such as AGP, have been developed for the PC.

http://www.webopedia.com/TERM/b/bandwidth.html

Base band

(1) The original band of frequencies of a signal before it is modulated for transmission at a higher frequency.
(2) A type of data transmission in which digital or analog data is sent over a single unmultiplexed channel, such as an Ethernet LAN. Baseband transmission use TDM to send simultaneous bits of data along the full bandwidth of the transmission channel.

http://www.webopedia.com/TERM/b/baseband.html

CMS

Software that enables one to add and/or manipulate content on a Web site.

http://www.webopedia.com/TERM/C/content_management_system.html

Coaxial Cable

A type of wire that consists of a center wire surrounded by insulation and then a grounded shield of braided wire. The shield minimizes electrical and radio frequency interference.

Coaxial cabling is the primary type of cabling used by the cable television industry and is also widely used for computer networks, such as Ethernet. Although more expensive than standard telephone wire, it is much less susceptible to interference and can carry much more data.

http://www.webopedia.com/TERM/c/coaxial_cable.html

CODEC

1) Short for compressor/decompressor, a *codec* is any technology for compressing and decompressing data. *Codecs* can be implemented in software, hardware, or a combination of both. Some popular *codecs* for computer video include MPEG, Indeo and Cinepak.

(2) In telecommunications, (short for coder/decoder) a device that encodes or decodes a signal. For example, telephone companies use *codecs* to convert binary signals transmitted on their digital networks to analog signals converted on their analog networks.

(3) The translation of a binary value into a voltage that can be transmitted over a wire.

http://www.webopedia.com/TERM/c/codec.html

Digital

Describes any system based on discontinuous data or events. Computers are digital machines because at their most basic level they can distinguish between just two values, 0 and 1, or off and on. There is no simple way to represent all the values in between, such as 0.25. All data that a computer processes must be encoded digitally, as a series of zeroes and ones.

The opposite of digital is analog. A typical analog device is a clock in which the hands move continuously around the face. Such a clock is capable of indicating every possible time of day. In contrast, a digital clock is capable of representing only a finite number of times (every tenth of a second, for example).

http://www.webopedia.com/TERM/d/digital.html

DVD

Short for digital versatile disc or digital video disc, a type of optical disk technology similar to the CD-ROM. A DVD holds a minimum of 4.7GB of data, enough for a full-length movie. DVDs are commonly used as a medium for digital representation of movies and other multimedia presentations that combine sound with graphics.

The DVD specification supports disks with capacities of from 4.7GB to 17GB and access rates of 600KBps to 1.3 MBps. One of the best features of DVD drives is that they are backward-compatible with CD-ROMs, meaning they can play old CD-ROMs, CD-I disks, and video CDs, as well as new DVD-ROMs. Newer DVD players can also read CD-R disks.

DVD uses MPEG-2 to compress video data.

For comparison and contrast, see DVD-R, DVD-RW, DVD+R, DVD+RW and DVD-RAM

http://www.webopedia.com/TERM/D/DVD.html
http://www.enterate.unam.mx/Articulos/dos/febrero/dvd.htm
http://www.enterate.unam.mx/Articulos/tres/noviembre/video.htm

Fiber Optic

A technology that uses glass (or plastic) threads (fibers) to transmit data. A fiber optic cable consists of a bundle of glass threads, each of which is capable of transmitting messages modulated onto light waves.

Fiber optics has several advantages over traditional metal communications lines:

- Fiber optic cables have a much greater bandwidth than metal cables. This means that they can carry more data.
- Fiber optic cables are less susceptible than metal cables to interference.
- Fiber optic cables are much thinner and lighter than metal wires.
- Data can be transmitted digitally (the natural form for computer data) rather than analogically.

The main disadvantage of fiber optics is that the cables are expensive to install. In addition, they are more fragile than wire and are difficult to split.
Fiber optics is a particularly popular technology for local-area networks. In addition, telephone companies are steadily replacing traditional telephone lines with fiber optic cables. In the future, almost all communications will employ fiber optics.

http://www.webopedia.com/TERM/f/fiber_optics.html

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FireWire

A very fast external bus standard that supports data transfer rates of up to 400Mbps (in 1394a) and 800Mbps (in 1394b). Products supporting the 1394 standard go under different names, depending on the company. Apple, which originally developed the technology, uses the trademarked name FireWire. Other companies use other names, such as i.link and Lynx, to describe their 1394 products.

