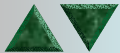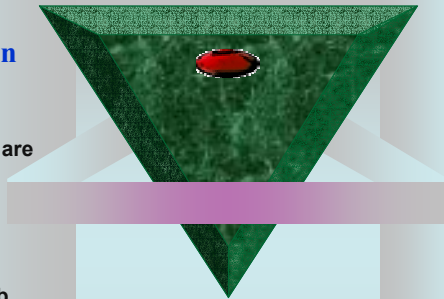## Chp 1. Internet – Architecture, Offered Services, Communication And Navigation

- 1.1 How WANs (and Internet) are organized

- 1.2 Service protocols

- 1.3 Web pages, sites and Web browsers – an introduction

- 1.4 Web services – an introduction

- Bibliography

by Professor Vasile AVRAM, PhD

1.1 How WANs (and Internet) are organized

1.1 How WANs (and Internet) are organized
- Client/Server Technology
- Applications of different Internet tools
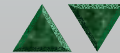- 1.1.1 The Logical Structure of Web Servers
- 1.1.2 The "transport" protocols
- 1.1.3 The IP addressing
- 1.1.4 The DNS
- 1.1.5 URL (Uniform Resource Locator)
- URI – Uniform Resource Identifiers

1.1 How WANs (and Internet) are organized

The WANs (and the most general one, Internet) are composed from (figure 1.1;[AvDg03]):
- at the lower level LANs, MANs etc or in other words sub-networks ($S_{i,j}$);
- at the next up the sub-networks are linked together, by using inter-network devices, in areas ($A_{k,l}$);
- the areas are linked together, by means of routers, into domains (D_m);
- all connected domains (by means of routers and using a packet or circuit switching transmission technology) form the WAN.
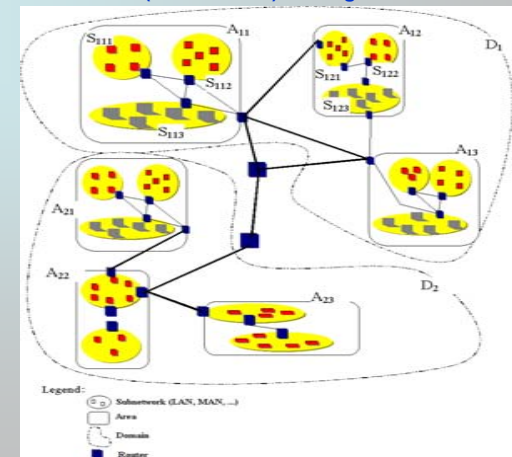
1.1 How WANs (and Internet) are organized

Figure 1.1 The WAN (Internet) architecture

1.1 How WANs (and Internet) are organized

The Internet is not a single network, but a worldwide collection of loosely connected networks that are accessible by individual computer hosts in a variety of ways, including gateways, routers, dial-up connections, cell phones Internet enabled, etc, and Internet Service Providers (ISP).

The Internet is easily accessible to anyone with a computer and a network connection. Individuals and organizations worldwide can reach any point on the network without regard to national or geographic boundaries or time of day.

**The main reason most people buy a modem — or an entire PC, for that matter — is to connect to the Internet.**
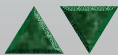
1.1 How WANs (and Internet) are organized

The Internet usage at world level by regions:

Regions	Population (2005 Estimated)	% percent from total population	Internet Usage	Grows 2000-2005	% Population (Penetration)	% usage at world level
			Internet usage			
Africa	896,721,874	14.0 %	23,867,500	428.7 %	2.7 %	2.5 %
Asia	3,622,994,130	56.4 %	327,066,713	186.1 %	9.0 %	34.2 %
Europe	731,018,523	11.4 %	273,262,955	165.1 %	37.4 %	28.5 %
Middle East	260,814,179	4.1 %	21,422,500	305.4 %	8.2 %	2.2 %
North America	328,387,059	5.1 %	223,779,183	107.0 %	68.1 %	23.4 %
Latin America and Caribbean	546,723,509	8.5 %	70,699,084	291.31 %	12.9 %	7.4 %
Oceania / Australia	33,443,448	0.5 %	17,655,737	131.7 %	52.8 %	1.8 %
WORLD TOTAL	6,420,102,722	100.0 %	957,753,672	165.3 %	14.9 %	100.0 %

NOTES: last updated in 2005, September, 30. The information regarding Internet usage is determined on the basis of publications of: Nielsen//NetRatings, International Telecommunications Union, local internet centers (NIC).
Source: Miniwatts International, LLC
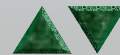
1.1 How WANs (and Internet) are organized

The usage of Internet in European countries group by EU members and non EU and the position of Romania:

The usage of Internet in Europe						
EUROPE	People (2005 Estimated)	% percent from total population	Internet users	Grows 2000-2005	% People (Penetration)	% usage at world level
European Union	460,270,935	7.2 %	225,006,820	141.5 %	48.9 %	23.5 %
Non EU Countries	270,747,588	4.2 %	48,256,135	385.8 %	17.8 %	5.0 %
TOTAL EUROPE	731,018,523	11.4 %	273,262,955	165.0 %	37.4 %	28.5 %
Other Countries	5,689,084,199	88.6 %	684,490,717	165.4 %	12.0 %	71.5 %
WORLD TOTAL	6,420,102,722	100.0 %	957,753,672	165.3 %	14.9 %	100.0 %
ROMANIA	21,377,426	0.33%	4,940,000	517.5 %	23.1 %	1.8 %

