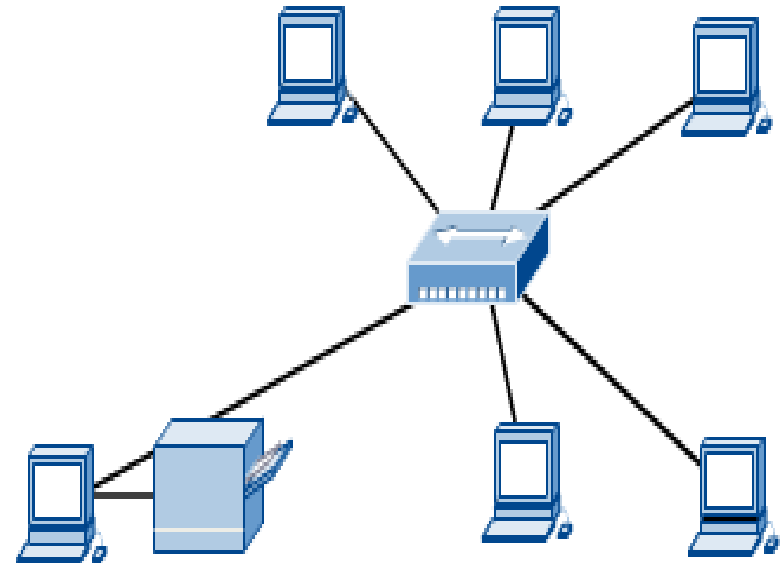


Computer Networks

Computer network connects two or more autonomous computers.

The computers can be geographically located anywhere.



LAN, MAN & WAN

- ❑ **Network in small geographical Area (Room, Building or a Campus) is called LAN (Local Area Network)**
- ❑ **Network in a City is call MAN (Metropolitan Area Network)**
- ❑ **Network spread geographically (Country or across Globe) is called WAN (Wide Area Network)**

Applications of Networks

▣ Resource Sharing

- ▣ Hardware (computing resources, disks, printers)
- ▣ Software (application software)

▣ Information Sharing

- ▣ Easy accessibility from anywhere (files, databases)
- ▣ Search Capability (WWW)

▣ Communication

- ▣ Email
- ▣ Message broadcast

▣ Remote computing

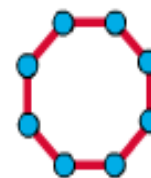
▣ Distributed processing (GRID Computing)

Network Topology

The network topology defines the way in which computers, printers, and other devices are connected. A network topology describes the layout of the wire and devices as well as the paths used by data transmissions.



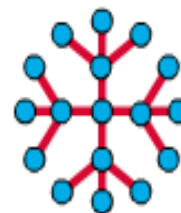
Bus Topology



Ring Topology



Star Topology



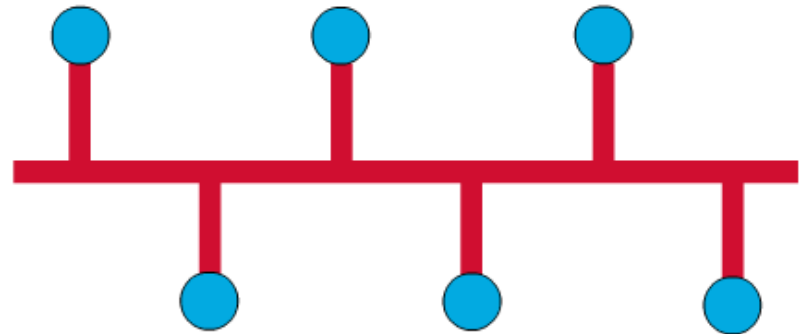
Extended Star Topology



Mesh Topology

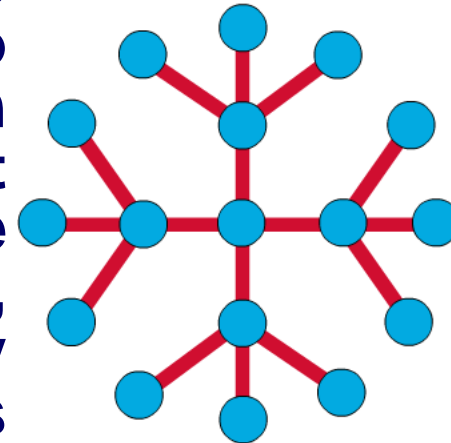
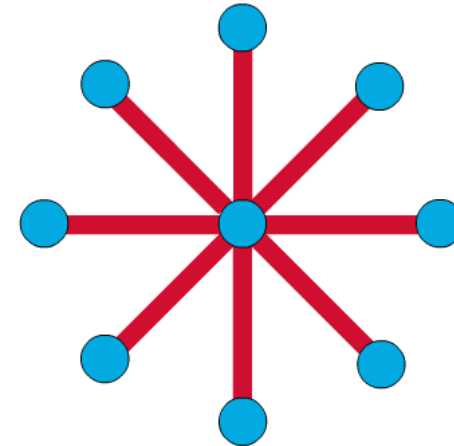
Bus Topology

- Commonly referred to as a linear bus, all the devices on a bus topology are connected by one single cable.



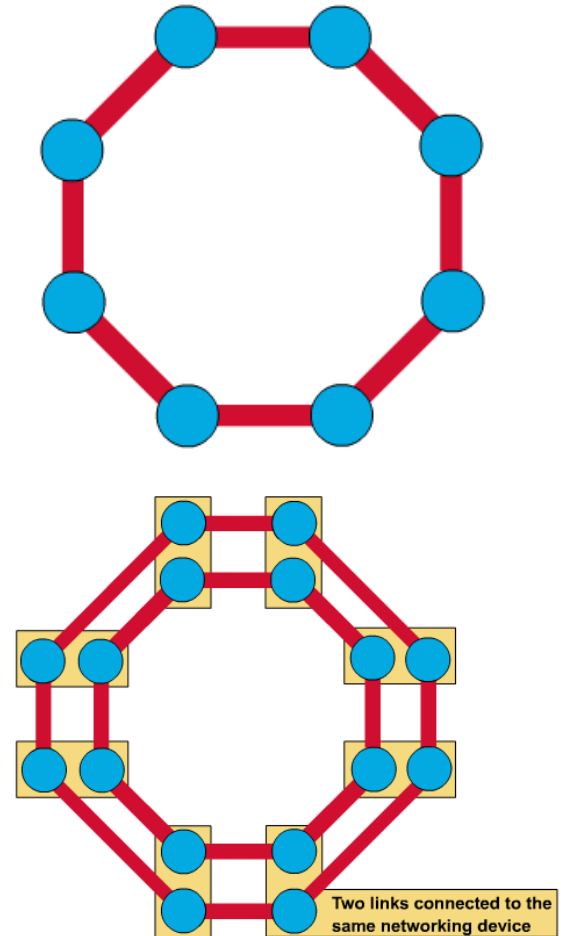
Star & Tree Topology

- ❑ The star topology is the most commonly used architecture in Ethernet LANs.
- ❑ When installed, the star topology resembles spokes in a bicycle wheel.
- ❑ Larger networks use the extended star topology also called tree topology. When used with network devices that filter frames or packets, like bridges, switches, and routers, this topology significantly reduces the traffic on the wires by sending packets only to the wires of the destination host.



