

Chapter 7 Application Layer

Prepared By:
Prof. Vishal A. Polara
Asst. Prof.
IT Department
BVM Engg. College

7.1 DNS (Domain name space)

- To map a name onto an IP address, an application program calls a library procedure called the resolver, passing it the name as a parameter.
- resolver, gethostbyname, in The resolver sends a UDP packet to a local DNS server, which then looks up the name and returns the IP address to the resolver, which then returns it to the caller. Armed with the IP address, the program can then establish a TCP connection with the destination or send it UDP packets.

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Outline

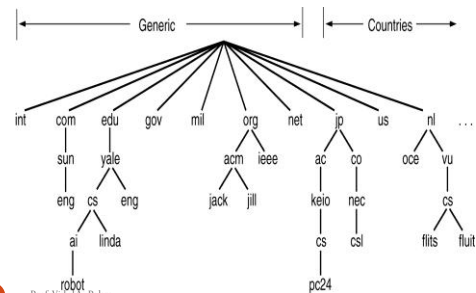
- DNS: The DNS name space, Resource records, Name servers
- Electronic mail: Architecture and services, User agent, Message formats, Message transfer, Final delivery
- World Wide Web: Architectural overview, HTTP

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The DNS Name Space

A portion of the Internet domain name space.



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7.1 DNS (Domain name space)

- DNS is the invention of a hierarchical, domain-based naming scheme and a distributed database system for implementing this naming scheme.
- It is used because it is difficult to remember IP address.
- If DNS is not there host name conflicts would occur constantly unless names were centrally managed.
- It is primarily used for mapping host names and e-mail destinations to IP addresses but can also be used for other purposes

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7.1 DNS (Domain name space)

- the Internet is divided into over 200 top-level domains.
- The top-level domains come in two flavors: generic and countries.
- Domain name component are separated by . Dot.
- Domain names can be either absolute or relative. An absolute domain name always ends with a period (eng.sun.com.). Relative names have to be interpreted in some context to uniquely determine their true meaning.
- Domain names are case insensitive, so edu, Edu, and EDU mean the same thing. Component names can be up to 63 characters long, and full path names must not exceed 255 characters.
- For example, Japan has domains ac.jp and co.jp that mirror edu and com

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7.1 DNS (Domain name space)

- For example, Japan has domains ac.jp and co.jp that mirror edu and com.
- The Netherlands does not make this distinction and puts all organizations directly under nl.
- Naming follows organizational boundaries, not physical networks. For example, if the computer science and electrical engineering departments are located in the same building and share the same LAN, they can nevertheless have distinct domains.

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7.2 Resource Records

- An SOA record provides the name of the primary source of information . the e-mail address of its administrator, a unique serial number, and various flags and timeouts.
- the A (Address) record. It holds a 32-bit IP address for some host.
- the MX record specifies the name of the host prepared to accept e-mail for the specified domain. It is used because not every machine is prepared to accept e-mail. If someone wants to send e-mail to. MX will provide this information.
- The NS records specify name servers. For example, every DNS database normally has an NS record for each of the top-level domains.
- CNAME records allow aliases to be created. Ex. **cs.mit.edu** 86400 IN CNAME **lcs.mit.edu**.

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7.2 Resource Records

Format:

Domain_name Time_to_live Class Type Value

The principal DNS resource records types

Type	Meaning	Value
SOA	Start of Authority	Parameters for this zone
A	IP address of a host	32-Bit integer
MX	Mail exchange	Priority, domain willing to accept e-mail
NS	Name Server	Name of a server for this domain
CNAME	Canonical name	Domain name
PTR	Pointer	Alias for an IP address
HINFO	Host description	CPU and OS in ASCII
TXT	Text	Uninterpreted ASCII text

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7.2 Resource Records

- CNAME, PTR points to another name. PTR is a regular DNS datatype whose interpretation depends on the context in which it is found. In practice, it is nearly always used to associate a name with an IP address to allow lookups of the IP address and return the name of the corresponding machine. These are called **reverse lookups**.
- HINFO records allow people to find out what kind of machine and operating system a domain corresponds to.
- TXT records allow domains to identify themselves in arbitrary ways.
- the Value field. This field can be a number, a domain name, or an ASCII string.

