Híradástechnika szigorlat - Infokom 2018.

1. Main characteristics and applications of twisted pair cables (telephone, data, ADSL)

Characteristics

Attenuation

Reduction in signal strength due to the material quality. Cables using higher frequencies have higher attenuation.

Characteristic impedance

Ratio of the voltage and current of a wave travelling along in a transmission line.

Delay

Electromagnetic wave speed. ~70% of the speed of light.

Reflection

Electromagnetic wave reflection.

Crosstalk

Interferences between two wires.

Near End Cross Talk (NeXT) is what comes out on the near end when we inject a signal.(nagyjel áthallatszik a kicsire - rossz)
Far End Cross Talk (FeXT) is what comes out on the far end when we inject a signal.

Noises and interferences

Other electromagnetic fields affect the cable.

Being twisted (and not screwed) reduces this interference.

Phenomenon at the end of terminated wire

reflection coefficient: r= U_0^- /U_0^+ ; r= Z-Z_0 / Z+Z_0
- matched termination: Z=Z_0 – no reflection
- shortcut: (no voltage, max current) – everything comes back (Z=0, full negative reflection)
- open end: (no current, max voltage) r=1, same phase, will define points, where amplitude is 0 due to standing waves – same wave comes back (Z=inf, full refelction)
- ohmic termination: max and min, but never 0 – standing waves

$$Z_0 = \sqrt{\frac{R + \mathrm{j}\,\omega\,L}{G + \mathrm{j}\,\omega\,C}}$$

Applications

UTP and SFTP cables are found in many Ethernet networks and telephone systems. Usually used in a <100m distance. CCTV cameras.

Telephone

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Data

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ADSL

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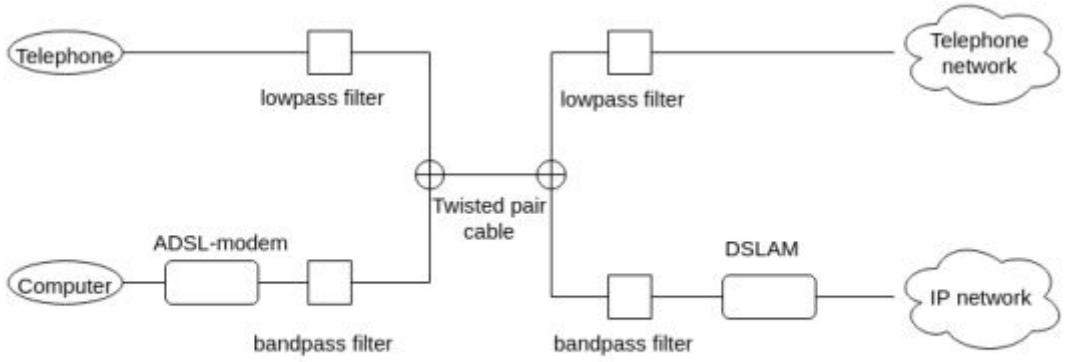


Figure 5: ADSL system components

2. Main characteristics of fibre cables. Main applications of fibre cables

Characteristics

An optical cable consists of a glass core and a glass cladding. The latter one's refractive index is smaller, therefore the light goes through the cable and cannot escape. The diameter of the glass core is about 100µm, but it may vary according to the propagation mode used in the cable.

Attenuation

Very low, we can connect Europe to North America with a single fibre cable without any repeater.

Delay

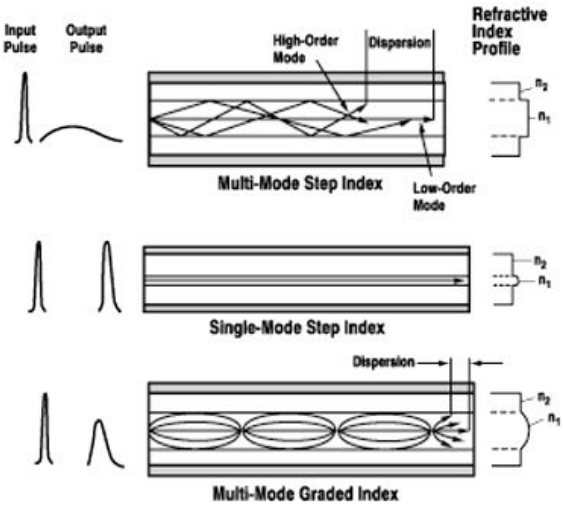
Almost the same as in a twisted pair cable, about 68% of the speed of the light.

Reflection

The light reflects differently in different propagation modes.

Dispersion

The time between the first and the last wave of a single signal.
It is higher in case of Multi-Mode Step Index, smaller in Multi-Mode Graded Index and theoretically zero in case of Single-Mode Step index, because there is only one wave for a given signal.



Propagation modes

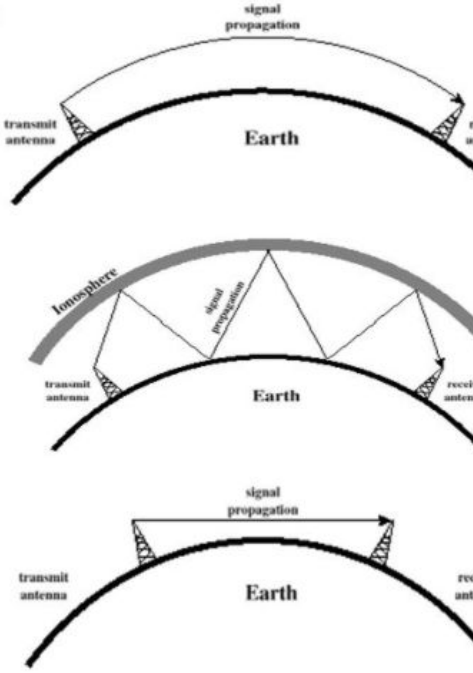
- Multi-Mode Step Index -small distance
- Single-Mode Step Index -long distance
- Multi-Mode Graded Index

Applications

Long distance telecommunication or providing practically unlimited bandwidth for data or providing a high-speed data connection between different parts of a building. Can be used near high voltage conductors, there's interference.

3. Main radio wave propagation modes, transmission characteristics of radio connections

Propagation modes



Ground wave propagation (<2MHz)

The ground wave can propagate a considerable distance over the earth's surface particularly in the low frequency and medium frequency portion of the radio spectrum. Ground wave radio propagation is used to provide relatively local radio communications coverage. LF(30-300kHz), MF(300-3000kHz)

Sky wave propagation (2-30MHz)

Reflected by the Ionosphere. HF(3-30MHz)

Line-of-sight propagation (30MHz<)

Any obstruction between the transmitter and the receiver will block the signal, just like the light that the eye may sense. Can be used for 30-50km due to spherical nature of the earth.
VHF(30-300MHz), UHF(300-3000MHz), SHF(3-30GHz), EHF(30-300GHZ)

Transmission parameters

Delay

The time of the wave to get to the receiver.

Path loss or path attenuation

The reduction in power density (attenuation) of an electromagnetic wave as it propagates through space.

Shadow fading or Multipath induced fading

Caused by multipath propagation of the radio waves.
Waves may reflect on obstacles with different attenuation and delay.

Jitter (késleltetés ingadozás)

Varying delay, may caused by fading.

Interferences

Multi user interference? Openness and privacy?

Polarization

Property of a radiated electromagnetic wave describing the time varying direction and relative magnitude of the electric-field vector. In general the field is elliptically polarized.