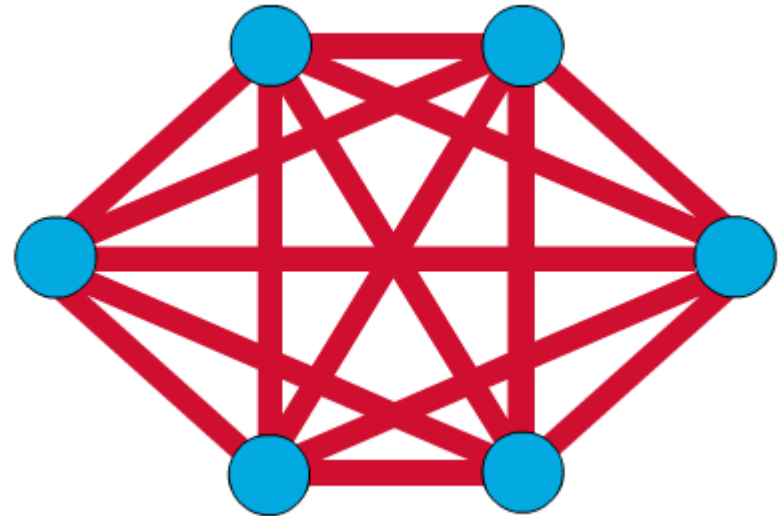
Ring Topology

- ❑ A frame travels around the ring, stopping at each node. If a node wants to transmit data, it adds the data as well as the destination address to the frame.
- ❑ The frame then continues around the ring until it finds the destination node, which takes the data out of the frame.
 - ❑ Single ring – All the devices on the network share a single cable
 - ❑ Dual ring – The dual ring topology allows data to be sent in both directions.



Mesh Topology

- ❑ The mesh topology connects all devices (nodes) to each other for redundancy and fault tolerance.
- ❑ It is used in WANs to interconnect LANs and for mission critical networks like those used by banks and financial institutions.
- ❑ Implementing the mesh topology is expensive and difficult.

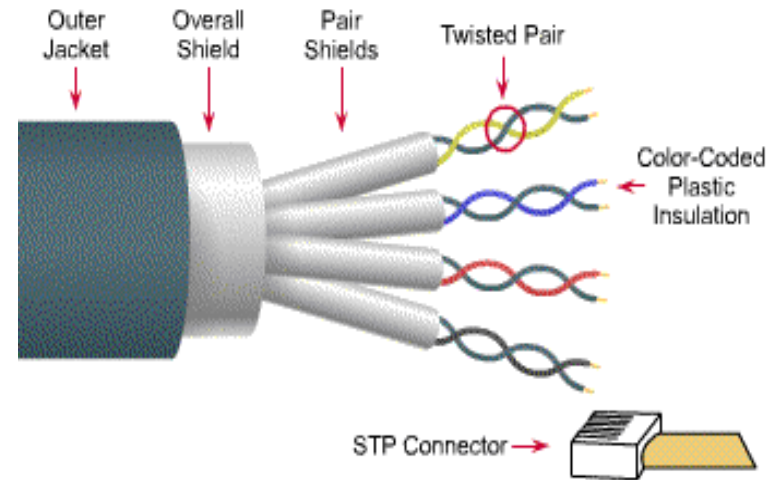


Network Components

- Physical Media
- Interconnecting Devices
- Computers
- Networking Software
- Applications

Networking Media

Networking media can be defined simply as the means by which signals (data) are sent from one computer to another (either by cable or wireless means).



- Speed and throughput: 10-100 Mbps
- Cost per node: Moderately expensive
- Media and connector size: Medium to Large
- Maximum cable length: 100m (short)

Networking Devices

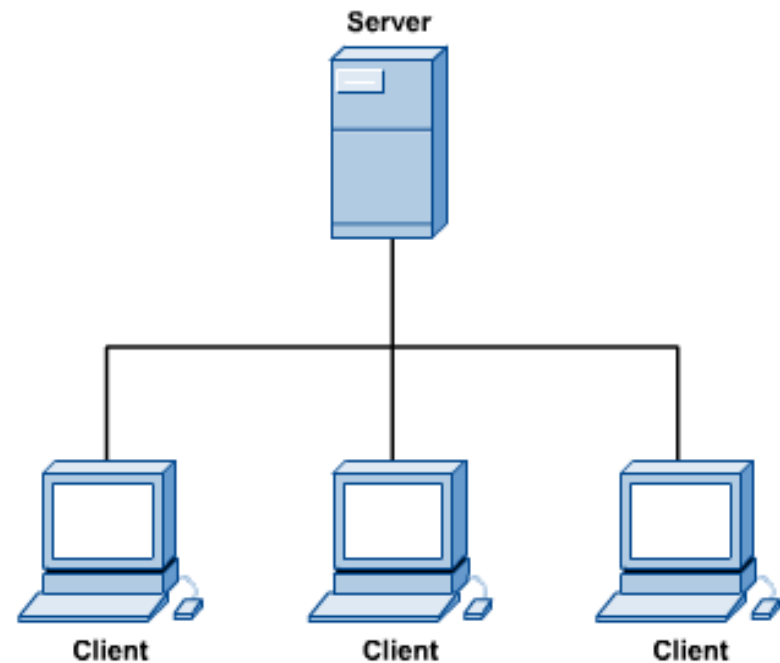
■ HUB, Switches, Routers, Wireless Access Points, Modems etc.



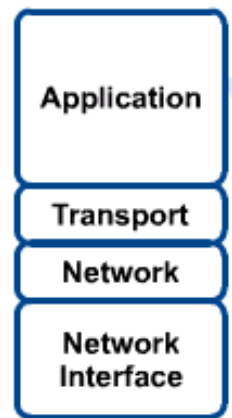
Computers: Clients and Servers

In a client/server network arrangement, network services are located in a dedicated computer whose only function is to respond to the requests of clients.

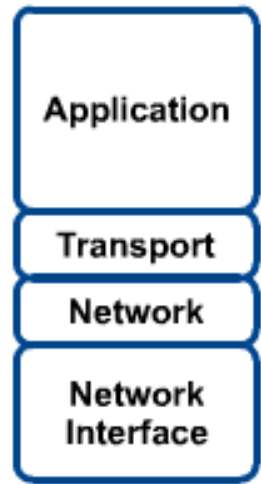
The server contains the file, print, application, security, and other services in a central computer that is continuously available to respond to client requests.



