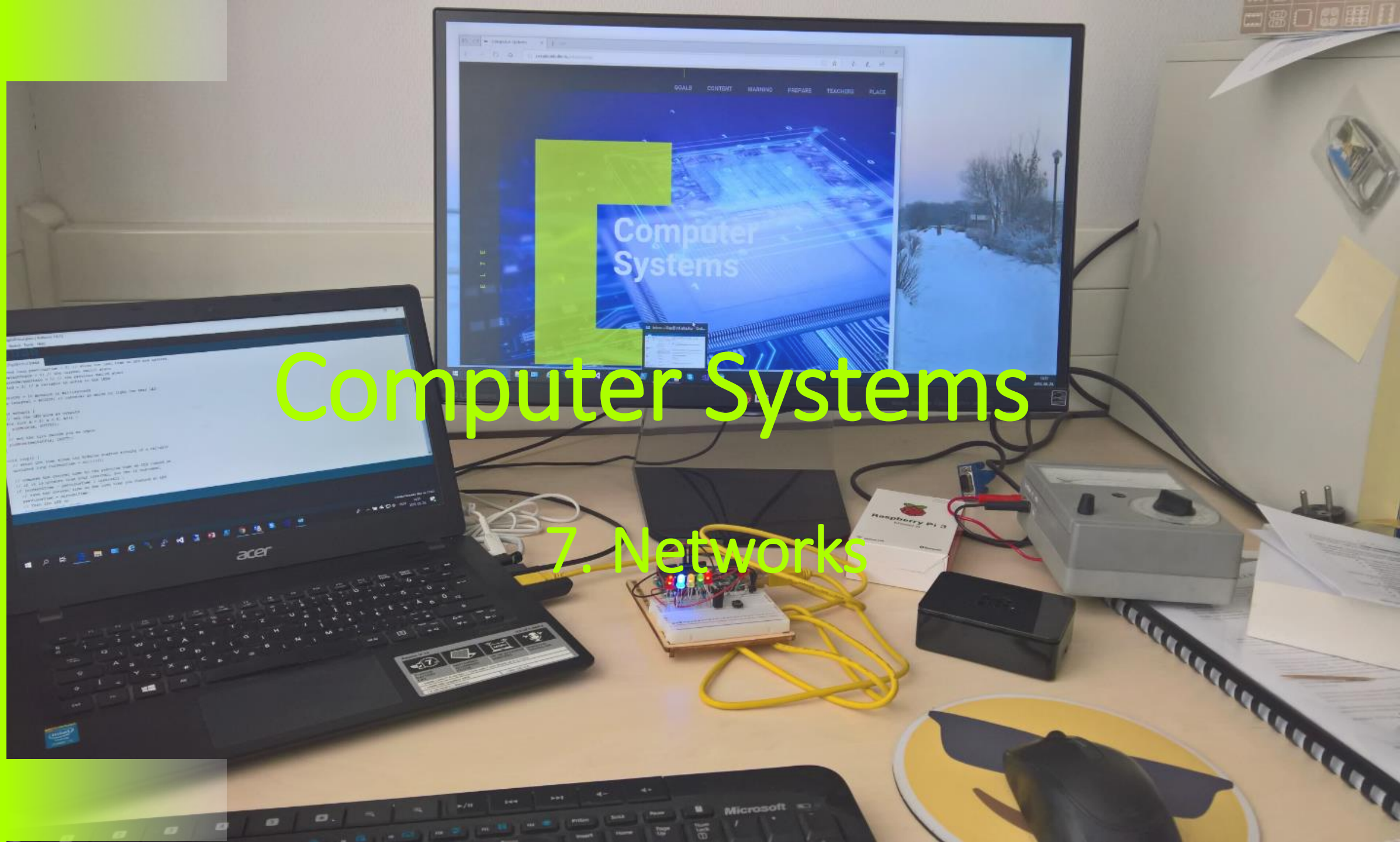


# Computer Systems

## 7. Networks



# Review

- Computers, information, number representation, code writing
- Architecture, client-server role, file systems
- Base commands, foreground and background processes
- I/O redirection, filters, regular expressions
- Variables, command substitution, arithmetical, logical expressions
- Script control structures
- Sed, awk

# What comes today?

- Bases of Unix-Linux management!
- Network elements
- ARPANET project
  - services
- Terminal, FTP, HTTP services
  - Later you will learn a lot about network possibilities in an other subject named „Computer networks”!