Propagation mechanisms

Reflection, scattering, diffraction

Reliability and availability

equipment and propagation parameters (lightning, snow, rain, fog, smoke)

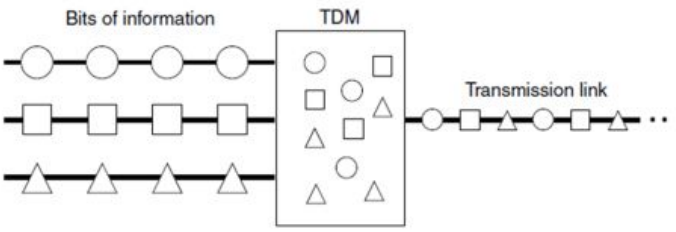
4. Main functions of multiplexing and switching nodes in the networks, the main features of circuit switching, packet switching and cell switching

Multiplexing

The main reason is to reduce transmission costs and to utilize higher bandwidth by framing and packing the information.

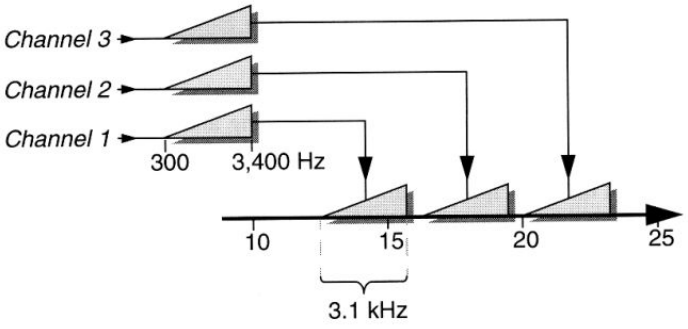
Time Division Multiplexing (TDM)

The channel is split to dedicated time frames.
Time-division multiplexing is a method of transmitting and receiving independent signals over
a common signal path by means of synchronized switches at each end of the transmission line so that each signal appears on the line only a fraction of time in an alternating pattern.



Frequency Division Multiplexing (FDM)

The channel is split up to dedicated non-overlapping frequency sub-bands, each of which is used to carry a separate signal. GSM, CaTV, radio.



Code Division Multiple Access (CDMA)

Spread Spectrum Concept, several transmitters can send information simultaneously over a single communication channel using a hopping technique.
Frequency Hopping Spread Spectrum (FHSS) - Transmitter and receiver use the same code to tune into a sequence of channels in synchronization.
Direct Sequence Spread Spectrum (DSSS) - Data spread by a pseudo noise bit source *(XOR-os ábra)*.

Wavelength Division Multiplexing (WDM)

As light has different colours on different frequency, we can separate in fibres by wavelength using a simple prism.

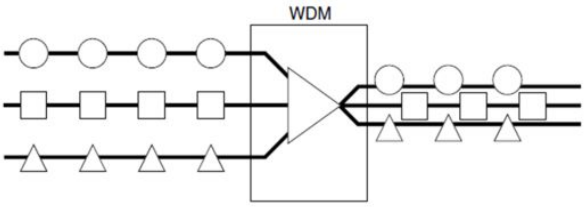


Figure 13: WDM

Switching technics

Packet switching vs Circuit switching

Packet switching routers cannot handle huge number of packets, because it has to handle every single pocket one by one, while circuit switching establishes a dedicated communication channel (circuit) between two nodes through the network before the nodes may communicate and works like the highway interchange we talked about during the seminar.
Routers for smaller bandwidth (copper cable) works with packet switching, while we use usually circuit switching for higher bandwidth cables such as optical fibre.
A rule of thumb: Band is cheap: circuit switching. Processing is cheap: packet switching.

Packet switching

Az adatokat csomagokba rakjuk melyet elküldünk, a packet egy header (cél) és egy payload (változó méretű adat) részből áll, hatékonyabban használja ki a hálózatot, viszont változó idejű késleltetéssel bír. FIFO alapú módon továbbítják általában a csomagokat a csomópontok. Connection oriented(guarantee is possible) vs connectionless(best effort).

Circuit switching

Két csomópont között előre lefoglal egy csatornát mielőtt elkezdene két csomópont kommunikálni, ezáltal a teljes csatorna sávszélessége használható adatátvitelre, viszont ha nem is használja éppen adatküldésre akkor is a teljes kommunikációra lefoglalja a csatornát. Ezt tekinthetjük úgy mintha a csomópontok fizikailag is össze lennének kötve egy elektromos hálózatban, mint a régi analog telefonnál. Fix késleltetés van a kommunikációban szemben a packet switching-gel ahol változó késleltetés.

Cell switching

Kisméretű, fix csomagokra vagyis cellákra osztjuk az adatot, melyeket elküldünk. Cell relay-nek is nevezik. Nem megbízható, manapság lassúnak számít. Videó és hang továbbításra használták elsődlegesen. Nincs benne hiba kezelés, flow control és adatvisszaállítás. Nagyon fontos adatok továbbítására megbízható elvileg. It is an unreliable, connection-oriented packet switched data communications protocol.

5. Next generation infocommunication systems

A next-generation network (NGN) is a packet-based network which can provide services including Telecommunication Services and able to make use of multiple broadband, Quality of Service-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unrestricted access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

In the core network, NGN implies a consolidation of several (dedicated or overlay) transport networks each historically built for a different service into one core transport network (often based on IP and Ethernet). It implies amongst others the migration of voice from a circuit-switched architecture (PSTN) to VoIP. In the wired access network, NGN implies the migration from the dual system of legacy voice next to xDSL setup in local exchanges to a converged setup in which the DSLAMs integrate voice ports or VoIP, making it possible to remove the voice switching infrastructure from the exchange. In the cable access network, NGN convergence implies migration of constant bit rate voice to CableLabs PacketCable standards that provide VoIP and SIP services. Both services ride over DOCSIS as the cable data layer standard. The Next Generation Mobile Networks to evaluate candidate technologies to develop the next evolution of wireless networks. Its objective is to ensure successful future mobile broadband networks. Mobile and stationary next-generation networks that access the photonic core are destined to become as ubiquitous as traditional telephone networks. These networks must efficiently provide adequate network quality to multimedia applications with high bandwidth and
strict quality-of-service requirements, as well as seamlessly integrate mobile and fixed architectures.

In an NGN, there is a more defined separation between the transport (connectivity) portion of the network and the services that run on top of that transport. This means that whenever a provider wants to enable a new service, they can do so by defining it directly at the service layer without considering the transport layer – i.e. services are independent of transport details. Increasingly applications, including voice, tend to be independent of the access network (de-layering of network and applications) and will reside more on end-user devices (phone, PC, set-top box).

Next-generation networks are based on Internet technologies including Internet Protocol (IP) and multiprotocol label switching (MPLS).

//TODO

6. Main elements and their functions in a GSM network (MSC, BSC, BTS, HLR, VLR, LA, MS…..)

SS (Switching System) components

AUC (Authentication Center)

Authenticate subscribers attempting to use a network.

HLR (Home Location Register)

A centralized network for subscriber identify, supplementary services, location and authentication information. In case of roaming into a new MSC service area the actual MSC request information from the subscriber's HLR.

VLR (Visitor Location Register)

Stores Information about subscribers located in an MSC service area (a copy of HLR information).

EIR (Equipment Identify Register)

Database to block calls from stolen, unauthorized or defective MS

MSC (Mobile service Switching Center)

Its function to manage billing, delivering SMSs.
It arranges handovers and supplementary services.
Controls BSCs. GMSC is the Gateway MSC for other MSCs

BSS (Base Station System) components

BSC (Base Station Controller)

Manages all the radio related functions of the network such as MS handover, radio channel assignment.
Controlled by a MSC.