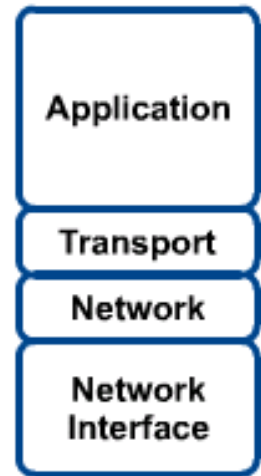
Networking Protocol: TCP/IP



- File transfer
TFTP*
FTP
NFS
- E-mail
SMTP
- Remote login
Telnet*
rlogin
- Network management
SNMP
- Name management
DNS



- TCP
- UDP



- IP
- ICMP
- ARP
- RARP
- RIP

Applications

- ❑ E-mail
- ❑ Searchable Data (Web Sites)
- ❑ E-Commerce
- ❑ News Groups
- ❑ Internet Telephony (VoIP)
- ❑ Video Conferencing
- ❑ Chat Groups
- ❑ Instant Messengers
- ❑ Internet Radio



What is Internet ?

- It is a **Global network of computers**,
(servers or clients).

to **exchange information**.

- It is a "**network of networks**" that includes **millions** of private and public, academic, business, and government networks (local or Global), **linked** by copper wires, wireless connections, and other technologies.

The Internet: Then and Now

- The Internet was created by the Advanced Research Projects Agency (ARPA) and the U.S. Department of Defense for scientific and military communications.
- The Internet is a network of interconnected networks. Even if part of its infrastructure was destroyed, data could flow through the remaining networks.
- The Internet uses high-speed data lines, called backbones, to carry data. Smaller networks connect to the backbone, enabling any user on any network to exchange data with any other user.
- ARPANET, NSFnet, Internet
- Internetworking: the process of connecting separate networks

Brief History of the Internet

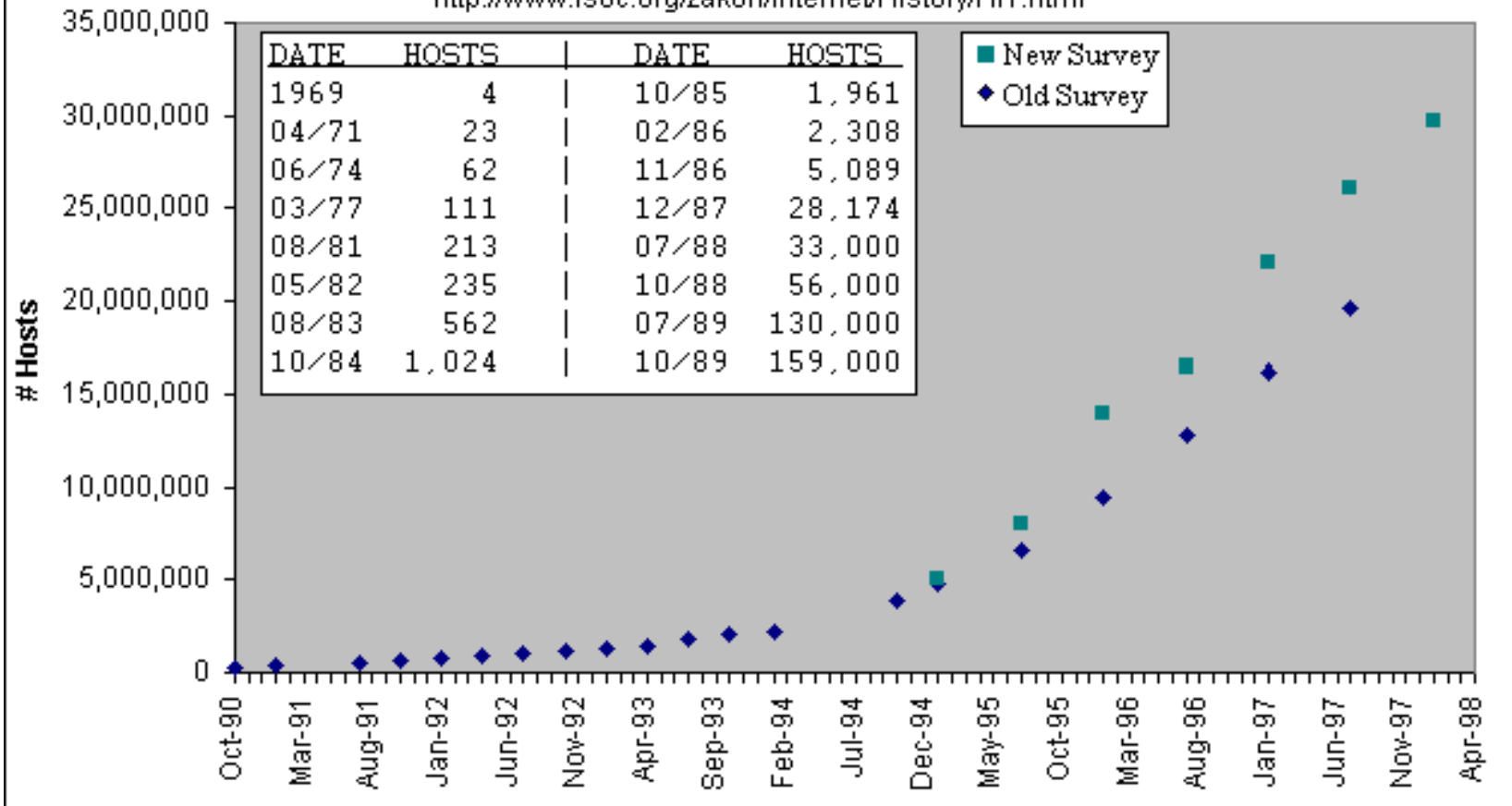
- 1968 - DARPA (Defense Advanced Research Projects Agency) contracts with BBN (Bolt, Beranek & Newman) to create ARPAnet
- 1970 - First five nodes:
 - UCLA
 - Stanford
 - UC Santa Barbara
 - U of Utah, and
 - BBN
- 1974 - TCP specification by Vint Cerf
- 1984 – On January 1, the Internet with its 1000 hosts converts en masse to using TCP/IP for its messaging

Internet Growth Trends

- 1977: 111 hosts on Internet
- 1981: 213 hosts
- 1983: 562 hosts
- 1984: 1,000 hosts
- 1986: 5,000 hosts
- 1987: 10,000 hosts
- 1989: 100,000 hosts
- 1992: 1,000,000 hosts
- 2001: 150 – 175 million hosts
- 2002: over 200 million hosts
- By 2010, about 80% of the planet will be on the Internet

No. of Participating Hosts Oct. '90 - Apr. '98

Hobbes' Internet Timeline Copyright ©1998 Robert H Zakon
<http://www.isoc.org/zakon/Internet/History/HIT.html>