# Unix-Linux boot

- Boot sector – MBR
  - LILO (Linux LOader) choosing an operating system
- Kernel loading
- Init process starting (/sbin/init)
  - /etc/inittab configuration file
    - Default run level settings
      - Run levels 0- shut down, 1- single user mode, 2,3,4,5- standard levels, 6- reboot
      - 2-5 levels are defined specially in each systems
    - What is the task in the case of the different run levels
      - /etc/init.d/rc szint
  - GETTY starting

# Bases of Unix-Linux management

- Central management programs
  - SMIT, YAST, YAST2
- Manual modifying
  - /etc directory
  - /etc/hosts, /etc/passwd, /etc/shadow, /etc/services
  - /etc/resolv.conf, /etc/sendmail.conf
  - /etc/inetd.conf Internet server configuration
  - /etc/sendmail.cf
  - /etc/httpd.conf

# User management

- Tool for central administration
  - It is existing in each Unix system
  - It is convenient, easy to use
  - Disadvantage: it is slow and uneasy in the case of a great number of users
  - Solution: script usage
- Manual method
  - /etc/passwd, /etc/shadow manual modification
  - There is adduser, useradd or something similar.
- E.g.: useradd.awk

# An independent computer or a network

- Nowadays it is unimaginable to have an independent computer!
  - The NETWORK is itself the computer!
- Elements of connection are among the base services of operating system!
- There are several type of network connection possibilities!
  - Serial port
  - Ethernet card
  - WIFI card
  - Bluetooth
  - ...

# Network - ARPANET

- The first network project: ARPANET - *Advanced Research Projects Agency Network, in the 1960th*
  - *For today the descendent project is: NFSNET*
- Packet switched network – in the packet there are the addresses of the sender and the destination, the ordinal number of the packet, data.
- The decentralization of network connections are important!



# ARPANET elements

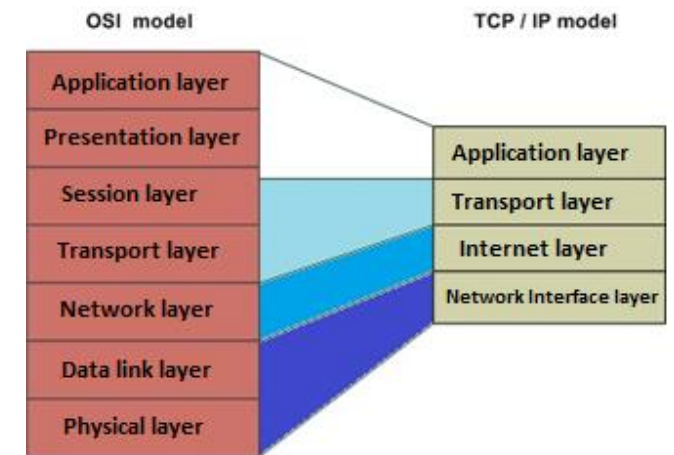
- Network Control Protocol – NCP is the first communication standard of ARPANET
- TCP/IP which is used nowadays was introduced in 1983!
- ARPANET services
  - File transfer (FTP – RFC354, 1971,73)
    - Terminal services (telnet – RFC 137, 1971, RFC854)
    - Sharing of resources (NFS)
  - Delivering messages (Mail- RFC524,561 1971,73)
  - Delivering voice (NVP) – it was not succesful, instead of it: VOIP!

# Bases of networks – OSI model

- Open Systems Interconnection - ISO/IEC 7498-1.
- 7 layers – each of the layers does its own task
  - 1. physical layer – ethernet, bluetooth, rs232, etc.
  - 2. data link layer – PPP,DHCP, L2TP,MAC, etc.
  - 3. network layer – IPv4,IPv6,AppleTalk,IPSec, etc.
  - 4. transport layer – TCP,UDP
  - 5. session layer – SSL, RPC etc. – SSL, RPC etc.
  - 6. presentation layer – HTML, CSS
  - 7. application layer – HTTP,SSH,Telnet etc.