BTS (Base Transceiver Station)

Controlled by BSC. Controls the radio interface to MS. Comprises transceivers and antennas

MS (Mobile Station)

Mobile subscriber to communicate with the network. Consists of mobile terminal and Subscriber Identity Module (SIM). Subscription is separated from the mobile terminal. Subscription information is stored in a "smart card" (SIM).

The possible states of MS

• Idle: the MS is ON but a call is not in progress
• Active: The MS is ON and a call is in progress
• Detached: The MS is OFF

OMC (Operation and Maintenance Center)

A computer system connected to MSCs and BSCs to control system parameters via data links. For short therm, regional issues.

NMC (Network Management Center)

Centralized control of a network. For long term, system wide issues.

Principles of cellular systems

Cell

Area of radio coverage by one Base Station antenna system assigned to specific number. Each cell has a separate frequency to its neighbours.

Location Area (LA)

Group of cells.

PLMN Service Area

Set of cells served by one network operator, eg. Telenor Hungary

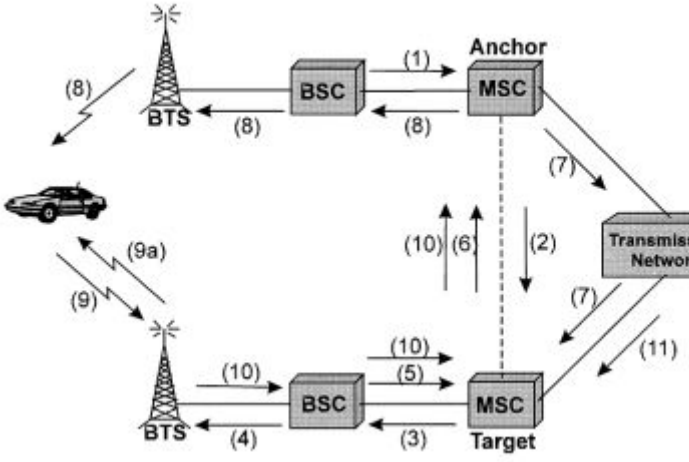
GSM Service Area

Geographic area in which a subscriber can gain access to a GSM network, eg. Europe.

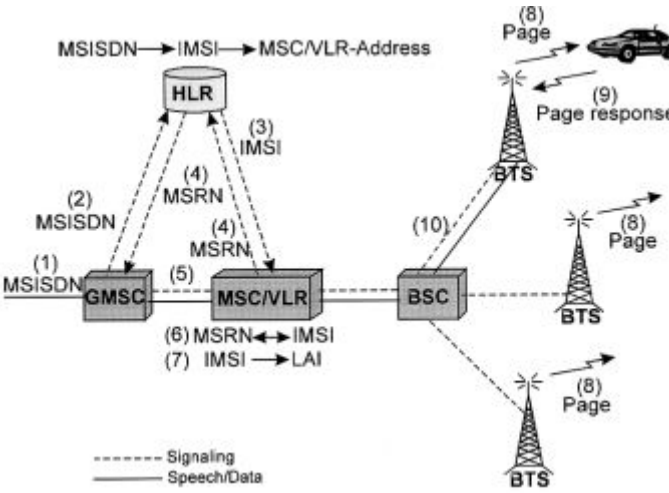
Handover, call to and from MS, keyterms

Basic handover

• BSC send handover-required message to the MSC
• The MSC ask the target MSC to assist. The Target MSC allocates a handover number that reroutes the call
• A handover request is sent down to the new BSC
• The BSC tells the new BTS to activate a TCH
• The MSC receives the information about the new Traffic CHannel
• The MSC passes info on new TCH from new BSC
• A speech path to the new MSC is set up
• A handover command goes to the MS with frequency and time slot data in the new cell
• The MS sends handover burst on the new TCH
• The target MSC is informed that the handover successful
• A new path in the Group Switch is set up

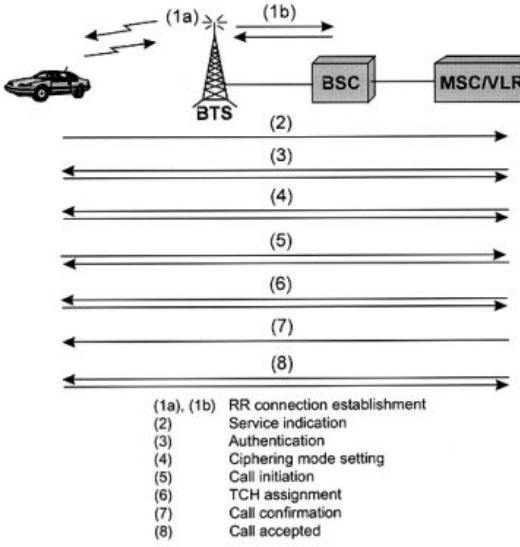


Steps to call MS



1. Call entering to GSM network is routed to the nearest GMSC
2. The GSM analyse the MSISDN to find the HLR (subscriber registered in) The MSC/VLR address is stored in HLR, the IMSI is stored in HLR
3. The HLR send request to an MSRN to the MSC/VLR included in the message the IMSI
4. The MSRN is returned via HLR to the GMSC
5. The GMSC routes the call to the MSC/VLR by MSRN
6. The MSC/VLR retrieve the Ms's IMSI
7. Using IMSI MSC identifies LA
8. The MS is paged in cells in the LA
9. MS responds, authentication, cipher mode setting, IMEI check are carried out
10. Traffic channel connected from MSC to BSC and the BTS

Steps to receive call from MS



1. Call start with a signalling channel using RACH (Random Access Channel)
2. MS indicates request, IMSI is analyzed, MS marked busy in the VLR
3. Authentication is performed by MSC
4. Ciphering is initiated, IMEI validated
5. MSC receives a setup message from MS (including B number)
6. Link established between MSC and BSC to assign traffic channel
7. Call confirmation
8. Call accepted

Idle key terms

- Registration: MS informs a network that it is attached
- Roaming: MS moves around the network in idle mode
- International Roaming: MS moves into a network which is not its home network
- Location Updating: MS inform the network when enters in new LA
- Locating: BSC function to suggest connection to another cell based on MS measurement reports
- Paging: The network tries to contact an MS by broadcasting message containing MS identity

Active key terms

- Handover: Process, where a call is switched from one physical channel to another, while MS moves
around

7. Basic services, supplementary services, service quality requirements of different services in the infocommunication systems

Services

Basic services

Mandatory service elements with minimal quality requirements such as real-time and understandable voice.

Supplementary services

To make basic services even more usable, eg. call transfer, conference call, automatic call back on busy, wake up services, least cost routing services, credit card based call, etc.

Value added services

Bank transaction by phone, televoting, telephone based donation, etc.

Service quality requirements

Voice, music, video

Sensitive on **delay** (max 300ms)
Sensitive on **jitter** (max 30ms)
Sensitive on **video-voice synchrony**
Error tolerant (bit error rate 10^{-3} is acceptable)

Games

Sensitive on **delay** (max 30ms)
Sensitive on **error**

Data, still picture

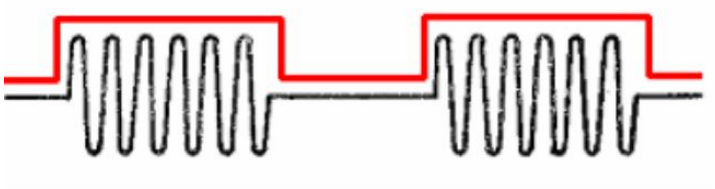
Sensitive on **error**
Delay and **jitter tolerant**

az orai diakban van egy csomo service fajta, teleservice, bearer service, interactive service, network service, stb… Ezek kellenek?