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7.2 Resource Records

- A resource record is a five- tuple. they are encoded in binary for efficiency, In most of the case, resource records are presented as ASCII text, one line per resource record.
- The **Domain_name** tells the domain to which this record applies.
- The **Time_to_live** field gives an indication of how stable the record is. Information that is highly stable is assigned a large value, such as 86400 (the number of seconds in 1 day). Information that is highly volatile is assigned a small value, such as 60 (1 minute).
- The third field of every resource record is the Class. For Internet information, it is always IN.
- The Type field tells what kind of record this is.

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Resource Records (2)

```
. Authoritative data for cs.vu.nl
cs.vu.nl. 86400 IN SOA star boss (952771.7200.7200.2419200.86400)
cs.vu.nl. 86400 IN TXT "Diverse Wikisource en Informatica."
cs.vu.nl. 86400 IN TXT "Vrije Universiteit Amsterdam."
cs.vu.nl. 86400 IN MX 1 zephyr.cs.vu.nl
cs.vu.nl. 86400 IN MX 2 top.cs.vu.nl

ftp.cs.vu.nl. 86400 IN HINFO Sun Unix
ftp.cs.vu.nl. 86400 IN A 130.37.16.112
ftp.cs.vu.nl. 86400 IN A 192.31.231.165
ftp.cs.vu.nl. 86400 IN MX 1 ftp.cs.vu.nl
ftp.cs.vu.nl. 86400 IN MX 2 zephyr.cs.vu.nl
ftp.cs.vu.nl. 86400 IN MX 3 top.cs.vu.nl
www.cs.vu.nl. 86400 IN CNAME star.cs.vu.nl
ftp.cs.vu.nl. 86400 IN CNAME zephyr.cs.vu.nl

rowboat IN A 130.37.56.201
rowboat IN MX 1 rowboat
rowboat IN MX 2 zephyr
rowboat IN HINFO Sun Unix

little-sister IN A 130.37.62.23
little-sister IN HINFO Mac MacOS

laserjet IN A 192.31.231.216
laserjet IN HINFO "HP Laserjet JIS" Proprietary
```

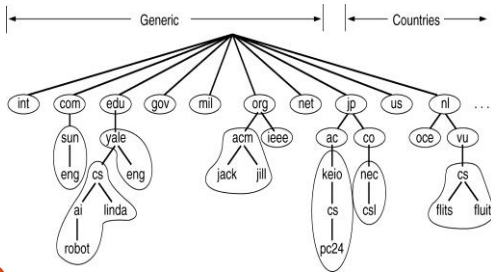
A portion of a possible DNS database for *cs.vu.nl*.

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7.3 Name Servers

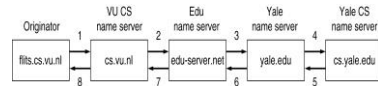
Part of the DNS name space showing the division into zones.



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Name Servers (2)



How a resolver looks up a remote name in eight steps.

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7.3 Name servers

- a single name server could contain the entire DNS database and respond to all queries about it. There is a problem of crash.
- To avoid the problems associated with having only a single source of information, the DNS name space is divided into no overlapping zones.
- Each zone contains some part of the tree and also contains name servers holding the information about that zone.
- Normally, a zone will have one primary name server, which gets its information from a file on its disk, and one or more secondary name servers, which get their information from the primary name server.
- Where the zone boundaries are placed within a zone is up to that zone's administrator.

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7.4 ELECTRONIC MAIL

One of the most popular Internet services is electronic mail (e-mail). The designers of the Internet probably never imagined the popularity of this application program. Its architecture consists of several components.

Two subsystems of Email:

1. User agents (UA) – local programs for command-based, menu based or graphical method interaction
2. Message transfer agents (MTA) – processes that run in background to move email through the system

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7.3 Name servers

- Yale has a server for yale.edu that handles eng.yale.edu but not cs.yale.edu, which is a separate zone with its own name servers.
- When a resolver has a query about a domain name, it passes the query to one of the local name servers. If the domain being sought falls under the jurisdiction of the name server, such as ai.cs.yale.edu falling under cs.yale.edu, it returns the authoritative resource records.
- **An authoritative record** is one that comes from the authority that manages the record and is thus always correct. Authoritative records are in contrast to cached records, which may be out of date.
- If, however, the domain is remote and no information about the requested domain is available locally, the name server sends a query message to the top-level name server for the domain requested.