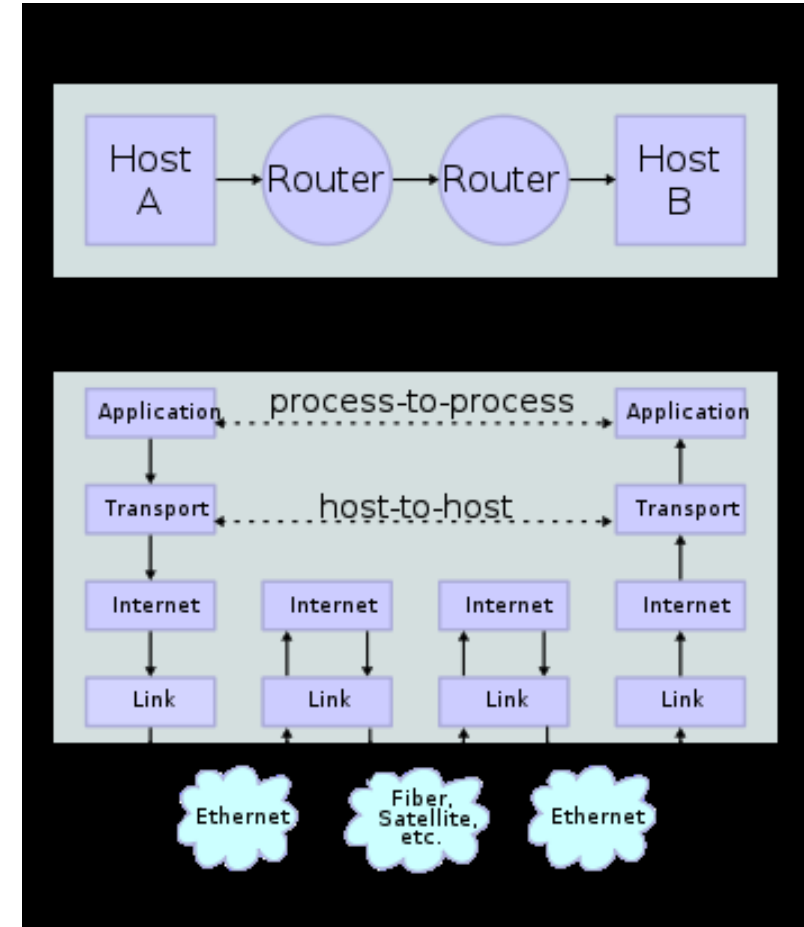
# TCP/IP

- TCP/IP packet is often called as „Internet protokol” packet! – RFC1122,1123,
- TCP- Transmission Control Protocol, IP- Internet Protocol
- Tasks of TCP/IP may be divided into 4 layers
  - Application layer
  - Transport layer
  - Internet layer
  - Network Interface layer
- TCP/IP reference: RFC1180-  
<https://tools.ietf.org/html/rfc1180>



# Example of network connection

- 2 host (computer), reach each other through 2 routers!
- Applications write to the and read from the data channels!
- Other details of the communication may not be seen!



# Network topologies

- Star topology – Usually it is used by the local networks! (UTP)
- Tree topology – hierarchical connection of stars
- Ring topology – Typical usage of it as a backbone topology.
- Bus topology – Formerly used (BNC).
- Linear topology – It is similar to bus topology but the failure of any of the elements is going to break the system!

# Network devices - SWITCH

- Computers are devices placed at the end-points of topologies!
- The central device of a star topology is a „switch“!
  - It guarantees the connection between the computers bound into the same local network. It is in the OSI 2. data link layer. It transports the packets only to the given port, using the MAC addresses. For this purpose it uses a table!
  - Formerly Repeaters and HUB-s were used as well. They worked in the physical layer!
- There are other network switchers, Frame Relay, X25 ancestor, long distance network switcher, or Fibre Channel what is the switcher of SAN systems!

# Network devices - BRIDGE

- It is also the device of the 2. layer, just as a switch.
- It's task is to connect 2 LAN-s!
- Formerly a bridge and a switch meant different devices!
- Nowadays practically you are not able to buy a BRIDGE as a device!
  - Switches often „know“ this function!
  - May be a simpler switch does not, but the router does!