8. Digital modulation systems and their applications (BPSK, QPSK, QAM)

Amplitude Shift Keying (ASK)

Amplitude-shift keying (ASK) is a form of amplitude modulation that represents digital data as variations
in the amplitude of a carrier wave. In an ASK system, the binary symbol 1 is represented by transmitting
a fixed-amplitude carrier wave and fixed frequency for a bit duration of T seconds. If the signal value is
1 then the carrier signal will be transmitted; otherwise, a signal value of 0 will be transmitted.



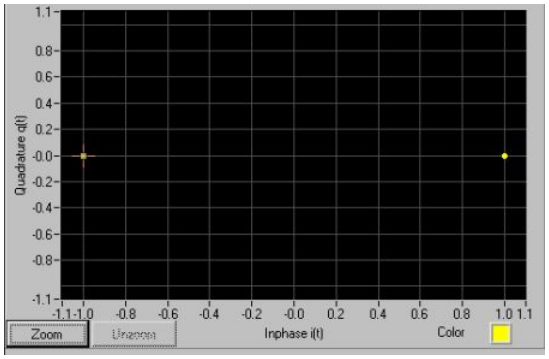
applications?

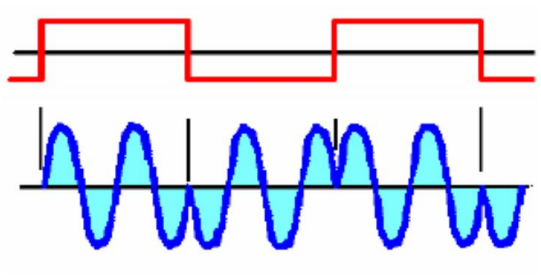
Binary Phase Shift Keying (BPSK)

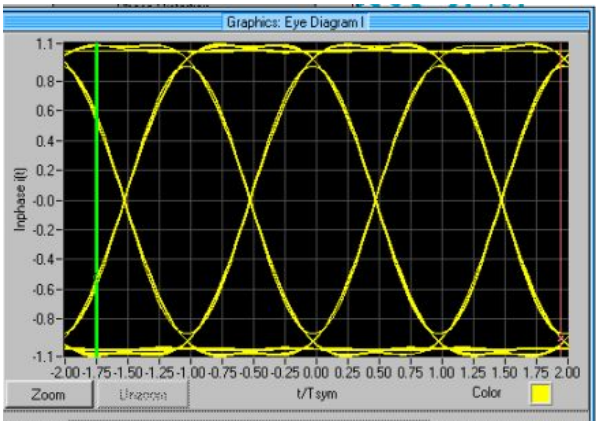
Phase-shift keying (PSK) is a digital modulation scheme that conveys data by changing (modulating) the phase of a reference signal (the carrier wave). The modulation is impressed by varying the sine and cosine inputs at a precise time. BPSK uses two phases which are separated by 180° and so can also be termed 2-PSK. This modulation is the most robust of all the PSKs since it takes the highest level of noise or distortion to make the demodulator reach an incorrect decision. It is, however, only able to modulate at 1 bit/symbol (as seen in the figure) and so is unsuitable for high data-rate applications. In the presence of an arbitrary phase-shift introduced by the communications channel, the demodulator is unable to tell which constellation point is which. As a result, the data is often differentially encoded **(ez mit jelent?)** prior to modulation. BPSK is functionally equivalent to 2-QAM modulation

It is widely used for wireless LANs, RFID and Bluetooth communication.

Constellation diagramm







Eye diagramm

Qadrature Phase Shift Keying (QPSK)

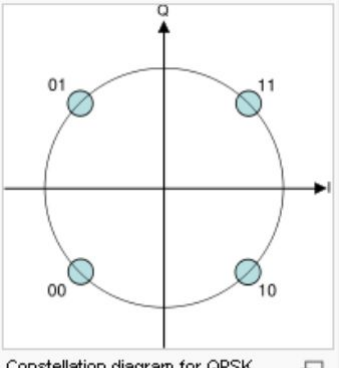
QPSK uses four points on the constellation diagram, equispaced around a circle. With four phases, QPSK can encode two bits per symbol, shown in the diagram with Gray coding to minimize the bit error rate (BER) sometimes misperceived as twice the BER of BPSK. The mathematical analysis shows that QPSK can be used either to double the data rate compared with a BPSK system while maintaining the same bandwidth of the signal, or to maintain the data-rate of BPSK but halving the bandwidth needed. In this latter case, the BER of QPSK is exactly the same as the BER of BPSK. The engineering penalty that is paid is that QPSK transmitters and receivers are more complicated than the ones for BPSK. However, with modern electronics technology, the penalty in cost is very moderate.

$$s_n(t) = \sqrt{\frac{2E_s}{T_s}} cos\left(2\pi f_c t + (2n-1)\frac{\pi}{4}\right),$$

(E_s: Energy per symbol, T_s: Symbol time, f_c: carrier freq.)

Comparing these basis functions with that for BPSK shows clearly how QPSK can be viewed as two
independent BPSK signals. Note that the signal-space points for BPSK do not need to split the symbol
(bit) energy over the two carriers in the scheme shown in the BPSK constellation diagram.

Summary:
• Two carriers: sine wave (Q - quadrature) and cosine wave (I - in-phase)
• The modulated signal is the sum of the two components
• One symbol is two bits



Constellation diagram for QPSK

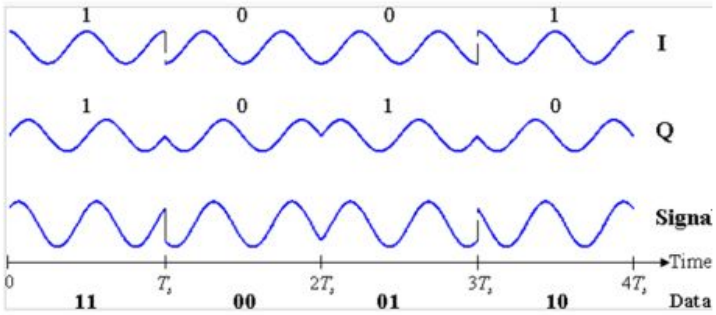


Figure 30: Qadrature Phase Shift Keying (QPSK)

Qadrature Amplitude Modulation (QAM)

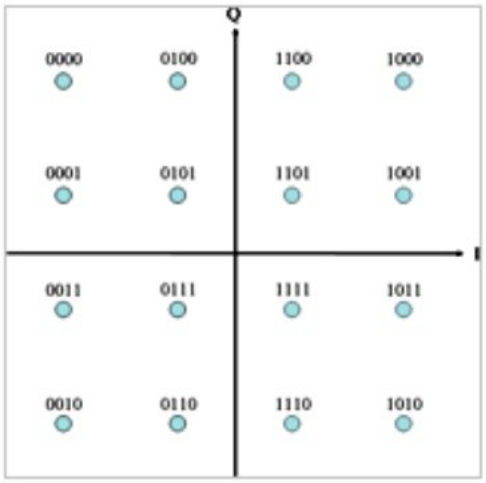
Quadrature amplitude modulation (QAM) is both an analog and a digital modulation scheme. It conveys two analog message signals, or two digital bit streams, by changing (modulating) the amplitudes of two carrier waves, using the amplitude-shift keying (ASK) digital modulation scheme or amplitude modulation (AM) analog modulation scheme.
The two carrier waves of the same frequency, usually sinusoids, are out of phase with each other by 90° and are thus called quadrature carriers or quadrature components - hence the name of the scheme. The modulated waves are summed, and the final waveform is a combination of both phase-shift keying (PSK) and amplitude-shift keying (ASK), or, in the analog case, of phase modulation (PM) and amplitude modulation.

$$s(t) = \mathbb{R}\left\{ \left(I(t) + iQ(t)\right) e^{i2\pi f_0 t} \right\} = I(t)cos(2\pi f_0 t) - Q(t)sin(2\pi f_0 t).$$

At the receiver, these two modulating signals can be demodulated using a coherent demodulator. Such a receiver multiplies the received signal separately with both a cosine and sine signal to produce the received estimates of I(t) and Q(t) respectively. Because of the orthogonality property of the carrier signals, it is possible to detect the modulating signals independently. In the ideal case I(t) is demodulated by multiplying the transmitted signal with a cosine signal, (and same with Q(t)) then applying a low pass filter to remove higher frequency components.The coherent demodulator needs to be exactly in phase with the received signal, or otherwise the modulated signals cannot be independently received. This is achieved typically by transmitting a burst subcarrier or a Pilot signal.