Growth of Internet Hosts *

Sept. 1969 - Sept. 2002

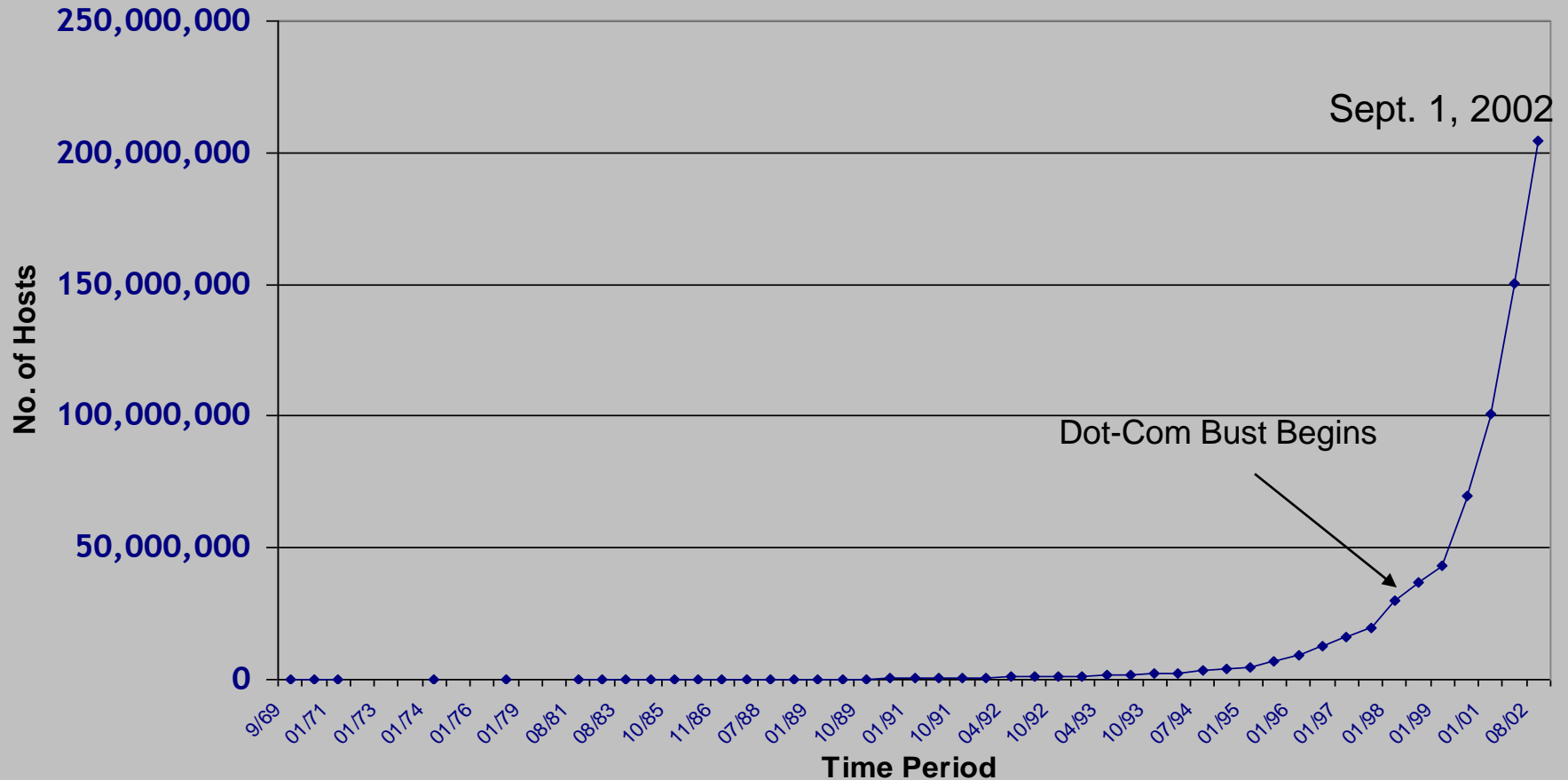
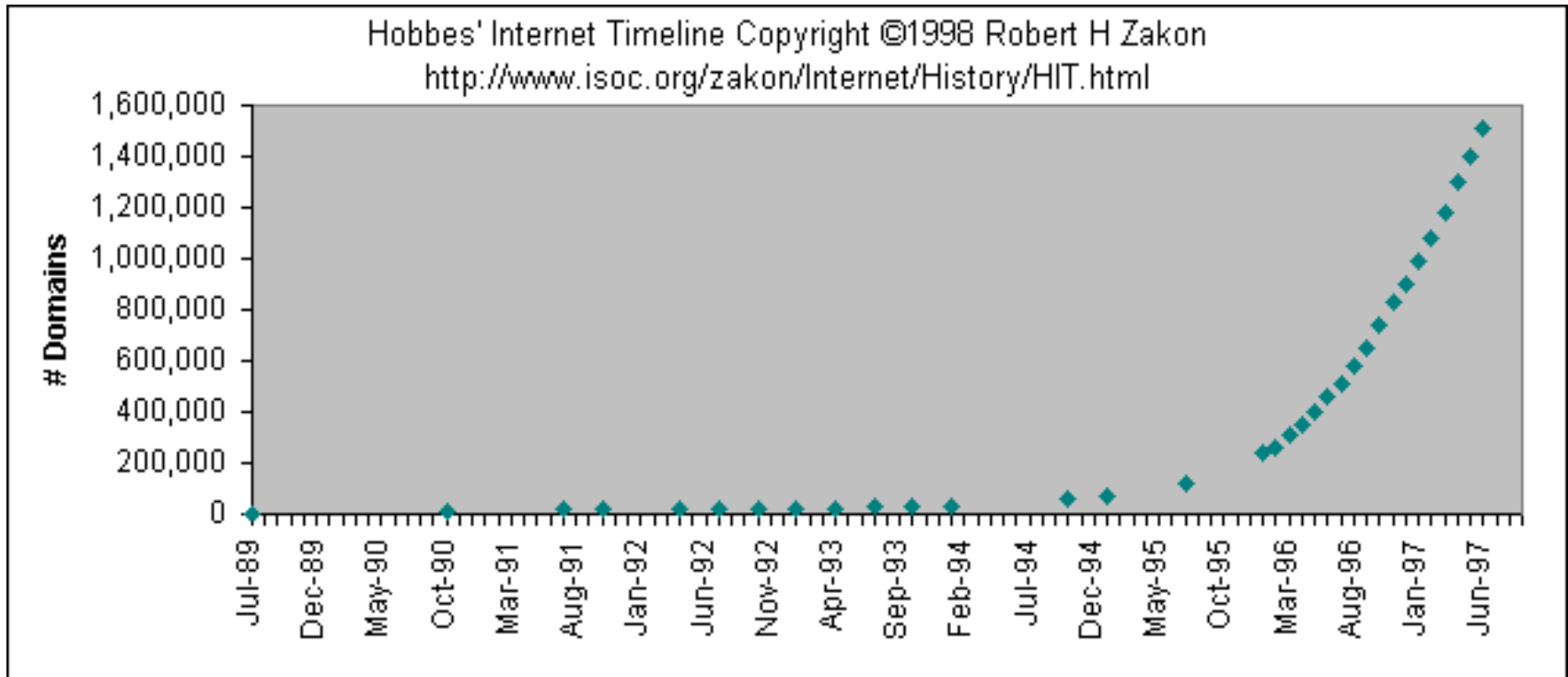


Chart by William F. Slater, III

The Internet was not known as "The Internet" until January 1984, at which time there were 1000 hosts that were all converted over to using TCP/IP.