A single 1394 port can be used to connect up 63 external devices. In addition to its high speed, 1394 also supports isochronous data -- delivering data at a guaranteed rate. This makes it ideal for devices that need to transfer high levels of data in real-time, such as video devices.

Although extremely fast and flexible, 1394 is also expensive. Like USB, 1394 supports both Plug-and-Play and hot plugging, and also provides power to peripheral devices.
http://www.webopedia.com/TERM/I/IEEE_1394.html

http://www.enterate.unam.mx/Articulos/2004/mayo/usb.htm

FTP

Short for File Transfer Protocol, the protocol for exchanging files over the Internet. FTP works in the same way as HTTP for transferring Web pages from a server to a user's browser and SMTP for transferring electronic mail across the Internet in that, like these technologies, FTP uses the Internet's TCP/IP protocols to enable data transfer.

FTP is most commonly used to download a file from a server using the Internet or to upload a file to a server (e.g., uploading a Web page file to a server).

http://www.webopedia.com/TERM/F/FTP.html

HDTV

Short for High-Definition Television, a new type of television that provides much better resolution than current televisions based on the NTSC standard. There are several competing HDTV standards, which is one reason that the new technology has not been widely implemented. All of the standards support a wider screen than NTSC and roughly twice the resolution. To pump this additional data through the narrow TV channels, images are digitized and then compressed before they are transmitted and then decompressed when they reach the TV.

http://www.webopedia.com/TERM/H/HDTV.html
http://www.enterate.unam.mx/Articulos/tres/septiembre/tvdigital.htm

HTML

Short for HyperText Markup Language, the authoring language used to create documents on the World Wide Web. HTML is similar to SGML, although it is not a strict subset.

There are hundreds of other tags used to format and layout the information in a Web page. Tags are also used to specify hypertext links. These allow Web developers to direct users to other Web pages with only a click of the mouse on either an image or word(s). For a more complete list of tags, check out some of the URLs below.

http://www.webopedia.com/TERM/H/HTML.html

http://www.revista.unam.mx/vol.5/num10/art73/int73.htm

HTTP

Short for HyperText Transfer Protocol, the underlying protocol used by the World Wide Web. HTTP defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands. For example, when you enter a URL in your browser, this actually sends an HTTP command to the Web server directing it to fetch and transmit the requested Web page.

The other main standard that controls how the World Wide Web works is HTML, which covers how Web pages are formatted and displayed.

HTTP is called a stateless protocol because each command is executed independently, without any knowledge of the commands that came before it. This is the main reason that it is difficult to implement Web sites that react intelligently to user input. This shortcoming of HTTP is being addressed in a number of new technologies, including ActiveX, Java, JavaScript and cookies.

http://www.webopedia.com/TERM/H/HTTP.html
http://www.enterate.unam.mx/Articulos/2004/Febrero/wap.htm

Hub

A common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

A passive hub serves simply as a conduit for the data, enabling it to go from one device (or segment) to another. So-called intelligent hubs include additional features enabling an administrator to monitor the traffic passing through the hub and to configure each port in the hub. Intelligent hubs are also called manageable hubs.

A third type of hub, called a switching hub, actually reads the destination address of each packet and then forwards the packet to the correct port.

http://www.webopedia.com/TERM/h/hub.html

Internet 2

Internet 2 is a testing-ground network for universities to work together and develop advanced Internet technologies such as telemedicine, digital libraries and virtual laboratories.

Requiring state-of-the-art infrastructure, Internet 2 universities are connected to the Abilene network backbone, which uses regional network aggregation points called gigaPoPs, high-speed Sonet facilities, and IP-over-Sonet routers. Abilene supports transfer rates between 2.4 gigabits per second and 9.6 gigabits per second.

With over 140 members, Internet2 currently has 30 gigaPoPs, about 150 HPC s, two backbones, and around 1500 routes.

In October of 1996, 34 US research universities began working on Internet 2, and in September of 1997, the University Corporation for Advanced Internet Development (UCAID) was created to give an organizational body to the project.

http://www.webopedia.com/TERM/I/I2.html
http://www.cudi.edu.mx/Conferencias/2002/CUDI/frame.htm

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IP

Abbreviation of Internet Protocol, pronounced as two separate letters. IP specifies the format of packets, also called datagrams, and the addressing scheme. Most networks combine IP with a higher-level protocol called Transmission Control Protocol (TCP), which establishes a virtual connection between a destination and a source.