# Network devices - ROUTER

- Different local and global networks are connected with the „router”!
- A router is placed in the 3. layer of OSI model!
  - It decides knowing the IPv4 (it is known in OSI 3. layer)
  - There is a LAN in each port of a router. It's task is to decide about each arriving packet to which connected network should they be transported or rather to build up routing informations (routing table).
  - Router protocols: RIP, OSPF, EIGRP([Enhanced Interior Gateway Routing Protocol](#), CISCO)

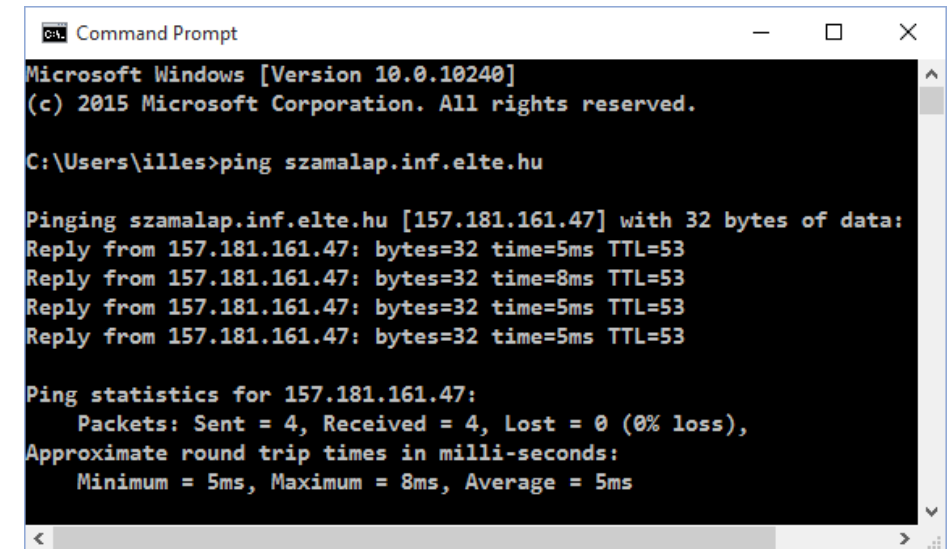


# IP settings

- Each of network elements has got a unique IP address!
- IPv4 protokol – 4 bytes (32 bits) IP address, RFC791
  - Can be divided into 2 parts – Network address + computer (host) identifier.
  - A class: 0.0.0.0-127.255.255.255, 8(1+7)/24 bit
  - B class: 128.0.0.0-191.255.255.255, 16(2+14)/16 bit
  - C class: 192.0.0.0-223.255.255.255, 24(3+21)/8 bit
  - D class: 224.0.0.0-239.255.255.255, 4/28 (groupid), multicast
  - E class: 240.255.255.255-247.255.255.255 – occupied, for later usage.

# IP address and name of a computer - DNS

- As many network cards as many IP addresses are existing.
- If it is not forbidden, ping will check the existence of the connection!
- DNS- Domain Name Service
  - Name – IP address coupling
  - fundofcomp.inf.elte.hu – 157.181.161.47
  - B class address – elte.hu domain
  - TTL-Time To Live, while it is >0 the packet is living!



```
Command Prompt
Microsoft Windows [Version 10.0.10240]
(c) 2015 Microsoft Corporation. All rights reserved.

C:\Users\illes>ping szamalap.inf.elte.hu

Pinging szamalap.inf.elte.hu [157.181.161.47] with 32 bytes of data:
Reply from 157.181.161.47: bytes=32 time=5ms TTL=53
Reply from 157.181.161.47: bytes=32 time=8ms TTL=53
Reply from 157.181.161.47: bytes=32 time=5ms TTL=53
Reply from 157.181.161.47: bytes=32 time=5ms TTL=53

Ping statistics for 157.181.161.47:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 5ms, Maximum = 8ms, Average = 5ms
```

# IP addresses - settings

- IP – 157.181.161.47 – you see, it is a B class address!
  - Irrespectively of this there is a C class subnet!
- Mask: 255.255.255.0 – it gives the size of the LAN (256)
- Broadcast: 157.181.161.255 – typically the last address of the LAN
- Subnet IP: 157.181.161.0 – the first address of the LAN, subnet address
- Gateway IP: IP address of the router, which sends packets out
  - /sbin/route