Source: Miniwatts International, LLC

The position of Romania in the European area is described as:

ROMÂNIA	% from total Population	% Internet usage
Reported to Europe	2.92%	1.81%
Reported to UE	4.64%	2.20%
Reported to non UE	7.90%	10.24%

1.1 How WANs (and Internet) are organized

The Internet has two aspects, physical and logical and it can be viewed as a collection of physical and logical pieces that are tied together physically and logically:

- The *physical aspect* is a collection of wires, optical fibers, and microwave radio links and other devices that carry digital signals between computers. The combination of connections forms a redundant network. Computers are linked to one another in a web that provides multiple signal paths between any two machines;
- The *logical aspect* is a set of standards for the signals that travel through that network. The Internet uses various protocols depending on what kind of job is to be done and what kind of data is being transferred. The languages that allow computers to talk to another are called protocols. The protocol is the method in which the network interface cards (NIC) communicate over the topology. Protocols are essentially electronic rules of behavior that allow the network interface cards to initiate and maintain communication.

1.1 How WANs (and Internet) are organized

The Internet was not designed to link computers but to tie together computer networks and, consequently, to allow data to flow between networks. The chief protocol and the defining standard of the Internet is TCP/IP (Transmission Control Protocol/Internet Protocol).

Information is transmitted from client PCs (individuals or companies) whose users request services to server computers (figure 1.2) that hold information and host business applications that deliver the services in response to request.

The client PCs within homes or business are connected to Internet via local Internet Service Provider (ISP) which, in turn, are linked to larger ISPs with connection to the major national and international infrastructure or backbone (high-speed data transport channels).

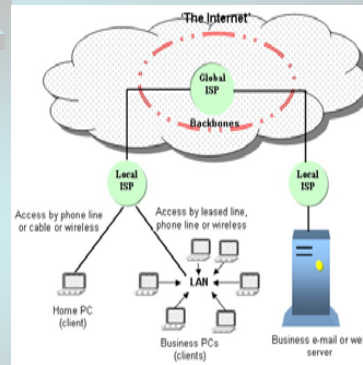## 1.1 How WANs (and Internet) are organized

Figure 1.2 Some infrastructure components of Internet

The web is accessed using a web browser that enables user to navigate through the information available and display any page of interest

The transmission of information across the Internet is often described as being based around either pull or push technology:

- *Pull technology* describes information sent out as a result of receiving specific request, for example a page is delivered to a web browsers in response to a specific request from the user;

- *Push technology* describes information that is sent without a user's specifically requesting it, for example a customized news service received by subscribing to a channel or e-mail.

1.1 How WANs (and Internet) are organized

Client/Server Technology

Client/Server Technology. The Internet is based on client/server technology (figure 1.3). All data, including e-mail messages and Web pages, are stored on server. The individuals access that resources and the net control through client applications, such as Web browser. A client uses the Internet to request information or services from a distant computer and the server sends the request information back to the client via Internet.
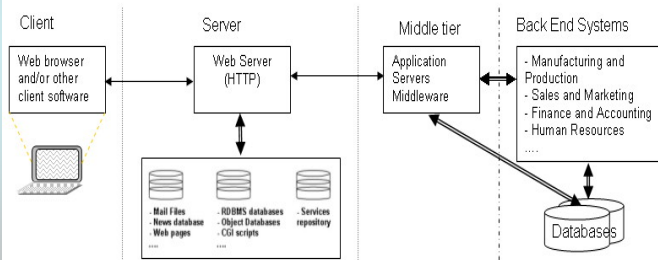

Figure 1.3 Client/server computing on the Internet

1.1 How WANs (and Internet) are organized

Client/Server Technology

The client platforms include a variety of devices and information appliance. An information appliance is a device (such as Internet-enabled cell phones, for example) that has been customized to perform, in a user friendly way, a few specialized computing tasks, such as:

Device	Description
PC	General purpose computing platform that can perform many different tasks. The performed tasks can be complex to use
Net PC	Network computer with minimal local storage and processing capabilities and designed to use software and services delivered over the networks and the Internet
Smart Phone	Provide voice communication and in addition has a small screen and keyboard for browsing the Web and exchanging e-mail
Game machine	Game machines provided with a modem, keyboard, and capabilities to function as Web access terminal
PDA	Wireless handheld personal digital assistant (PDA) with e-mail and Internet services. Typical functions for PDAs include address book, appointment scheduler, calculator, clock, expense tracking, currency conversions, alarm etc. Sophisticated PDA can include communications, spreadsheet and word processing applications
E-mail machine	Telnet with keyboard that provides textual e-mail capabilities (it requires linking to an e-mail service) or Internet Tablet
Set-top box	Is an important component of the interactive digital TV system and is used to receive and decode message (from cable, satellite dish, aerial antenna etc) and then display on a conventional TV. It provides also surfing and e-mail capabilities using a television set and wireless keyboard (or remote control). The set-top box includes a modem that is used to pass back selections made on interactive channels (such as the interactive shopping channels, for example).