IP by itself is something like the postal system. It allows you to address a package and drop it in the system, but there's no direct link between you and the recipient. TCP/IP, on the other hand, establishes a connection between two hosts so that they can send messages back and forth for a period of time.

The current version of IP is IPv4. A new version, called IPv6 or IPng, is under development.

http://www.webopedia.com/TERM/I/IP.html

ISDN

Abbreviation of Integrated Services Digital Network, an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires. ISDN supports data transfer rates of 64 Kbps (64,000 bits per second).

There are two types of ISDN:

- Basic Rate Interface (BRI) -- consists of two 64-Kbps B-channels and one D-channel for transmitting control information.
- Primary Rate Interface (PRI) -- consists of 23 B-channels and one D-channel (U.S.) or 30 B-channels and one D-channel (Europe).

The original version of ISDN employs baseband transmission. Another version, called B-ISDN, uses broadband transmission and is able to support transmission rates of 1.5 Mbps. B-ISDN requires fiber optic cables and is not widely available.

http://www.webopedia.com/TERM/I/ISDN.html

ISO

Short for International Organization for Standardization. Note that ISO is not an acronym; instead, the name derives from the greek word iso, which means equal. Founded in 1946, ISO is an international organization composed of national standards bodies from over 75 countries. For example, ANSI (American National Standards Institute) is a member of ISO. ISO has defined a number of important computer standards, the most significant of which is perhaps OSI (Open Systems Interconnection), a standardized architecture for designing networks.

http://www.webopedia.com/TERM/I/ISO.html
http://www.iso.org
http://www.economia.gob.mx/?P=204

ITU

Short for International Telecommunication Union, an intergovernmental organization through which public and private organizations development telecommunications. The ITU was founded in 1865 and became a United Nations agency in 1947. It is responsible for adopting international treaties, regulations and standards governing telecommunications. The standardization functions were formerly performed by a group within the ITU called CCITT, but after a 1992 reorganization the CCITT no longer exists as a separate entity.

http://www.webopedia.com/TERM/I/ITU.html
http://www.itu.org

Kbps

Short for kilobits per second, a measure of data transfer speed. Modems, for example, are measured in Kbps. Note that one Kbps is 1,000 bits per second, whereas a KB (kilobyte) is 1,024 bytes. Data transfer rates are measured using the decimal meaning of K whereas data storage is measured using the powers-of-2 meaning of K. Technically, kbps should be spelled with a lowercase k to indicate that it is decimal but almost everyone spells it with a capital K.

http://www.webopedia.com/TERM/K/Kbps.html

Mbps

(1) When spelled Mbps, short for megabits per second, a measure of data transfer speed (a megabit is equal to one million bits). Network transmissions, for example, are generally measured in Mbps.
(2) When spelled MBps, short for megabytes per second.

http://www.webopedia.com/TERM/M/Mbps.html

MCU

Short for multipoint control unit, a device in videoconferencing that connects two or more audiovisual terminals together into one single videoconference call. The MCU collects information about the capabilities of the systems at each of the videoconference endpoints and sets the conference at the lowest common denominator so that everyone can participate.

http://www.webopedia.com/TERM/M/MCU.html

MPEG

Short for Moving Picture Experts Group, and pronounced m-peg, a working group of ISO. The term also refers to the family of digital video compression standards and file formats developed by the group. MPEG generally produces better-quality video than competing formats, such as Video for Windows, Indeo and QuickTime. MPEG files can be decoded by special hardware or by software.

MPEG achieves high compression rate by storing only the changes from one frame to another, instead of each entire frame. The video information is then encoded using a technique called DCT. MPEG uses a type of lossy compression, since some data is removed. But the diminishment of data is generally imperceptible to the human eye. There are three major MPEG standards: MPEG-1, MPEG-2 and MPEG-4.

http://www.webopedia.com/TERM/M/MPEG.html

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Multicast

To transmit a single message to a select group of recipients. A simple example of multicasting is sending an e-mail message to a mailing list. Teleconferencing and videoconferencing also use multicasting, but require more robust protocols and networks.