QAM is being used in optical fiber systems as bit rates increase, WiFi, ethernet, adsl, hdtv, dvb.

Summary:
• Two carriers: sine wave (Q) and cosine wave (I)
• The modulated signal is the sum of the two components
• Different amplitude and different phase values for one symbol
• 16QAM means: one symbol is four bits



Constellation diagram for rectangular 16-QAM.

9. Typical structures and technologies in PSTN networks

PSTN (Public Switched Telephone Networks)

The public switched telephone network (PSTN) is the aggregate of the world's circuit-switched telephone networks that are operated by national, regional, or local telephony operators, providing infrastructure and services for public telecommunication. The PSTN consists of telephone lines, fiber optic cables, microwave transmission links, cellular networks, communications satellites, and undersea telephone cables, all interconnected by switching centers, thus allowing most telephones to communicate with each other. Originally a network of fixed-line analog telephone systems, the PSTN is now almost entirely digital in its core network and includes mobile and other networks, as well as fixed telephones.

Components

Backbone networks

A backbone is a part of computer network that interconnects various pieces of network, providing a path for the exchange of information between different LANs or sub-networks. A backbone can tie together diverse networks in the same building, in different buildings in a campus environment, or over wide areas. Normally, the backbone's capacity is greater than the networks connected to it
Long distances, high traffic, interconnection of nodes, transport bits of any services, high reliability, high availability.

Access networks

Local distances, interconnection of terminals and local nodes

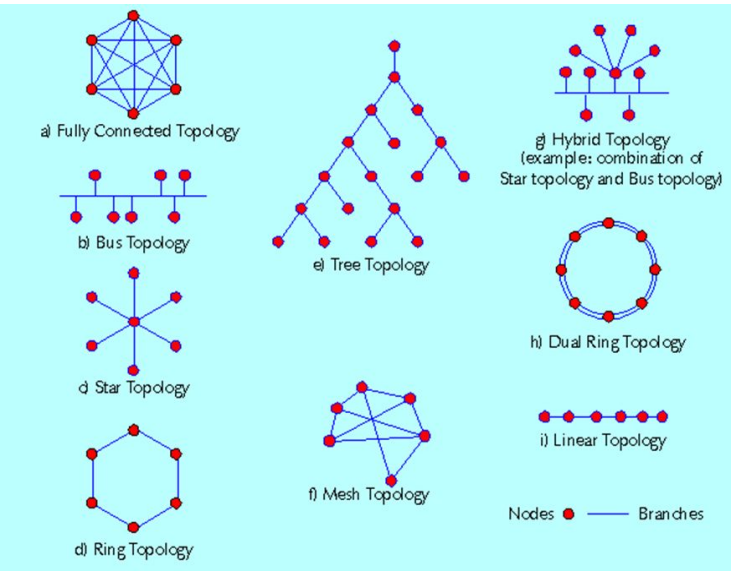
Network planning

Selecting topology, optimal selection of positions of nodes, dimensioning of node traffic handling capacities, dimensioning of link capacities, selecting technologies, enough space in cable duct system for future expansion.

Topoliges

- Star topology
- Multipolar topology
- Meshed topology
- Ring topology
- Bus topology
- *Tree topology*

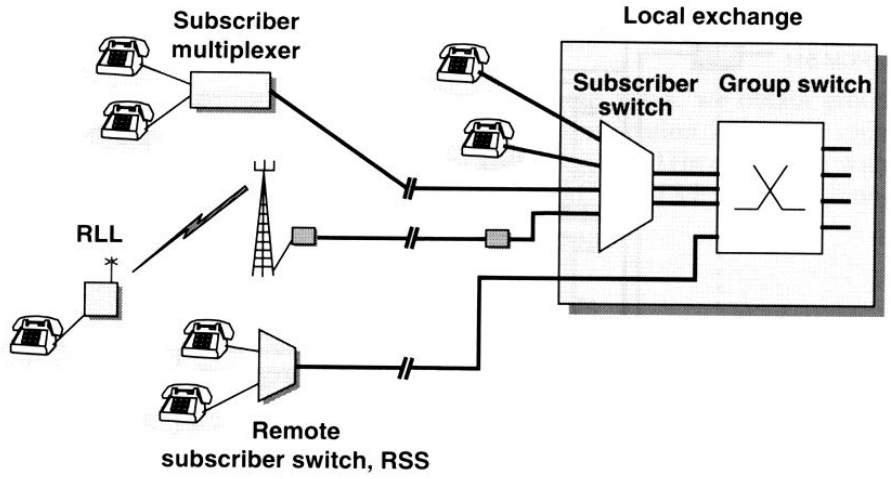
Megj: Matav structure is tree, Pantel uses railway lines