1.1 How WANs (and Internet) are organized
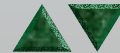
Client/Server Technology

In the right side of the figure we consider the **back end systems** (or **back office**) that are in use by enterprises. The enterprise software consists of a set of interdependent modules for applications such as sales and distribution, financial accounting, investment management, production planning, plant maintenance and human resources etc that allows data to be used by multiple functions and business processes for more precise coordination and control. The modules can communicate with each other directly or by sharing common repository data. Contemporary enterprise system uses client/server computing architecture.
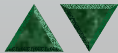
1.1 How WANs (and Internet) are organized

Client/Server Technology

In the companies in operation before PC and Internet appears we can found many existing legacy mainframe applications that are essential to daily operations and very risky to change. In general these ones are incompatible with the new applications developed for PC platforms. The legacy systems can be made more useful if their information and business logic can be integrated with other applications. One way to integrate various legacy systems is by using special software called **middleware**. Middleware is a special software which allows different software applications to communicate (it allows and assists data transfers between incompatible systems similarly to the way the network gateway operates in Internet).
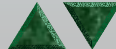
1.1 How WANs (and Internet) are organized
Client/Server Technology

Another way to integrate the existing systems is the use of an enterprise application integration software. This kind of software is dedicated to tie together multiple applications to support enterprise integration. The software allows system builders to model their business process graphically and define the rules that applications should follow to make this process work. The software then generates the under-laying program instructions to link existing applications to each other to support those processes.
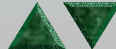
1.1 How WANs (and Internet) are organized
Applications of different Internet tools

The information can be exchanged in Internet, by individuals or enterprises, by intermediate of a variety of end-user tools, from which the most common are listed in the table that follows.

Tool	Description
e-mail	Person-to-person messaging and document sharing. E-mail packages offers a lot of features including attachments, viewing tools, filters, management tools, encryption, managing addresses, signature files.
Usenet newsgroups (Forums)	Discussion groups on electronic bulletin board. Developed first to be accessed by special software today is a feature accessed from browsers
LISTSERVs	Discussion groups and messaging using e-mail mailing list servers
Gopher, Archie and WAIS	These tools where important before the advent of the Web for storing and searching documents on the Internet
Internet Relay Chat (IRC)	Interactive conversations with the possibility of using instant messaging (allows participants to create their own private channels such as Yahoo Messenger or AOL Instant Messenger). The Internet relay chat is a synchronous communication tool that allows text based 'chat' between users that are logged on at the same time. New features added by Yahoo Messenger and AOL Instant Messenger includes text, voice (microphone and speakers), and video (video camera) chatting

1.1 How WANs (and Internet) are organized

Applications of different Internet tools
(cont.)

Tool	Description
Telnet	This allows remote access to computer systems so that you can log on to one computer system and do work on another
Push channel	Information is broadcast over Internet or intranet and received using a Web browser or special program for which a subscription to this channel has been set up
FTP	Transfers files from computer to computer across Internet (moving files across Internet)
World Wide Web (WWW)	Retrieve, format, and display information using hypertext links. Is widely used for publishing information and running business applications over Internet
Internet Telephony	Allows companies and individuals to use Internet for telephone voice transmission. VoIP (voice over IP) technology uses Internet Protocol (IP) to deliver voice information in digital form using packet switching technology (the line phones uses a circuit switching technology)
VPN	Virtual Private Network is a secure connection between two points across Internet. The VPN services are available through ISPs

1.1 How WANs (and Internet) are organized
The Logical Structure of Web Servers

The base plate of a web server (figure 1.4) composed by three basic elements: the physical server, the server operating system (must include a network operating system - NOS) and the server called HTTP (HyperText Transport Protocol).
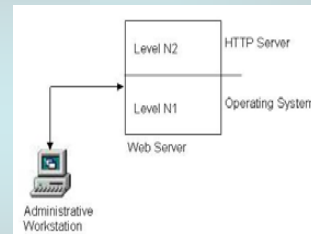

Figure 1.4 The functional architecture of the base plate of a web server

Very briefly the elements in the figure:

- **Administrative workstation (or the system console) is the workstation used to administer the operating system running on the server.**

- **Servers uses a Network Operating System (NOS) that must enough capable to offer simultaneously services to most clients.**

- **HTTP is the protocol that governs how web browsers (clients) and web servers talk to each other. All messages sent between browsers and servers must be formatted according to the HTTP specification. The HTTP commands allow an application to interpret a page together with his HTML (HyperText Markup Language) links. The HTTP server manages, interprets and acts the HTTP commands.**

1.1 How WANs (and Internet) are organized
The Logical Structure of Web Servers

The best view of the Internet comes with following a packet from your personal computer: when you log into a web site, you actually send a command to a distant server telling it to download a page of data to your personal computer (figure 1.5).
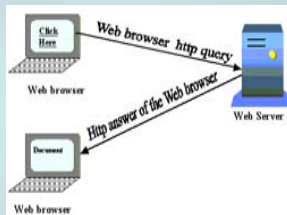

Figure 1.5 The principle of communication between a Web browser and a Web server

Your web browser packages that command into a packet labeled with the address of the server storing the page that you want. Your personal computer sends the packet to your modem (or terminal adapter), which transmits it across your telephone or other connection to your Internet Service Provider (ISP).

The ISP actually operates as a message forwarder. At the ISP, your message gets combined with those from other PCs and sent through a higher speed connection (at least you should hope it is a high speed connection) to yet another concentrator that eventually sends your packet to one regional center. There the major Internet carriers exchange signals, routing the packets from your modem to the carrier that haul them to their destination based on their Internet address.

1.1 How WANs (and Internet) are organized
The Logical Structure of Web Servers

The HTTP protocol is a request/response protocol. The HTTP protocol allow to clients and web servers to establish a connection based on TCP (Transmission Control Protocol) allowing data transfers (documents, images etc) from server to client or from client to server.