# IPv4 addresses

- Size: 4 byte – max.  $2^{32}$  device
  - It is not much at all – moreover it is not enough!
- What can we do?
- Out of the woods: address intervals which are not „rout“-able (RFC1918)
  - A class: 10.x.x.x (8/24)
  - B class: 172.16.0.0-172.16.255.255 (20/12)
  - C class: 192.168.x.x (There is 16/16, 256 C class address)

# IPv6

- Due to the restricted number of free IPv4 addresses we need more possibilities!
- IPv6 uses 128 bits long addresses!
  - The hexa form of 8 16 bits long number:
    - 2015:0a0d:0102:1961:0324:fe01:03ab:0405
  - First 64 bits: subnet prefix
  - Second 64 bit: interface identifier
  - First standard: RFC2640 (1998 dec.)
- IPv4 – IPv6 corresponding
  - 80 bit of 0, then 16 bit of 1, then comes the 32 bit of IPv4.

# DHCP

- Dynamic Host Configuration Protocol
- IP address can be given static
  - Manual configuration!
- Giving of dynamic settings (ip,mask,gw)
  - On the server: giving of an address-interval (IP pool)
  - Restrictions can be used, e.g. only registered computers (mac address) get settings!

# Connect to a Server

- IP configuration
  - Command line possibility
    - ifconfig, or ip command (eth0, lo(opback))
  - Administrator interface
    - SUSE- yast, IBM-smit, stb.
- Terminal connection
  - Ssh
  - FTP
    - FTP over SSL
- Web connection

# FTP(s) vs HTTP(s)

- What is the difference between them?
  - File transfer – Hypertext transfer
- HTTP is a later standard but practically nowadays it is used only!
- Why?
  - You can upload or download files with the help of HTTP as well!
  - We can upload and download using a web-browser!
- FTP – it is quicker, but the user needs an authorization similar to telnet!
  - Binary - text file transfer!



# Web publication, authorization

- public\_html directory
  - Modifiable, in httpd.conf file
  - System operator (root) authorization
  - If there is an index.html (def. document), then it gives back that one.
  - If there is no index.html file, then it works as an ftp catalog!
- Everything is public for everybody!

# Authorization, password protection

- It is valid for the given directory if there is a .htaccess file in it (special form)
- htpasswd, basic, there is no coding, in the case of apache2 the name is htpasswd2
  - In szamrend.inf.elte.hu computer: it is in /usr/bin directory
  - Usage: htpasswd [-c] filename username
    - -c filename will be a new file
    - It asks the password and writes the username and the coded password into the file
    - -c must use only first case!

# Authorization, protection II.

- htdigest, MD5 coding (in case of apache2, htdigest2)
  - Usage: htdigest [-c] filename username
  - May be browser dependent (IE ?, FireFox ...)
- The mod\_auth\_digest modul must be installed before the „digest” mode can be used!
- A Basic authentication is installed by default!
  - If not, in the Apache configuration file the users directories must be decorated with „AllowOverride AuthConfig”!

# Apache literature

- Apache Web server configuration
  - /etc/httpd.conf
  - Or recently : /etc/apache2/ and several small conf. here
- <http://httpd.apache.org/docs/1.3/howto/htaccess.html>
- Google
- Bookstore

# .htaccess content

- AuthType Basic
- AuthName „Fruit tree collection“
- AuthUserFile /usr/people/illes/public\_html/letolt/apple
- Require user apple
- Order deny,allow # order: disallowance, allowance
- Deny from all
- Allow from elte.hu
- allow from 81.82.83.94
- Satisfy any # at least one of the criteriums must be true to be able to get the content

# Sample

- The simplest .htaccess file.
  - The browser will ask login parameters!
- ```
ali@os:~/public_html/titkos> cat .htaccess
AuthType Basic
AuthName "Adja meg adatait!"
AuthUserFile
/home/ali/public_html/titkos.pw
Require user alma

ali@os:~/public_html/titkos>
```

# Apache config- Virtual host

- Meaning: we can reference an address with another name
- Httpd.conf
  - Usually in /etc directory
  - In webprogramozas server /etc/apache2 directory
    - (Suse linux) It is not in one file it is divided into parts by functionality.
  - SSI, CGI permissions
    - For a directory, .shtml extension
    - Mod\_userdir.conf
  - Virtual directory
    - In Vhosts.d directory, there are .conf files with given names

Thank you!