Standards are being developed to support multicasting over a TCP/IP network such as the Internet. These standards, IP Multicast and Mbone, will allow users to easily join multicast groups.

Note that multicasting refers to sending a message to a select group whereas broadcasting refers to sending a message to everyone connected to a network.

The terms multicast and narrowcast are often used interchangeably, although narrowcast usually refers to the business model whereas multicast refers to the actual technology used to transmit the data.

http://www.webopedia.com/TERM/m/multicast.html

PCM

Short for pulse code modulation, a sampling technique for digitizing analog signals, especially audio signals. PCM samples the signal 8000 times a second; each sample is represented by 8 bits for a total of 64 Kbps. There are two standards for coding the sample level. The Mu-Law standard is used in North America and Japan while the A-Law standard is use in most other countries.
PCM is used with T-1 and T-3 carrier systems. These carrier systems combine the PCM signals from many lines and transmit them over a single cable or other medium.

http://www.webopedia.com/TERM/P/PCM.html
http://www.enterate.unam.mx/Articulos/dos/abril/audiodig.htm

Radiofrequency

Short for radio frequency, any frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space. Many wireless technologies are based on RF field propagation.

These frequencies make up part of the electromagnetic radiation spectrum:

- Ultra-low frequency (ULF) -- 0-3 Hz
- Extremely low frequency (ELF) -- 3 Hz - 3 kHz
- Very low frequency (VLF) -- 3kHz - 30 kHz
- Low frequency (LF) -- 30 kHz - 300 kHz
- Medium frequency (MF) -- 300 kHz - 3 MHz
- High frequency (HF) -- 3MHz - 30 MHz
- Very high frequency (VHF) -- 30 MHz - 300 MHz
- Ultra-high frequency (UHF)-- 300MHz - 3 GHz
- Super high frequency (SHF) -- 3GHz - 30 GHz
- Extremely high frequency (EHF) -- 30GHz - 300 GHz

http://www.webopedia.com/TERM/R/RF.html

Router

A device that forwards data packets along networks. A router is connected to at least two networks, commonly two LANs or WANs or a LAN and its ISP's network. Routers are located at gateways, the places where two or more networks connect.

Routers use headers and forwarding tables to determine the best path for forwarding the packets, and they use protocols such as ICMP to communicate with each other and configure the best route between any two hosts.

http://www.webopedia.com/TERM/r/router.html

RTSP

Short for Real Time Streaming Protocol, a standard for controlling streaming data over the World Wide Web.

Like H.323, RTSP uses RTP (Real-Time Transport Protocol) to format packets of multimedia content. But whereas H.323 is designed for videoconferencing of moderately-sized groups, RTSP is designed to efficiently broadcast audio-visual data to large groups.

RTSP grew out of work done by Columbia University, Netscape and RealNetworks.

http://www.webopedia.com/TERM/R/RTSP.html

Server

A computer or device on a network that manages network resources. For example, a file server is a computer and storage device dedicated to storing files. Any user on the network can store files on the server. A print server is a computer that manages one or more printers, and a network server is a computer that manages network traffic. A database server is a computer system that processes database queries.

Servers are often dedicated, meaning that they perform no other tasks besides their server tasks. On multiprocessing operating systems, however, a single computer can execute several programs at once. A server in this case could refer to the program that is managing resources rather than the entire computer.

http://www.webopedia.com/TERM/s/server.html

S-Video

Short for Super-Video, a technology for transmitting video signals over a cable by dividing the video information into two separate signals: one for color (chrominance), and the other for brightness (luminance). When sent to a television, this produces sharper images than composite video , where the video information is transmitted as a single signal over one wire. This is because televisions are designed to display separate Luminance (Y) and Chrominance (C) signals. (The terms Y/C video and S-Video are the same.).

Computer monitors, on the other hand, are designed for RGB signals. Most digital video devices, such as digital cameras and game machines, produce video in RGB format. The images look best, therefore, when output on a computer monitor. When output on a television, however, they look better in S-Video format than in composite format.