A client sends a request to the server in the form of a request method, URI (Uniform Resource Identifiers), and protocol version, followed by a MIME-like (Multipurpose Internet Mail Extensions) message containing request modifiers, client information, and possible body content over a connection with a server.

The server responds with a status line, including the message's protocol version and a success or error code, followed by a MIME-like message containing server information, entity meta-information, and possible entity-body content.

URI's have been known by many names: WWW addresses, Universal Document Identifiers, Universal Resource Identifiers, and finally the combination of Uniform Resource Locators (URL) and Names (URN). As far as HTTP is concerned, Uniform Resource Identifiers are simply formatted strings which identify - via name, location, or any other characteristic - a resource.
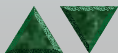
1.1 How WANs (and Internet) are organized
The Logical Structure of Web Servers

The data transferred have an associated data-type (a header describing the content text, image, HTML etc and how they coded) and the transfer uses the ASCII character set and the MIME standard. The information using the MIME standard are converted as MIME standard requires and provided with a header having, for example, the following fields:

MIME-version: 1.0
Content-Type: type/specification parameter_name=parameter_value
Content-ID:
Content-Description:

The client application (a general browser or another web oriented application) contact the *http* server and then send his request in which it specifies the type of action the browser whishes the server to perform. The server applications, executes the client request and, send to this one an answer including the information corresponding to the query execution. The typical structure of a client query is: *method identifier*, *required object name*, *the client http protocol version number*. In the context of HTTP, a method is essentially the name of a command.

1.1 How WANs (and Internet) are organized
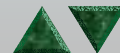**The "transport" protocols**

TCP/IP groups together the communication protocols used to manage the data transmission over Internet, where:
TCP - Transmission Control Protocol;
IP - Internet Protocol.
Very simply explaining, TCP handles packet flow between systems and IP handles the routing of packets.

The functioning principle is simple: TCP divides data into packets provided with an envelope containing the required data for identification and validation; IP provide for each packet the destination address. The packets are placed onto the network and the routers define for each one the pathway to fallow. To the destination (receiver) the IP address checked together with the TCP content and if success the packets are reassembled.
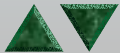
1.1 How WANs (and Internet) are organized
The "transport" protocols

The today networks are designed using a layered approach. Each layer presents a predefined interface to the layer above it. By doing so, a modular design can be developed so as to minimize problems in the development of new applications or in adding new interfaces.

The ISO/OSI protocol with seven layers is the usual reference model. Since TCP/IP was designed before the ISO/OSI model was developed it has four layers (the differences between the two are mostly minor).
(read chp. 7 from [AvDg03] reference for more details)

1.1 How WANs (and Internet) are organized
The "transport" protocols

The OSI protocol stack

7.	Application (A)	End user services such as email; for example the program such as web browser that creates and receives messages.
6.	Presentation (P)	Data problems and data compression. The protocols are usually part of the operating system.
5.	Session (S)	Authentication and authorization. This includes data-transfer protocols such as SMTP, HTTP and FTP.
4.	Transport (T)	Guarantee end-to-end delivery of packets. This layer ensures the integrity of data transmitted.
3.	Network (N)	Packet routing. It defines protocols for opening and maintaining links between servers (the best known are Internet Protocol – IP and Novell IPX).
2.	Data Link Control (DLC)	Transmit and receive packets. It defines the rules for sending and receiving information.
1.	Physical (PH)	The cable or physical connection itself. It realizes the low-level description of physical transmission.
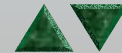
1.1 How WANs (and Internet) are organized
The "transport" protocols

   Within the OSI model, a user presents data to the application layer. Data is passed downward through the hierarchy with each layer adding addressing and/or control information (figure 1.6). When data reaches the lowest layer (the physical layer), it is actually sent to a device. At the receiving end, the process is reversed. Data is passed upward through the layer hierarchy with each layer stripping address or control information.
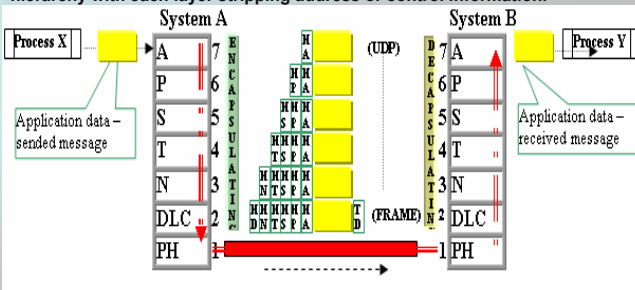
Figure 1.6 Data transmission in OSI model

1.1 How WANs (and Internet) are organized
The "transport" protocols

The datagram, frame, and packet notions are used by OSI protocols (and TCP/IP also, figure 1.7) in the message transmission/reception process:

- A **datagram** is the unit of transmission in the network layer (such as IP). A datagram may be encapsulated in one or more packets passed to the data link layer;

- A **frame** is the unit of transmission at the data link layer (DLC). A frame may include a header and/or a trailer, along with some number of units of data;

- A **packet** is the basic unit of encapsulation, which is passed across the interface between the network layer and the data link layer. A packet is usually mapped to a frame; the exceptions are when data link layer fragmentation is being performed, or when multiple packets are incorporated into a single frame.