Domain Name Registration

Jan. '89 - Jul. '97



April 2001: 31,000,000 Domain Names!!!

Hardware and Software of Internet

Variety of **hardware** and **software** are used *to* make **Internet functional**.

- **Modem**

Device that enables computers to communicate through phone lines.

When we start internet the **our modem communicates to modem of ISP**.

Continued...

- **Computer**

In addition to a modem, you need a client capable of handling **multiple data types**.

- **Software**

Two types of software's required to enable your PC as an Internet PC.

- **Communication software** *to* establish connection
- **Client software** *for* browsing, e-mail, news.

these software's are provided with windows itself.

Applications Of Internet

- Download programs and files
- E-Mail
- Voice and Video Conferencing
- E-Commerce
- File Sharing
- Information browsing
- Search the web addresses for access through search engine
- Chatting and many more...

Disadvantages of Internet

- **Theft of personal information** such as name, address, credit card number etc.
- **Virus threats** nothing but a program which disrupts the normal functioning of your system.
- **Spamming** refers to receiving unwanted e-mails in bulk, which provide no purpose and needlessly obstruct the entire system.
- **Pornography** This is perhaps the biggest threat related to children's healthy mental life. A very serious issue concerning the Internet.

Though, internet can also create havoc, destruction and its misuse can be very fatal, the *advantages* of it outweigh its *disadvantages*.

Intranet

What is Intranet ?

- Internal company or private network that uses Internet standards (HTML, HTTP & TCP/IP protocols) & software.
 - Provide employees with easy access to corporate information
 - Used to deploy corporate applications
 - Examples – policies and procedures manuals; human resource forms; product catalogs
 - Security is a concern
 - Security measures include – public key security, encryption, digital certificates, firewalls

Intranet Security

Two levels of Security required:

- Internal

It can be imposed by Public Key Security & Encryption Key.

- External

Through Firewall.

What is Firewall ?

- Security device located between firm's internal network (intranet) & external network (internet).
- Regulates access into & out of a company's network based on a set of rules.

Note : needs to be upgraded from time to time to check latest potential security problems.

Applications of Intranet

- Sharing of company policies/rules & regulations
- Access employee database
- Distribution of circulars/Office Orders
- Access product & customer data
- Sharing of information of common interest
- Launching of personal/departmental home pages
- Submission of reports
- Corporate telephone directories

Disadvantages

Management problem	<ul style="list-style-type: none">● A company may not have person to update their Intranet on a routine basis● Fear of sharing information and the loss of control● Limited bandwidth for the business
Security problem	<ul style="list-style-type: none">● Unauthorized access● Abuse of access● Denial of service
Productivity problem	<ul style="list-style-type: none">● Information overload lowers productivity● True purpose of the Intranet is unknown to many employees/departments● Hidden or unknown complexity and costs

Extranet

What is Extranet ?

- Extranet is an Intranet for outside authorized users using same internet technology.
- Inter-organizational information system.
- enable outsiders to work together with company's employees.
- open to selected suppliers, customers & other business partners
- An extension of an intranet to selected outside business partners, such as suppliers, distributors, and key customers
 - Provide business partners with easy access to corporate information and easy collaboration
- Security
 - Critical to prevent unwanted entry into internal systems
 - Virtual private networks (VPNs) are often used to add security to Internet communication

Extranets (*continued*)

- Extranet configurations
 - One company sets up a Extranet for its dealers, customers, or suppliers
 - Companies within an industry set up a collaborative Extranet for mutual benefit
 - Several companies collaborate over an Extranet for joint venture
- Benefits include –
 - Lower communication costs; better communication; improved order entry and customer service; improvement in business effectiveness

Examples..

- Dealers/distributors have access to product files such as :-
 1. product specification,
 2. pictures,
 3. images, etc.to answer the queries of the customer.

Components of extranets



Some basic infrastructure components such as the internet Including :-

- TCP/IP protocols,
- E-mail,
- Web-browsers,
- External business partners &
- Tele-commuting employees place order, check status & send E-mail.

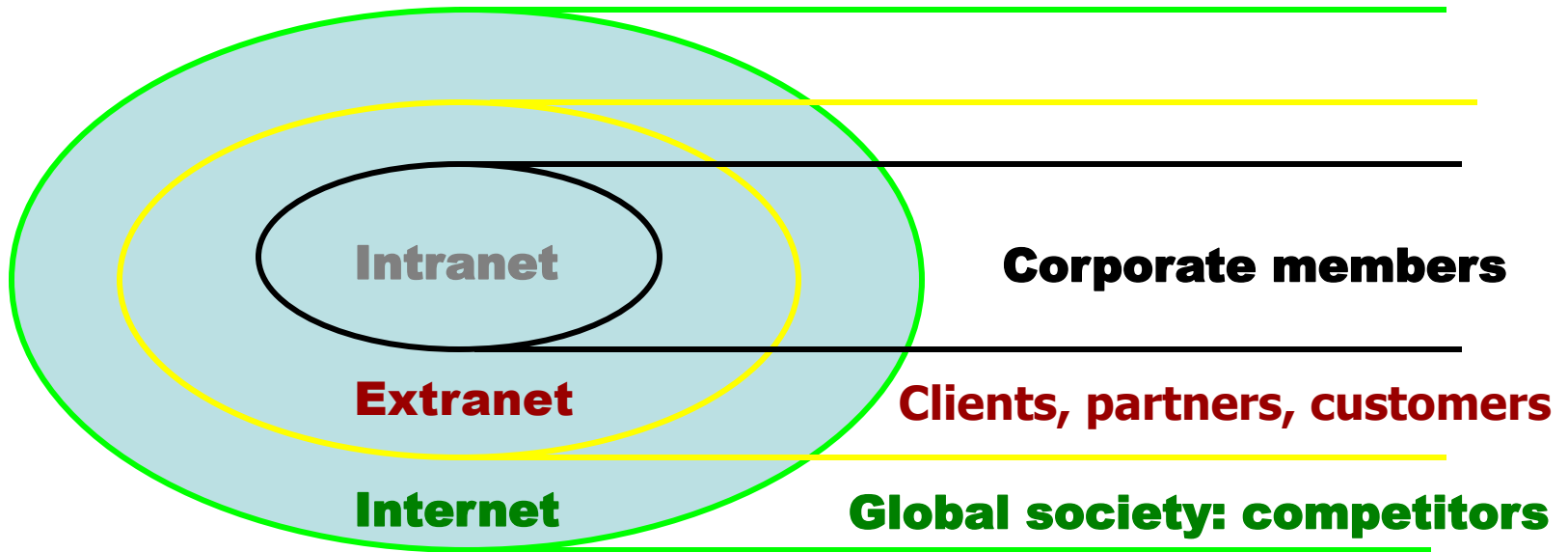
Benefits of Extranet

- Improved quality.
- lower travel costs.
- lower administrative & other overhead costs.
- reduction in paperwork.
- delivery of accurate information on time.
- improved customer service.
- better communication.
- overall improvement in business effectiveness.