To use S-Video, the device sending the signals must support S-Video output and the device receiving the signals must have an S-Video input jack. Then you need a special S-Video cable to connect the two devices.

http://www.webopedia.com/TERM/S/S_Video.html

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Switch	(1) In networks, a device that filters and forwards packets between LAN segments. Switches operate at the data link layer (layer 2) and sometimes the network layer (layer 3) of the OSI Reference Model and therefore support any packet protocol. LANs that use switches to join segments are called switched LANs or, in the case of Ethernet networks, switched Ethernet LANs. (2) A small lever or button. The switches on the back of printers and on expansion boards are called DIP switches. A switch that has just two positions is called a toggle switch. (3) Another word for option or parameter -- a symbol that you add to a command to modify the command's behavior. http://www.webopedia.com/TERM/s/switch.html
TCP	Abbreviation of Transmission Control Protocol, and pronounced as separate letters. TCP is one of the main protocols in TCP/IP networks. Whereas the IP protocol deals only with packets, TCP enables two hosts to establish a connection and exchange streams of data. TCP guarantees delivery of data and also guarantees that packets will be delivered in the same order in which they were sent. http://www.webopedia.com/TERM/T/TCP.html
Twisted Pair cable	Short for unshielded twisted pair, a popular type of cable that consists of two unshielded wires twisted around each other. Due to its low cost, UTP cabling is used extensively for local-area networks (LANs) and telephone connections. UTP cabling does not offer as high bandwidth or as good protection from interference as coaxial or fiber optic cables, but it is less expensive and easier to work with. Often abbreviated STP, a type of copper telephone wiring in which each of the two copper wires that are twisted together are coated with an insulating coating that functions as a ground for the wires. The extra covering in shielded twisted pair wiring protects the transmission line from electromagnetic interference leaking into or out of the cable. STP cabling often is used in Ethernet networks, especially fast data rate Ethernets. http://www.webopedia.com/TERM/S/shielded_twisted_pair.html
UDP	Abbreviated UDP, a connectionless protocol that, like TCP, runs on top of IP networks. Unlike TCP/IP, UDP/IP provides very few error recovery services, offering instead a direct way to send and receive datagrams over an IP network. It's used primarily for broadcasting messages over a network. http://www.webopedia.com/TERM/U/User_Datagram_Protocol.html
Unicast	Communication that takes place over a network between a single sender and a single receiver. http://www.webopedia.com/TERM/u/unicast.html

http://www.revista.unam.mx/vol.5/num10/art73/int73.htm

USB

Short for Universal Serial Bus, an external bus standard that supports data transfer rates of 12 Mbps. A single USB port can be used to connect up to 127 peripheral devices, such as mice, modems, and keyboards. USB also supports Plug-and-Play installation and hot plugging.

Starting in 1996, a few computer manufacturers started including USB support in their new machines. It wasn't until the release of the best-selling iMac in 1998 that USB became widespread. It is expected to completely replace serial and parallel ports.
http://www.webopedia.com/TERM/U/USB.html

http://www.enterate.unam.mx/Articulos/2004/mayo/usb.htm

VRVS

VRVS is a web oriented system for videoconferencing and collaborative work over IP networks. The Virtual Room Videoconferencing System provides a low cost, bandwidth-efficient, extensible means of videoconferencing and remote collaboration over networks within the High Energy and Nuclear Physics communities. Recently VRVS also extends the service to other various academic/research areas.

Since it went into production service in early 1997, deployment of the Web-based system has expanded to include 12150 registered hosts running the VRVS software in 63 countries. A set of 58 VRVS Reflectors interconnected using unicast tunnels and multicast manage the traffic flow at HENP labs and universities in the US, Europe, Asia, and South America. VRVS provides the versatile collaboration tools: MBone (e.g. UCL vic/rat, OM vic/vat), H.323 (e.g. Polycom, NetMeeting, Gnomemeeting), QuickTime, Desktop/Application sharing and Chat on various platforms.

Recent and on going developments include support for MPEG2/MPEG4 and SIP videoconferencing, shared collaborative environments, QoS over networks, etc. The goal is to support a set of new and essential requirements for rapid data exchange, and a high level of interactivity in large-scale scientific collaborations.

http://www.vrvs.org

Webcast

(1) To use the Internet to broadcast live or delayed audio and/or video transmissions, much like traditional television and radio broadcasts. For example, a university may offer on-line courses in which the instructor Webcasts a pre-recorded or live lecture, or an enterprise may Webcast a press conference in lieu of or in addition to a conference call. Users typically must have the appropriate multimedia application in order to view a Webcast.

(2) To use push technology, to send Web-based information to an Internet user.

http://www.webopedia.com/TERM/W/Webcast.html