1.1 How WANs (and Internet) are organized
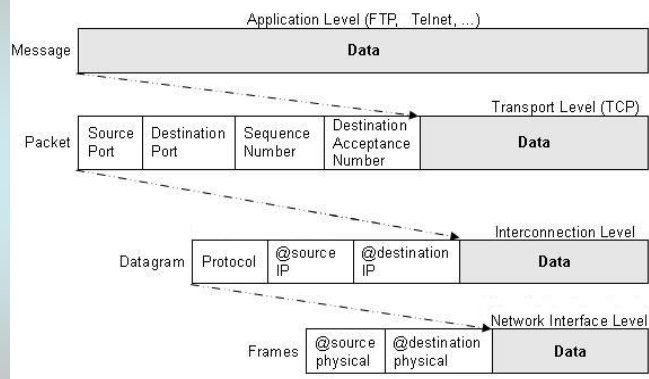### The "transport" protocols

Figure 1.7 TCP/IP datagram

1.1 How WANs (and Internet) are organized
The "transport" protocols

TCP/IP Protocol Stack and some software components

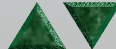|			
5.	Application	Authentication, compression, and end user services. The application layer in TCP/IP handles the responsibilities of layers 5, 6, and 7 in the OSI model.	Application programs such as HTTP, Telnet, FTP, RLOGIN (based on TCP), SMTP (mail), NFS, DNS, NTP (based on UDP), PING and TRACEROUTE (based on ICMP and UDP). **SMTP (Simple Mail Transfer Protocol) is an electronic mail protocol; FTP (File Transfer Protocol) and TFTP (Trivial File Transfer Protocol) allows file transfers with and, respectively without authentication; Telnet emulates the terminal of a TCP/IP machine;** The utilities with an "R" prefix (REXEC, RLOGIN, RSH, RCP etc) executes remote commands.
4.	Transport	Handles the flow of data between systems and provides access to the network for applications. The transport layer in TCP/IP does not always guarantee reliable delivery of packets as the transport layer in the OSI model does. TCP/IP offers an option called UDP that does not guarantee reliable packet delivery.	The transport level uses two protocols, UDP and TCP. **UDP which stands for User Datagram Protocol does not guarantee packet delivery and applications which use this must provide their own means of verifying delivery. UDP - provides a simpler protocol which as lower overhead for single messages or for software which wishes to do its own error checking. TCP - is responsible for verifying the correct delivery of data from client to server. Data can be lost in the intermediate network. TCP adds support to detect errors or lost data and to trigger retransmission until the data is correctly and completely received. TCP does guarantee delivery of packets to the applications which use it.**

14

1.1 How WANs (and Internet) are organized
The "transport" protocols

TCP/IP Protocol Stack and some software components

3.	Network	Packet routing	**IP - is responsible for moving packet of data from node to node. IP forwards each packet based on a four byte destination address (the IP number). The Internet authorities assign ranges of numbers to different organizations. The organizations assign groups of their numbers to departments. IP operates on gateway machines that move data from department to organization to region and then around the world. ICMP - which provides low level support for IP, including, error messages, routing assistance, and echo requests.**
2.	Physical	Kernel OS/device driver interface to the network interface on the computer	The link layer is concerned with the actual transmittal of packets as well as IP to Ethernet address translation. This layer is concerned with **ARP, the device driver, and RARP.**
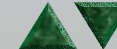
1.1 How WANs (and Internet) are organized
The "transport" protocols

The TCP/IP protocol suite includes:
- Internet Protocol (IP) which is the low level protocol, which transports raw data over networks;
- Internet Control Message Protocol (ICMP), which provides low level support for IP, including, error messages, routing assistance, and echo requests;
- Address Resolution Protocol (ARP), which translates logical network addresses (internet addresses) to hardware addresses (Ethernet addresses) and RARP (Reverse Address Resolution Protocol) is used to translate hardware addresses into internet addresses.
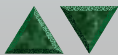
1.1 How WANs (and Internet) are organized
    The "transport" protocols

Other two protocols used by TCP/IP over specific connections are SLIP and PPP:

SLIP – Serial Line Transfer Protocol – is a protocol for IP frames transport over a serial link. This protocol and, his compact version CSLIP, cannot negotiate the IP address they only transmit the information.

PPP – Point-to-Point Protocol – is a transfer protocol that transfers data packets from one point to another one. It transports any kind of packets (does not matter which protocol used to make the packets) by encapsulating this in PPP packet format. This protocol is used by almost dial-up connections.

1.1 How WANs (and Internet) are organized
    The IP addressing

Currently there are two types of Internet Protocol (IP) addresses in active use, IP version 4 (IPv4) and IP version 6 (IPv6):
    - IPv4 was initially deployed on 1 January 1983 and is still the most commonly used version. IPv4 addresses are 32-bit numbers often expressed as 4 octets in "dotted decimal" notation (for example, 192.0.32.67).
    -Deployment of the IPv6 protocol began in 1999. IPv6 addresses are 128-bit numbers and are conventionally expressed using hexadecimal strings (for example, 1080:0:0:0:8:800:200C:417A).