Disadvantages

- The suppliers & customer who don't have technical knowledge feel problem.
- Faceless contact.
- Information can be misused by other competitors.
- Fraud may be possible.
- Technical Employees are required.

Layered System View



TCP/IP Addresses

- Every host on the Internet must have a unique IP address
- The IP address is a 32-bit number which we write in dotted decimal notation
- The first part of the IP address is the network address – the remainder is the host ID
- A subnet mask is used to determine the network address from a IP host address
- All hosts on the same network are configured with the same subnet mask

Network Address Example

Host address: 192.252.12.14

Subnet mask: 255.255.255.0

To obtain the network address, AND the host IP with its subnet mask:

Host IP: 11000000.11111100.00001100.00001110

Mask: 11111111.11111111.11111111.00000000

Net addr: ~~11000000.11111100.00001100.00000000~~ _____

which is: _____

192.152.12.0

Obtaining an Internet Network Address

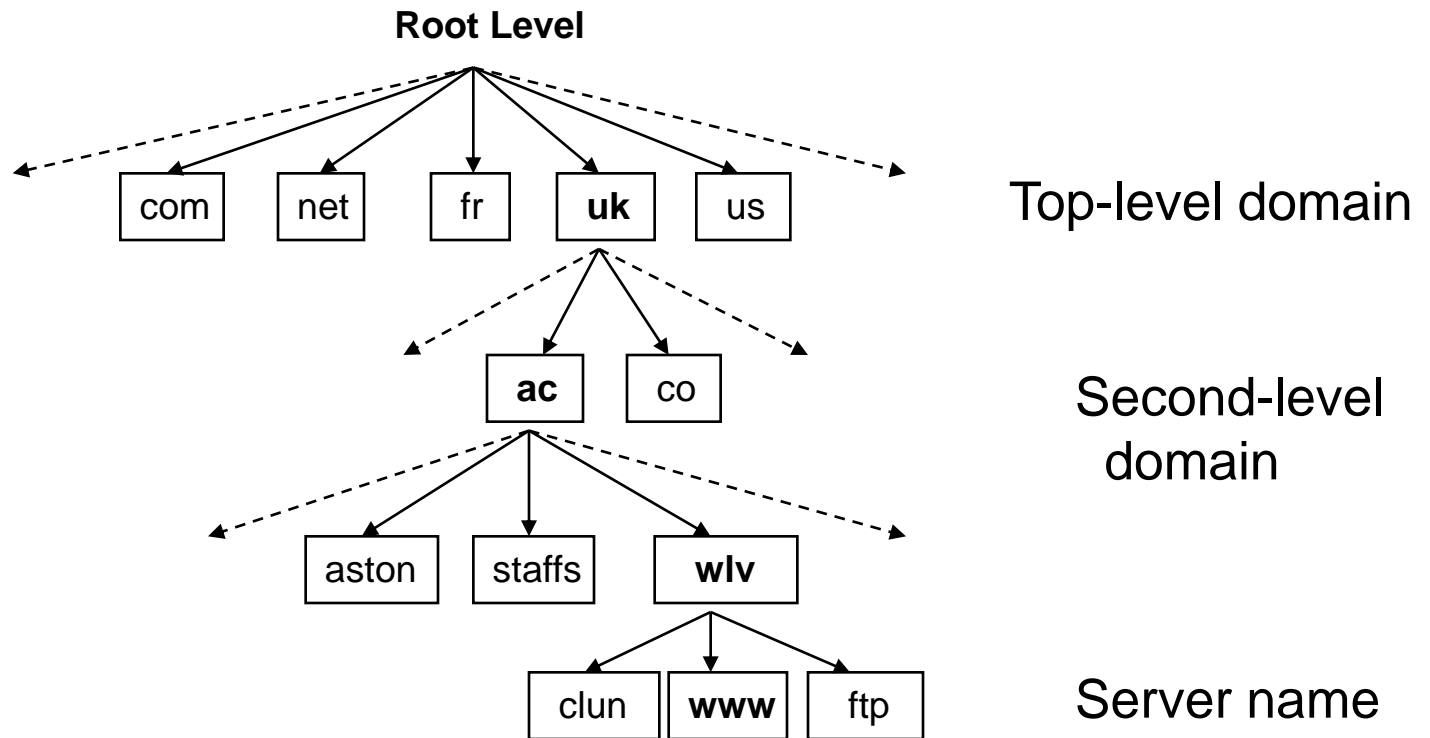
- IP network addresses must be unique, or the Internet will not be stable
- The Internet Network Information Centre (InterNIC) was originally responsible for issuing Internet network addresses
- Today, the Internet Assigned Number Authority (IANA) issues network addresses to Information Service Providers (ISPs)
- ISPs split networks up into subnets and sell them on to their customers

Domain Name System (DNS)

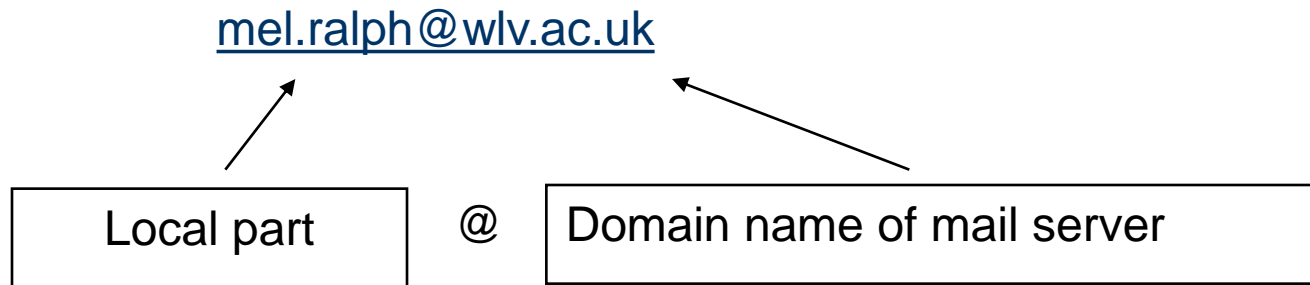
- IP addresses are used to identify hosts on a TCP/IP network
- Example: 134.220.1.9
- Numbers are not 'friendly' – people prefer names
- DNS is a protocol used to map IP addresses to textual names
- E.g. `www.wlv.ac.uk` maps to 134.220.1.9