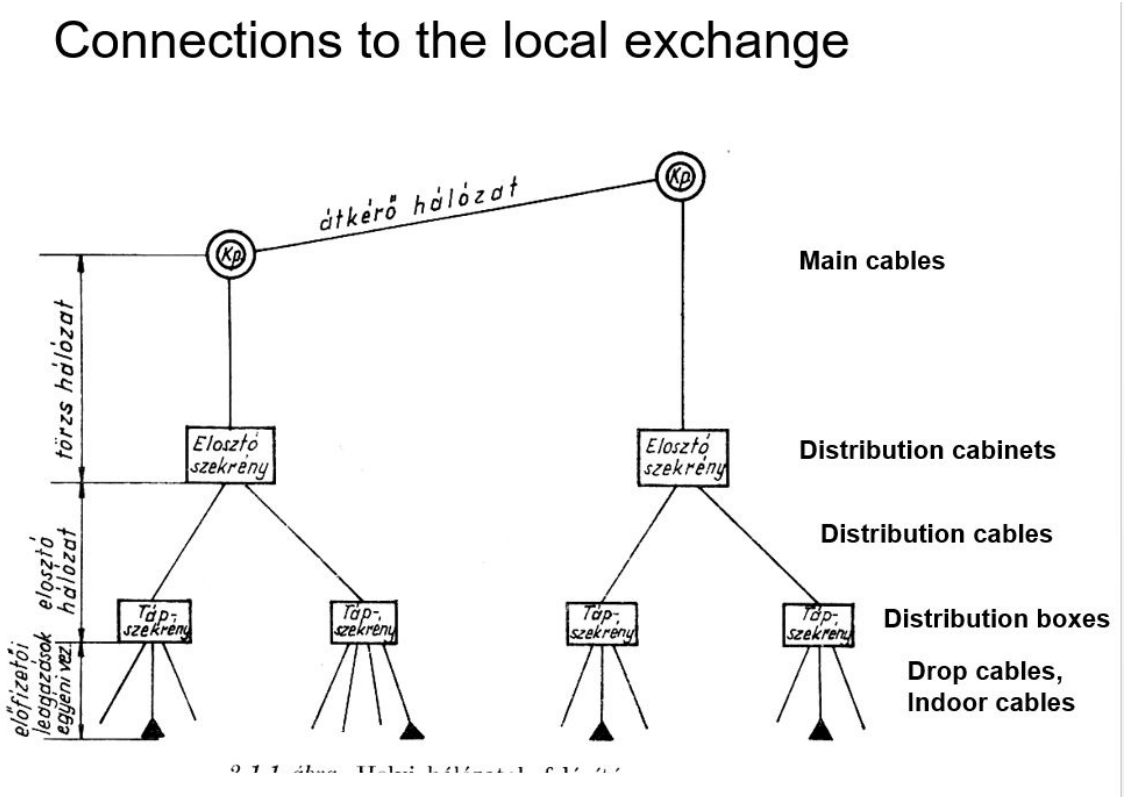


Basics of telephony

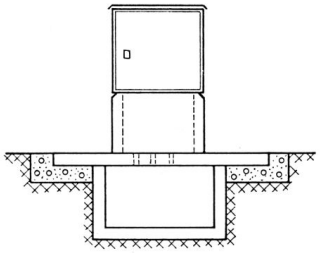
• 2/4 wire for voice
• Feeding of circuit
• Access solutions
• Backbone
• Signalling basics for a telephone call
• Source of revenues
• ADSL principles

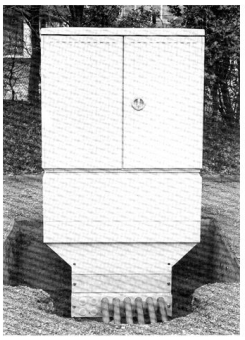
Access solutions:



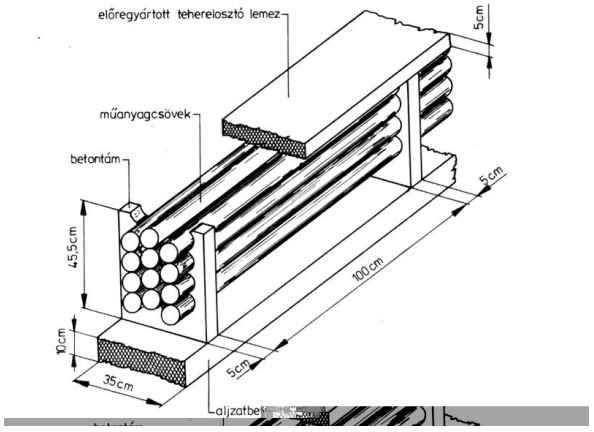


Cable distribution cabinet (street version) implementation

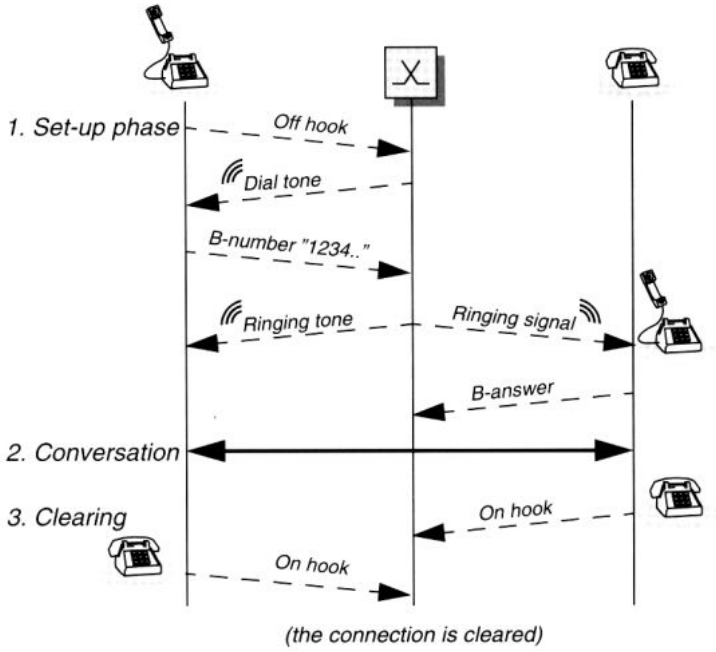


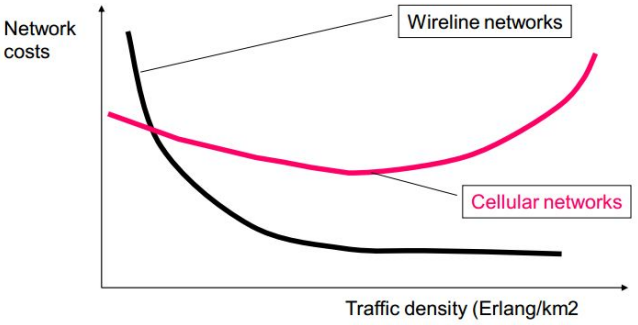


Cable duct system implementation



Signalling basics for a telephone call





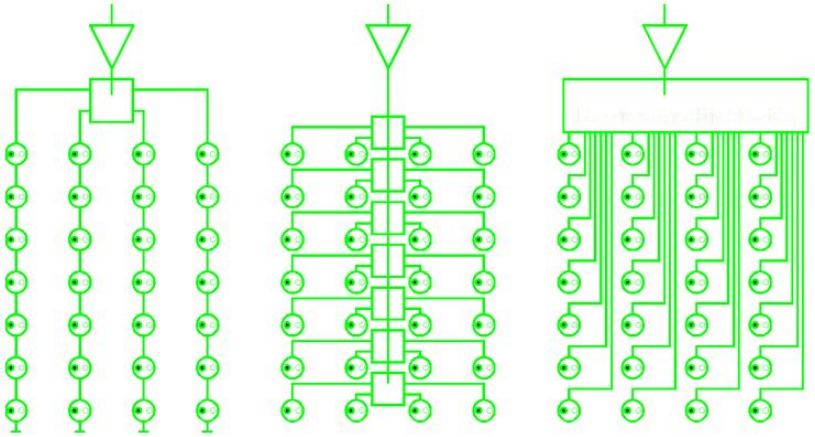
10. CaTV, private (academic and university) networks

CaTV

Cable television is a system of delivering television programming to paying subscribers via radio frequency (RF) signals transmitted through coaxial cables or, in the 2010s, light pulses through fiber-optic cables. This contrasts with broadcast television, in which the television signal is transmitted over the air by radio waves and received by a television antenna attached to the television.

Traditional analogue AM-VSB TV sets.
Set top boxes for receiving DVB programs including demodulator, MPEG decoder and a descrambler.
Internat frequency plan with 8 MHz raster.
In a 8 MHz channel there are 8 TV and 8 radio channels.
Nominal impedance is 75Ω.

Topologies
• string - can’t turn off the service for one individual user?
• tap-off
• star - more cabeling
melyiknek mi volt elonye hatranya?