The computers in TCP/IP based networks, even having only one computer, are called hosts. This name comes from the first deployment of TCP/IP – in the moment the standard defined the personal computers and workstation don't exists yet – all existing computers are multi-user and for that reason they called host.
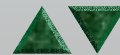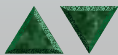
1.1 How WANs (and Internet) are organized
The IP addressing

In Internet each station has a unique number (IPv4)expressed as a 32-bit number (all of the Internet addresses are global) in so called dotted-decimal notation (for example for the number 2188611658 the address can be written -in 256 base- as
$130 \times 256^3 + 115 \times 256^2 + 144 \times 256^1 + 69 \times 256^0 \Rightarrow 130.115.144.69$).
The Internet addresses are organized in five classes from A to E. Each address belonging in the class A, B or C consists of two parts:
a) a **network identifier** (netid – network address; we denote this by letter N), distributed by the non-governmental organization InterNIC (Internet Network Information Center - www.internic.org; www.internic.net) or one of the regional centers. This address is used for routing over Internet (the choosing of the pathway from router to router);
b) a **host identifier** (hostid – the address of the machine in the network; we denote this by letter H). This address part can be also divided into two parts – sub-network address and the hardware address. The subnet address allows routing inside the private network that can provide routers or other interconnection devices that splits the network.

1.1 How WANs (and Internet) are organized
The IP addressing

Both IPv4 and IPv6 addresses are assigned in a delegated manner. Users are assigned IP addresses by Internet service providers (ISPs). ISPs obtain allocations of IP addresses from a local Internet registry (LIR) or national Internet registry (NIR), or from their appropriate Regional Internet Registry (RIR):
AfriNIC (African Network Information Centre) - Africa Region
APNIC (Asia Pacific Network Information Centre) - Asia/Pacific Region
ARIN (American Registry for Internet Numbers) - North America Region
LACNIC (Regional Latin-American and Caribbean IP Address Registry) – Latin America and some Caribbean Islands
RIPE NCC (Réseaux IP Européens) - Europe, the Middle East, and Central Asia
The Internet Assigned Numbers Authority - IANA - has the role to allocate IP addresses from the pools of unallocated addresses to the RIRs according to their established needs. When an RIR requires more IP addresses for allocation or assignment within its region, the IANA makes an additional allocation to the RIR.
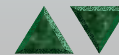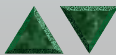
1.1 How WANs (and Internet) are organized
The IP addressing

The address range values for the five classes are**:**

Class	Address range		1st byte
A	0.0.0.0	121.255.255.255	1-127
B	128.0.0.0	191.255.255.255	128-191
C	192.0.0.0	223.255.255.255	192-223
D	224.0.0.0	239.255.255.255	224-239
E	240.0.0.0	241.255.255.255	240-254

The range values for the first classes (A, B, and C) classes are:

Class	The maximal number of networks	The maximal number of hosts per network	Address structure*	Comments
A	128	16777216	N.H.H.H	Major networks
B	16384	65536	N.N.H.H	Large sites
C	2097152	256	N.N.N.H	Small cites, or groups of midsize

1.1 How WANs (and Internet) are organized
The IP addressing

IP partitions the routing problem into three parts:
- routing exchanges between end systems and routers (ARP),
- routing exchanges between routers in the same routing domain (interior routing), and,
- routing among routing domains (exterior routing).

The machines having standard IP addresses can change information over Internet. Two machines that are members of two different networks must passes through an interconnection system of the network, a router (it is possible to pass through many routers to go from one machine to another one). Each router is connected at least to two machines.

The distinction between the hardware address and network address is realized by intermediate of a so called subnet mask. The comparison between the destination address of an IP packet and the subnet-mask shows if the receiver (the destination) is a member of the same network or not. If the receiver is not a member of the same network with the sender the packet is transmitted (passed) to router that decides, according with his routing table and other reasons (the traffic, for example), to which other router will be send. If the receiver is in the same network an address resolution frame of the logic address with the hardware (physical) address is send over the network. The receiver that recognize that address resolution frame (ARP) respond by giving his hardware address and from that moment the communication between the two machines can really take place.

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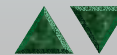
1.1 How WANs (and Internet) are organized

The DNS

The usage of dotted-decimal addresses can be very restrictive for common users.

In Internet the common users access the servers and other shared resources by using names, almost of the time meaningful names. These names are associated to the dotted-decimal address of the station and are allowed and managed by DNS (Domain Name System).

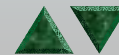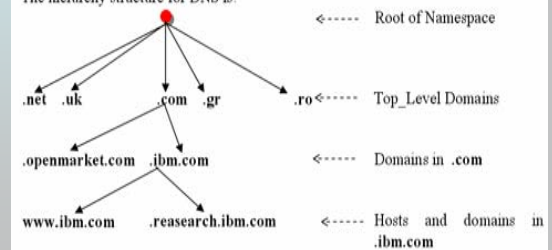DNS, was specified in 1983 and, allows the mapping of symbolic names to Internet addresses.
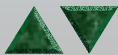
1.1 How WANs (and Internet) are organized

The DNS

DNS defines:
•A hierarchical namespace for hosts;
•A host table implemented as a distributed database;
•Library routines for access ;
•Routing for e-mail;
•A protocol to exchange naming information.

The hierarchy structure for DNS is:

‹----- Root of Namespace

.net .uk .com .gr .ro ‹----- Top_Level Domains

.openmarket.com .ibm.com ‹----- Domains in .com

www.ibm.com .reasearch.ibm.com ‹----- Hosts and domains in .ibm.com

1.1 How WANs (and Internet) are organized
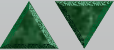
The DNS

The DNS:
• Is organized as tree of domains with ascending authority;
• Offers two types of top-level domains
- 3 letter in US (such as com, edu, gov, mil, net, org, intr, arpa etc). The "three" letters (can be more than three) can be used worldwide;
- 2 letter national (ISO – such as ro, fr, uk, gr, us etc);
•Contains second level domains assigned by InterNIC (Network Information Center) or RIPE in Europe;
•Allows creating as desired, by organizations having second level domains, lower level sub-domains (e.g. ie.ase.ro)
•Allows delegating authority to create further sub-domains (e.g. vb.ie.ase.ro).