DNS on the Internet

DNS names have a hierarchical structure
Example: `www.wlv.ac.uk`

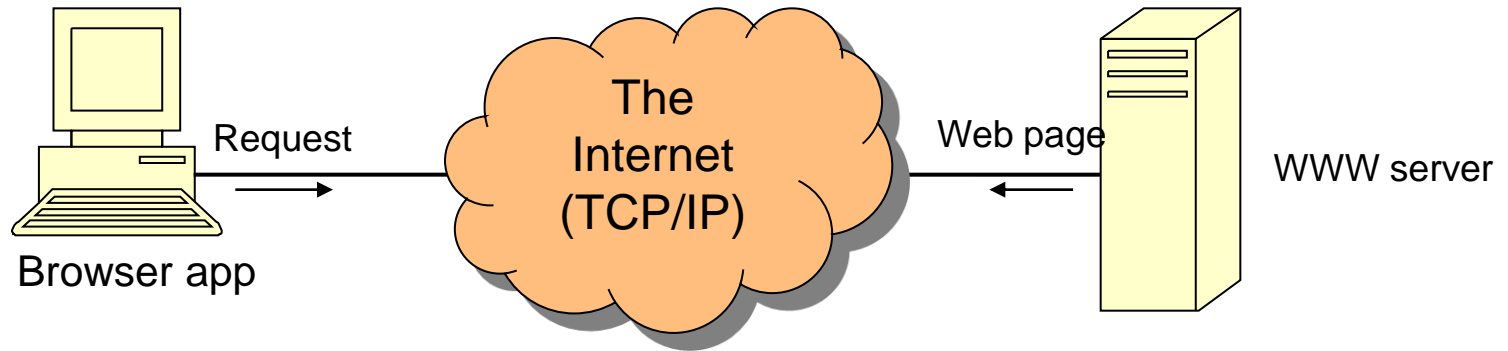


Internet Email Addresses



- The Local part is the name of a special file stored on the mail server called the user's mailbox
- The Domain name is resolved using DNS
- The mail server is also known as a mail exchanger

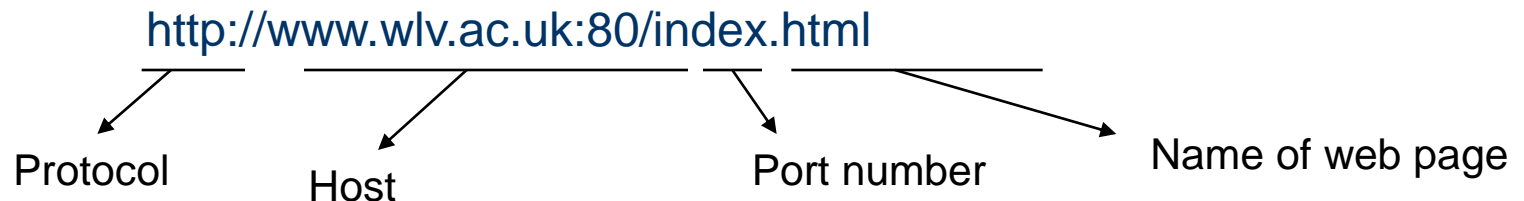
Hypertext Transfer Protocol (HTTP)



- HTTP is the protocol used to access resources on the World Wide Web
- A browser application is used to send a request to the WWW server for a resource, e.g. a web page, graphics file, audio file, etc.
- The server responds by sending the resource (a file) to the client and closing the connection

Uniform Resource Locator (URL)

- URL is the standard for specifying the whereabouts of a resource (such as a web page) on the Internet
- A URL has four parts:



- The protocol used to retrieve the resource
- The host where the resource is held
- The port number of the server process on the host
- The name of the resource file

URL Defaults

- A server will normally be setup to use standard defaults
- This enables the URL to be simplified
- In the case of a Web server for example
 - Default port will be 80
 - Default name for home page will be index.html
- Hence the previous URL can be shortened to

<http://www.wlv.ac.uk/>

File Transfer Protocol (FTP)

<ftp://ftp.demon.co.uk/pub/>

- Protocol for copying files between client and an FTP server
- Uses a TCP connection for reliable transfer of files with error-checking
- Most browsers support FTP, or you can use a dedicated FTP client program, e.g WS_FTP
- Trivial File Transfer Protocol (TFTP) is a lightweight version for small memory devices

Telnet

- Telnet allows a user to run commands and programs remotely on another computer across the Internet
- The user runs a Telnet client program on the local host
- A Telnet server process must be running on the remote host
- The user must have the necessary permissions and password to access the remote host

Internet Services – Web Services

- Delivery of software components via a web site rather than through traditional means (disks, CDs)
- .NET – Microsoft's new platform for XML Web services. Integrates web sites and programs to deliver applications.

Internet Services – World Wide Web

- An application that uses the Internet transport functions
- A system with universally accepted standards for storing, retrieving, formatting, and displaying information via a client/server architecture
- Based on HTML - standard hypertext language used in Web
- Handles text, hypermedia, graphics, and sound

The World Wide Web (*continued*)

- Home Page - a text and graphical screen display; first, introductory page in a web site
- Web Site - all the pages of a company or individual
- Hyperlinks - ways to link and navigate around the pages on a web site
- Webmaster - the person in charge of a Web site
- Uniform Resource Locator (URL) - points to the address of a specific resource on the Web
- Hypertext Transport Protocol (HTTP) - communications standard used to transfer pages across the WWW portion of the Internet

The World Wide Web (*continued*)

- **Browsers** – graphical software that enables WWW users to request and view web documents
- **Offline Browsers** – software that retrieves pages from Web sites automatically at predetermined times
- **Search Engines** - programs that return a list of Web sites or pages that match some user-selected criteria
- **Metasearch Engines** - automatically enter search queries into a number of other search engines and return the results
- **To be included in a search engine's database**
 - Web Crawlers
 - Registration

How the Internet Works

- **TCP/IP**
- **Routing Traffic Across the Internet**
- **Addressing Schemes**
- **Domains and Subdomains**