Private networks

• Closed User Group, Special Purpose network
• Railway, transport, pipeline, fleet
• Water management
• Energy systems
• Emergency services
• Police networks

• Military networks
• Government networks
• Company-wide networks (MOL, OTP)
• Global Company Networks (Coca Cola)
• Seat Reservation Networks (SITA)
• Insurance companies, Retail Chains (e.g. TESCO)

Common features of private networks

• Internal numbering schemes, addressing system
• Strictly regulated gateway function for interconnection to other (public) networks
• The transmission part of networks might be leased line or own connection (radio)
• The multiplexing, switching, management, authentication processes are private functions
• Task oriented service quality parameters (reliability, usability, error rate, response time, redundancy, backup time …)
• Separated frequency management („governmental" use)

Examples of private networks

• Hungarnet -- for research and academic community in Hungary
• Pázmány CU is one of the members
• Governmental support (?)
• Part of EU GEANT project
• The transmission part is set of leased dark fibre connections
• The switching and operation function in the hand of HUNGARNET (HUNGARNET backbone is HBONE)

The GÉANT network technology

As one of the largest and most complex research and education networks in the world, the GÉANT network needs to support a diverse range of users and services from standard IP transit services to ultra-high capacity data centre interconnects. GÉANT has built a dual layer network able to integrate these service demands across a single core structure. The two layers are: transmission and packet

Network planning problems

- Existing or new building
- Single site or separated sites
- Integrated or dedicated networks
- Selecting of the transport technologies (optical, copper or radio)
- Design of the network topology (star, meshed, ...)
- Optimal placing and dimensioning of nodes
- Duct system planning

Illetve a korábbi pontokon belül mire kell figyelni (pl épületeknél a gerinchálózat meg h a függőleges kábelcsatorna hol legyen meg mekkora).

Selecting topology, optimal selection of positions of nodes, dimensioning of node traffic handling capacities, dimensioning of link capacities, selecting technologies, enough space in cable duct system for future expansion
//TODO

11. Main functions and characteristics of terminals, interfaces, regulation of terminals

Terminals are parts of the network but individual elements. Terminals are usually available to buy in shops and owned by users such as telephone (Mobile Station).
Without a terminal there is no communication over the channel. Terminals have basic technical functions and requirements, eg. handset/handfree terminal, keyboard, display..

Main functions (BORSCHT)

- Battery supply
- Overload protection
- Ringing
- Signalling, supervision
- Coding
- Hybrid, 2/4 wire transformation
- Testing

Characteristics

//TODO
Talán ez lenne?

Eg. Telephone:

- Basic technical functions and requirements
- Handset requirements
- Hands free terminal requirements
- Keyboard requirements
- Display requirements
- Intelligence in the terminal
- Special requirements of elderly or handicapped people

Interfaces

- Speech circuit
- Dialer circuit
- Handset
- Ringing circuit
- Display

Regulations

Stages

- Természetes (állami) monopólium (hatósági ár, ellátási kötelezettség, végberendezések, egységes rendszer - kevés szabályoznivaló)

- Posta, távközlés, műsorszórás, hatósági területek szétválasztása.
- Magánkézbe adás, koncessziós működés a kizárólagosság – ellátási kötelezettség megtartásával és fejlesztési kötelezettséggel
- Korlátozott verseny, új piacra lépők segítése a ”kimazsolázás” lehetőségével, jelentős piaci erővel rendelkezők kötelezettségeivel (RIO-RUO), eszköz piac liberalizálása (rengeteg szabályoznivaló)
- Kiegyenlített, piaci viszonyok által áthatott működés (kevés szabályoznivaló)

Monopoly vs competition

Competition is better for development, this is the reason why technology is evolving so fast. Demand and
supply. Business, they want us to feel that we need of their products.

EU cselekvések

- Cél volt az elektronikus kommunikációs szektor liberalizációja és a verseny élénkítése. Ennek jogi alapját adta a 2002-ben elfogadott öt direktíva: ‘Framework’, ‘Access’, ‘Authorisation’, ‘Universal Service’, ‘Privacy’. Ezt ültette a magyar jogrendbe a 2003. évi C. törvény.
- 2009-ben a Bizottság felülvizsgálta a direktívákat és létrehozta az Európai Elektronikus Hírközlési Szabályozók Testületét (BEREC) és Hivatalát. A módosított direktívák tartalmát tette át a magyar jogrendszerbe a 2011. évi CVII. törvény.

//TODO

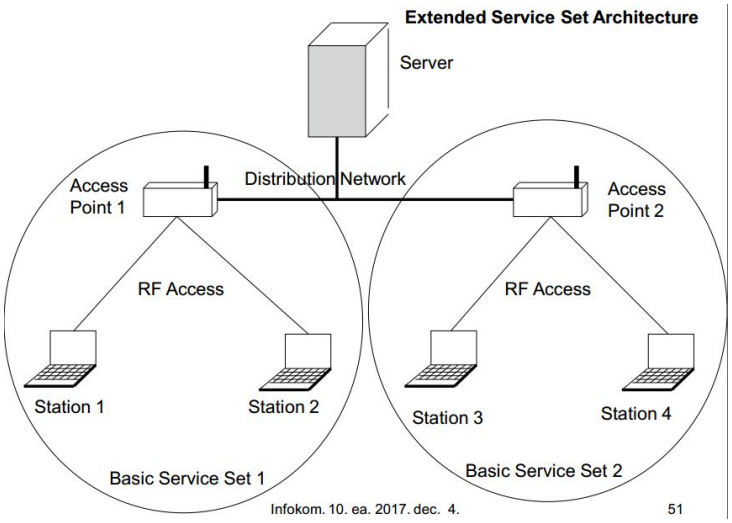
12. Wireless LAN principles, IEEE802.11 standard

RLAN (Radio LAN, Rádiós helyi hálózat más néven WLAN)

• In-door communication
• Distance: 150 m or less
• LAN (Local Area Network, Helyi hálózat) – Communication of near computers or devices by radio
• WiFi (Wireless Fidelity) – Commercial name of RLAN fit to IEEE 802.11 standard operating in frequency band 2,4 GHz (2400 – 2483,5 MHz) or in band 5,6 GHz

The 802.11 Architecture

• User Stations (laptop PCs and PDAs)
• Access Points (APs)
• Backbone Network (Distribution System, DS)
• The User Stations competing for access over a shared medium is termed the Basic Service Set (BSS).
• Two or more of these BSSs are interconnected by a DS network.
• The complete set of BSSs and the interconnecting network are termed an extended service set (ESS).
A service set is the set of all the devices associated with a particular Wi-Fi network. The service set can be local, independent, extended or mesh.
Each service set has an associated identifier, the 32-byte Service Set Identifier (SSID), which identifies the particular network. The SSID is configured within the devices that are considered part of the network, and it is transmitted in the packets. Receivers ignore wireless packets from networks with a different SSID.



Media Access Control (MAC)

• MAC is mandatory for all stations

• MAC is to assemble data into a frame including local address and error detection field
• MAC checks the frame address, perform error correction on the frame, disassemble the frame and passes it to the Logical Link Control.
• The LLC identifies higher layer programs to handle the data and provides and interface to these higher-layer programs while perform flow and error control.

Collision Avoidance Approach

• The access method differs from the wired Ethernet's CSMA/CD (Carrier Sensing Media Access and Collision Detection) operation.
• 802.11 networks use a collision avoidance approach (CSMA/CA)
• Collisions are avoided rather than detected.
• This avoidance approach requires each station to listen for transmission from the others.
• If the channel is idle, this indicates that no one else is currently transmitting and thus the station can now transmit.

Other devices using 2.4Ghz

Additionally, other devices use the 2.4 GHz band: microwave ovens, ISM band devices, security cameras, ZigBee devices, Bluetooth devices, video senders, cordless phones, baby monitors, and, in some countries, amateur radio, all of which can cause significant additional interference.

//TODO

13. IPTV, MPEG, TS (Transport Stream), multimedia program distribution

IPTV

IPTV (Internet Protocol Television) is a system where a digital television service is delivered using Internet Protocol over a network infrastructure, which may include delivery by a broadband connection. IPTV is typically supplied by a service provider using a closed network infrastructure. This closed network approach is in competition with the delivery of TV content over the public Internet, called Internet Television.
IPTV is defined as multimedia services such as television/video/audio/text/graphics/data delivered over IP-based networks managed to support the required level of QoS/QoE, security, interactivity and reliability.