Note that domains reflect organizational structure whereas IP addresses reflect network connectivity (for routing purposes). These are often the same but do not need to be.
The letters defining a domain are used as Internet Domain Name Suffixes.
The list of common Internet Domain Name Suffixes is shown in table 1.6.
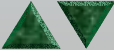
1.1 How WANs (and Internet) are organized

The DNS

Table 1.6 **Common Internet Domain Name Suffixes**

Ending	Kind of application
.arts	Cultural groups
.biz	Showbiz
.com	General business and individuals
.edu	Schools
.firm	Businesses
.gov	Government
.info	Information services
.mil	Military
.net	Internet service providers or general network
.nom	Individuals
.org	Organizations
.rec	Recreation sites
.store	Retailers
.web	Web-related organizations
.ro, .fr, .deu, .uk …	The country domain

1.1 How WANs (and Internet) are organized

The DNS

Figure 1.8 shows the evolution of the number of servers for Internet domains hosting and table 1.5 shows the number of hosts RIPE in the East European countries.

Figure 1.8 The evolution of Internet Domain Hosts
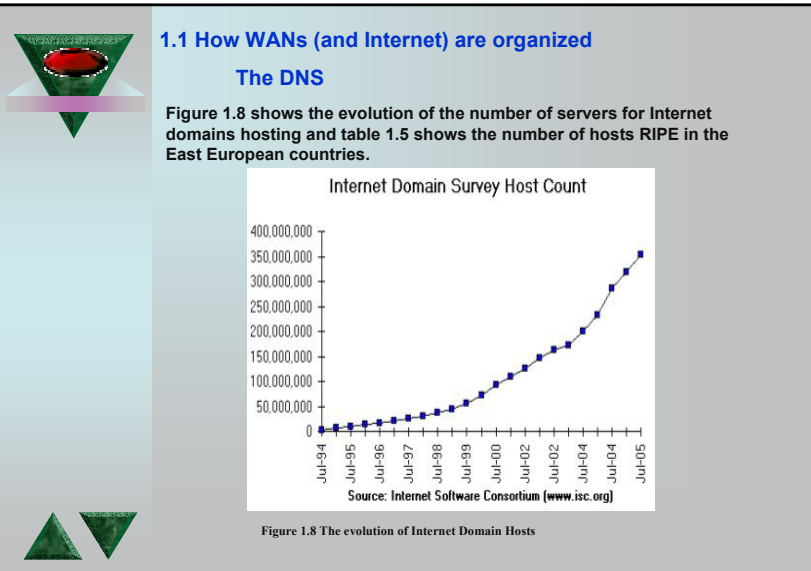
1.1 How WANs (and Internet) are organized

The DNS

Table 1.5 **The number of hosts RIPE in the East European countries**

| Country	Hosts RIPE	People/Host RIPE	Hosts ISC	People/Host ISC
Bosnia and Herzegovina	2343	1667	538	7259
Bulgaria	17393	531	10799	855
Croatia (Hrvatska)	17419	328	11657	490
Czech Republic	133033	95	93943	134
Russian Federation	252233	746	179941	1045
Greece	77362	154	64725	184
Serbia	12018	1028	8299	1488
Macedonia, FYRO	1626	1407	892	2564
Poland	229392	231	171657	308
Romania	37245	707	21667	1215
Slovakia	35395	203	21667	331
Slovenia	25574	89	20141	113
Turkey	99738	758	52479	1440
Ukraine	43877	1896	27807	2991
Hungary	130434	91	96499	123
Source: Romanian Space Agency - Agenţia Spaţială Română, www.rosa.ro				

1.1 How WANs (and Internet) are organized
    URL (Uniform Resource Locator)

Web pages and related files are located and accessed in Internet by means of special constructions called URL. Internet addresses are separate and distinct from the domain names used as **Uniform Resource Locators (URLs)** through which you specify Web pages.
URL is an acronym for Uniform Resource Locator. URL is expressed as a character string that supplies the Internet address of a site or of a www resource. The general syntax of URL is:

   communicationservice://hostname[:portnumber]/pathname/resourcename

In a Web page the links are represented by specially formatted text strings or by graphical elements that, when acted (by a mouse click, for example) displays more text or graphics. This files tagged by links can be represented by other Web pages or any kind of files such as graphic, image, sound, video, data fill-in forms, Java applets, movies and any kind of necessary file.
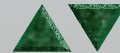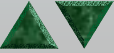

**1.1 How WANs (and Internet) are organized
URL (Uniform Resource Locator)**

A hypothetical URL can take the following general structure:

http:// www.sels.ase.ro /courses/generalinformatics/index.html

protocol   domain   directory path   file name

An URL address can consist of five parts: protocol, domain, directory path, file name and anchor. For these elements a brief description follows:
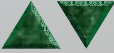- protocol: represented by rules that governs the data transfer in the network. Internet uses for Web pages (HTML pages) the http (HyperText Transport Protocol) – the word in the example URL *http:*
- domain: represented by the name of the host computer (hostname) and the Internet namespace - *www.sels.ase.ro*
- directory path: the absolute or relative location of the file - *courses/generalinformatics*
- file name: the web page, graphic, or sound file - *index.html*
- anchor: a marker which identifies a location inside a file (like a bookmark in normal documents) to which you can link. Once an anchor is placed in a location you can create a link to that spot.