How the Internet Works - TCP/IP

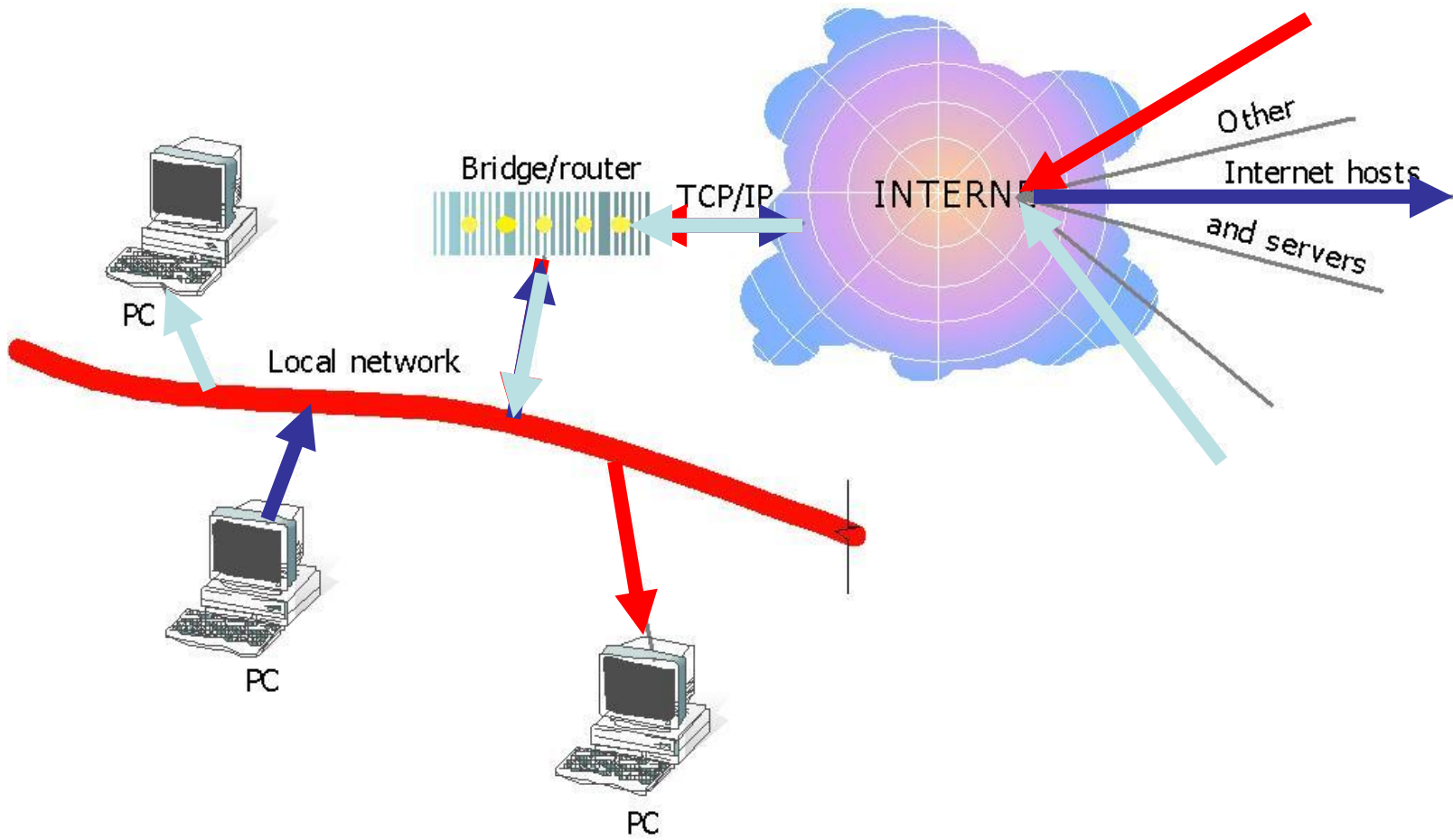
- Every computer and network on the Internet uses the same protocols (rules and procedures) to control timing and data format.
- The protocol used by the Internet is the Transmission Control Protocol/Internet Protocol, or TCP/IP.
- No matter what type of computer system you connect to the Internet, if it uses TCP/IP, it can exchange data with any other type of computer.

How the Internet Works - Routing Traffic Across the Internet

- Most computers don't connect directly to the Internet. Instead, they connect to a smaller network that is connected to the Internet backbone.
- The Internet includes thousands of host computers (servers), which provide data and services as requested by client systems.
- When you use the Internet, your PC (a client) requests data from a host system. The request and data are broken into **packets** and travel across **multiple networks** before being reassembled at their destination.

The Operation of the Internet

- Packets of information flow between machines governed by common rules (protocols):
 - Internet protocol (IP)
 - Transport control protocol (TCP)
- Internet is a packet-switching network
 - Messages are decomposed into packets, containing part of the message, plus information on the sending and receiving machines and how the packet relates to the other packets
 - Packets travel independently and possibly on different routes through the Internet
 - Packets are reassembled into the message at the receiving machine.

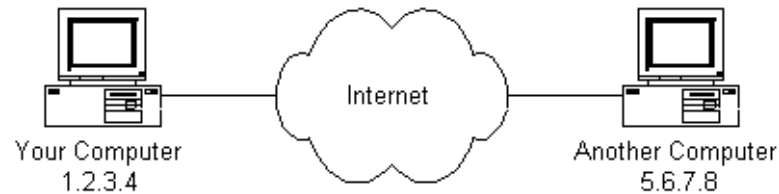


How the Internet Works - Addressing Schemes

- In order to communicate across the Internet, a computer must have a unique address.
- Every computer on the Internet has a unique numeric identifier, called an Internet Protocol (IP) address.
- Each IP address has four parts – each part a number between 0 and 255. An IP address might look like this: 205.46.117.104.

Where to Begin? Internet Addresses

- Because the Internet is a global network of computers each computer connected to the Internet **must** have a unique address. Internet addresses are in the form **nnn.nnn.nnn.nnn** where nnn must be a number from 0 - 255. This address is known as an IP address. (IP stands for Internet Protocol; more on this later.)
- The picture below illustrates two computers connected to the Internet; your computer with IP address 1.2.3.4 and another computer with IP address 5.6.7.8. The Internet is represented as an abstract object in-between.



- If you connect to the Internet through an Internet Service Provider (**ISP**), you are usually assigned a temporary IP address for the duration of your dial-in session. If you connect to the Internet from a local area network (**LAN**) your computer might have a permanent IP address or it might obtain a temporary one from a DHCP (Dynamic Host Configuration Protocol) server. In any case, if you are connected to the Internet, **your computer has a unique IP address.**

How the Internet Works - Domains and Subdomains

- In addition to an IP address, most Internet hosts or servers have a Domain Name System (DNS) address, which uses words.
- A domain name identifies the type of institution that owns the computer. An Internet server owned by IBM might have the domain name `ibm.com`.
- Some enterprises have multiple servers, and identify them with subdomains, such as `products.ibm.com`.

Internet Domains

Domain	Type of Organization	Example
.com	Business (commercial)	ibm.com (International Business Machines Corp.)
.edu	Educational	center.edu (Centre College, Danville, KY)
.gov	Government	Whitehouse.gov (The White House)
.mil	Military	Navy.mil (The United States Navy)
.net	Gateway or host (or business/commercial)	Mindspring.net (A regional Internet service provider)
.org	Other organization (typically nonprofit)	isoc.org (The Internet Society)