IP alapú átvitel hibalehetőségei

– Csomag bithibával érkezik – a bithibák jellemzője BER (Bit Error Rate), további jellemzője, hogy mennyire egyenletesen vagy csomósodva fordul elő
– Csomag elvész (Packet Loss), további jellemzője, hogy mennyire egyenletesen vagy csomósodva fordul
elő – fontos, hogy milyen átlagidőre számítjuk a csomagvesztést (ha ritka és nem csomós)
– Csomag késve érkezik (delay, Latency)
– A csomag késleltetési ideje ingadozik (jitter)
– Csatornaváltás ideje, bekapcsolási idő (Channel change times „zapping times” and startup times)

FEC alapelve:
• megbecsüli a csomag elvesztések számát és megelőzi azt redundáns adatok küldésével, amelyek lehetővé teszik, hogy a vevő helyreállítsa a hiányzó csomagokat (egy adott darabszámig)

Minta közbeszúrás (Interleaving)

• Pl: 20 ms-os hanganyagok egyenként 160 mintát tartalmaznak
• Ha egy csomag elveszik, 20 ms-nyi hang kimarad
• Legyen A és B két egymás után 20 ms-os anyaghoz tartozó mintaállomány
• 5 ms-es szakaszonként vegyesen készítik el az első csomagot, majd ugyanezt teszik a B és a soron következő C mintakészlet bevonásával
• Ha kimarad egy csomag, csak 5 ms-es kiesések vannak, ami csak kisebb recsegést jelent
• This technique distributes the effect of the lost packets in order to reduce the impact on quality. The information of a speech part is distributed in multiple packets. The data units are regrouped in a crossed form before transmission such that they are distributed, and at the receiver they are rearranged in their original form.
• Thus, instead of losing the whole packet small parts from distributed packets are lost

MPEG

MPEG-2 principles

• Intra-coding relies on two characteristics of typical images. First, not all spatial frequencies are simultaneously present, and second, the higher the spatial frequency, the lower the amplitude is likely to be. Intra-coding requires analysis of the spatial frequencies in an image.
• Inter-coding relies on finding similarities between successive pictures. The next picture can be created by sending only the picture differences. The shifting process is controlled by a pair of horizontal and vertical displacement values (collectively known as the motion vector) that is transmitted to the decoder. The motion vector transmission requires less data than sending the picture-difference data.
???
Ezeknek a lényege nem az lenne, hogy ameddig az intra-coding minden képkockát egyesével küld el, addig az inter-coding pedig csak a különbséget az előző képkockához képest, így sokkal hatékonyabb, csak rosszabb képminőséget eredményez.

Structure
• Hierarchikus
• Szekvencia
• Képcsoport
• Kép
• Szelet
• Makroblokk
• Blokk

MPEG stream and transport stream

- An elementary stream is an endless near real-time signal. Program streams have variable-length packets with headers. *PES=Packetized Elementary Stream*
- In a transport stream the PES packets are further subdivided into short fixed-size packets and multiple programs can be carried in the same stream.

Multimedia program distribution

3 kind of basic transport networks
• Traditional broadcasting network (analogue or digital)
• Dedicated data network for multimedia transport (IPTV, t-home)
• Multimedia content on general networks like :
  – Internet based multimedia
  – Multimedia over GPRS/UMTS

Ezek szerintem az utolsó pont két lehetőségét taglalják, de lehet nem kell ebbe a tételbe.

1. Application: file transfer
Starting the player:

- After complete download
- Starting after downloading in the moment when content enough to avoid the risk of empty buffer.
- The target is the safety download of the content and the delay has secondary importance.

2. Alkalmazás: media streaming

Nem csak egyedül a tartalom célba juttatása, hanem az időbeli hűség is fontos:

- Néhány másodperces késleltetést elviselünk az indulásig
- Ha már elegendő mennyiség megérkezett ahhoz, hogy a lejátszást el tudjuk kezdeni, akkor folyamatos lejátszást kell biztosítani.

3. Alkalmazás: interaktív átvitel

Az időbeli hűség az elsődleges szempont:

- Azonnali indulás fogadható csak el
- Körbefordulási idő: 200 ms jó, max. 400 ms

A megbízhatóság csak másodlagos szempont: legyen a lehető legjobb a minőség, de ez semmiképpen sem ronthat az időbeliségen.

Ennyi van csak diában kb hozzá.

//TODO

14. VoIP, SIP, ADSL

VoIP

Voice over Internet Protocol (VoIP): voice traffic carried wholly or partly using IP over broadband networks competing with incumbent operators. VoIP is an acronym for Voice Over Internet Protocol, or in more common terms phone service over the Internet. If you have a reasonable quality Internet connection you can get phone service delivered through your Internet connection instead of from your local phone company. VoIP 6= Skype!!

Examples

• Hard Phones
• Cordless Hard Phones (vezetéknélküli vezetékes telefon, teljesen logikus, boltban hülyén néznek ha ezt mondod :P)
• Dialup Hard Phones: A dialup hard phone is a hard phone with a built-in modem instead of the Ethernet port
• WLAN or WiFi Phones: A WLAN or WiFi phone is a hard phone with a built-in WiFi transceiver unit instead of an Ethernet port to connect to a WiFi base station and from there to a remote VoIP server
• Hard Phones (voice and video): Hard phones with video telephony support
• Soft Phones (voice only): A soft phone is an IP telephone in software. It can be installed on a personal computer and function as an IP phone. Soft phones require appropriate audio hardware to be present on the personal computer they run
• Soft Phones (voice and video)

SIP (Session Initiation Protocol)

• Creation and management of a session, where a session is considered an exchange of data between an association of participants.
• Users may:
    • move between endpoints
    • addressable by multiple names
    • communicate in several different media - sometimes simultaneously.

SIP is an application-layer control protocol that can establish, modify, and terminate multimedia sessions (conferences) such as Internet telephony calls. SIP can also invite participants to already existing sessions, such as multicast conferences. Media can be added to (and removed from) an existing session. SIP transparently supports name mapping and redirection services, which supports personal mobility (users can maintain a single externally visible identifier regardless of their network location).

SIP supports five facets of establishing and terminating multimedia communications:
• User location: determination of the end system to be used for communication;
• User availability: determination of the willingness of the called party to engage in communications;

• User capabilities: determination of the media and media parameters to be used;
• Session setup: "ringing", establishment of session parameters at both called and calling party;
• Session management: including transfer and termination of sessions, modifying session parameters, and invoking services.

VoIP CODECS

• Codecs are used to convert an analog voice signal to digitally encoded version. Codecs vary in the sound quality, the bandwidth required, the computational requirements, etc.
• Each service, program, phone, gateway, etc typically supports several different codecs, and when talking to each other, negotiate which codec they will use.

ADSL

ADSL principles

• Asymmetric Digital Subscriber line
• A modem technology
• Convert existing twisted-pair telephone lines into access paths for multimedia and high speed data communication
• Can transmit to 30 Mbps downstream (VDSL 100 Mbps)
• Can transmit up to 20 Mbps upstream
• Transform the existing PSTN network to a powerful system capable of bringing multimedia, full motion video to the subscriber's home

VDSL

Very-high-bit-rate digital subscriber line (VDSL or VHDSL) is a digital subscriber line (DSL) technology providing data transmission faster than asymmetric digital subscriber line (ADSL) over a single flat untwisted or twisted pair of copper wires (up to 52 Mbit/s downstream and 16 Mbit/s upstream),
and on coaxial cable (up to 85 Mbit/s down- and upstream) using the frequency band from 25 kHz to 12 MHz.

//TODO