**1.1 How WANs (and Internet) are organized
URL (Uniform Resource Locator)**

The most common URL type is:
file:// - a local URL located in your hard drive(s) for example file://c|/index.htm that points the file called index.htm stored in the root of the local drive C: (Windows, MS-DOS);
http:// - which gives the Internet address of a Web page (hypertext URLs);
gopher:// - gives the Internet address of a Gopher directory. Gopher is a system used to locate and transfer information that index the filenames in Internet. The syntax of a gopher URL is gopher://hostname:port/filename, where hostname is the name of the host computer (that usually is a LAN), port is the address of his port;
telnet:// - allows connect you in real time with another computer in Internet and then to use that computer as you use a local one. For example for networks running under UNIX operating system (and clones), the syntax for telnet:// is telnet:// or tn3270:// followed by the name of the computer we want to connect to.
ftp:// - which gives the Internet address of a FTP resource. FTP - File Transport Protocol – is the common command set used to upload/download files to/from Web sites.
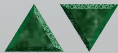
1.1 How WANs (and Internet) are organized
    URI – Uniform Resource Identifiers

Uniform Resource Identifiers (URI) provide a simple and extensible means for identifying a resource. A URI is a compact string of characters for identifying an abstract or physical resource.

[T. Berners-Lee – RFC 1630] The web is considered to include objects accessed using an extendable number of protocols, existing, invented for the web itself, or to be invented in the future. Access instructions for an individual object under a given protocol are encoded into forms of address string. Other protocols allow the use of object names of various forms. In order to abstract the idea of a generic object, the web needs the concepts of the universal set of objects, and of the universal set of names or addresses of objects.
A Universal Resource Identifier (URI) is a member of this universal set of names in registered name spaces and addresses referring to registered protocols or name spaces. A Uniform Resource Locator URL), defined elsewhere, is a form of URI which expresses an address which maps onto an access algorithm using network protocols.
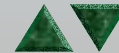

1.1 How WANs (and Internet) are organized
    URI – Uniform Resource Identifiers

URI are characterized by the following definitions for the words that give his name:
1. *Uniform* - uniformity provides several benefits: it allows different types of resource identifiers to be used in the same context, even when the mechanisms used to access those resources may differ; it allows uniform semantic interpretation of common syntactic conventions across different types of resource identifiers; it allows introduction of new types of resource identifiers without interfering with the way that existing identifiers are used; and, it allows the identifiers to be reused in many different contexts, thus permitting new applications or protocols to leverage a pre-existing, large, and widely-used set of resource identifiers.
2. *Resource* - a resource can be anything that has identity.
3. *Identifier* - an identifier is an object that can act as a reference to something that has identity.
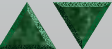
1.1 How WANs (and Internet) are organized
   URI – Uniform Resource Identifiers

A URI can be classified as a locator, a name, or both:
- the term "Uniform Resource Locator" (URL) refers to the subset of URI that identify resources via a representation of their primary access mechanism (e.g., their network "location"), rather than identifying the resource by name or by some other attribute(s) of that resource.
- the term "Uniform Resource Name" (URN) refers to the subset of URI that are required to remain globally unique and persistent even when the resource ceases to exist or becomes unavailable.
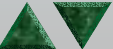
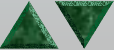**The following examples illustrate URI that are in common use:**
ftp://ftp.ie.ase.ro/courses/generalinformatics.pdf - ftp scheme for File Transfer Protocol services
gopher://spinaltap.micro.umn.edu/00/Weather/California/Los%20Angeles - gopher scheme for Gopher and Gopher+ Protocol services
http://www.math.uio.no/faq/compression-faq/part1.html - http scheme for Hypertext Transfer Protocol services
mailto:courseadmin@ie.ase.ro - mailto scheme for electronic mail addresses
news:comp.infosystems.www.servers.unix - news scheme for USENET news groups and articles
telnet://melvyl.ucla.edu/ - telnet scheme for interactive services via the TELNET Protocol

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The presentation will be continued with the subjects that follows in the next slides
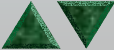
The last slides contains the reference list.

1.2 Service protocols

1.2 Service protocols
- **1.2.1 TCP/IP - HTTP**
- **1.2.2 SMTP/POP**
    - **SMTP**
    - **POP (Post Office Protocol)**
- **1.2.3 FTP**
    - **Using FTP line commands**
- **1.2.4 NNTP**
- **1.2.5 RTP and Multimedia**
- **1.2.6 Applications gateways**
- **1.2.7 Applets**
- **1.2.8 Wireless Web**

1.3 Web pages, sites and Web browsers – an introduction

1.3 Web pages, sites and Web browsers – an introduction
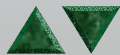- **1.3.1 Web pages and web site - definitions**
- **1.3.2 Web browsers**
- **1.3.3 Finding information on the Internet**
    - **Web addresses**
    - **Search engines**
    - **Web catalogs or directories**
    - **Web guides**
    - **Other techniques of finding information**

1.4 Web services – an introduction

1.4 Web services – an introduction

    SOAP
    WSDL
    UDDI

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