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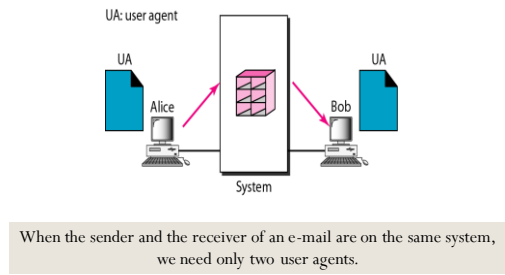
First scenario

- In the first scenario, the sender and the receiver of the email are users on the same system. The administrator has created one mailbox for each user where the received messages are stored.
- A mailbox is part of a local hard drive, a special file with permission restrictions.

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Figure First scenario in electronic mail



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Third scenario

- Bob as in the second scenario is directly connected to his system. Alice is separated from his system. Alice is connected to the system via a point to point WAN such as a dial-up modem. Or a cable modem.
- They are connected to one mail server for handling e-mails.
- When the sender is connected to the mail server via a LAN or a WAN, we need two UAs and two pairs of MTAs (client and server).
- When Alice want to send message. His message goes from MTA client to MTA server.

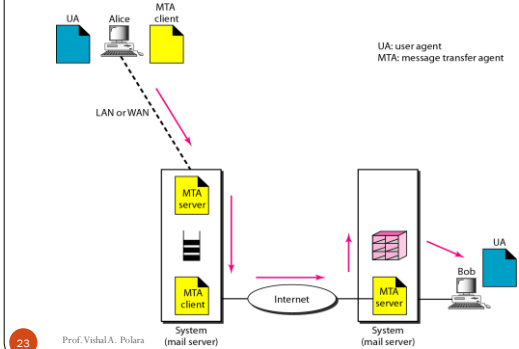
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Second scenario

- In the second scenario the sender and the receiver of the email are users on two different systems. The message needs to be sent over the internet. Here we need user agents and message transfer agents(MTA).
- we need two UAs and a pair of MTAs (client and server).
- Alice need to use a user agent program to send his message to the system at his own site. The system at her site uses a queue to store messages waiting to be sent.
- Now message sent through internet from alice to bob an bob will retrieve using user agent program. Serve need to run continuously while the client on the other hand can be altered by the system when there is a message in the queue to be sent.

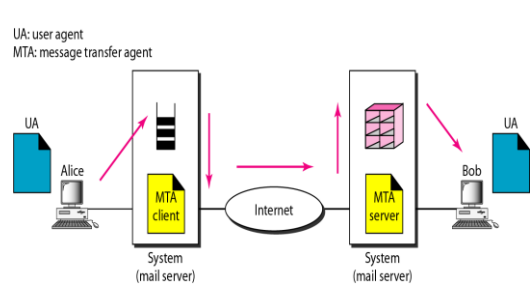
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Figure Third scenario in electronic mail



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Figure Second scenario in electronic mail



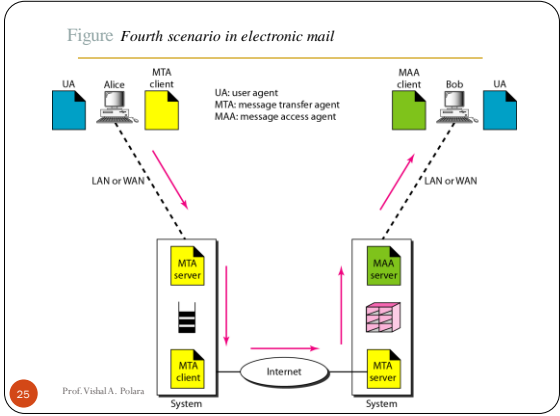
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Fourth scenario

- In this scenario both are not connected directly. They are connected through LAN or WAN.
- Bob need to retrieve message. We need another set of client/server agents, which we call message access agents(MAA). Bob uses an MAA client to retrieve his messages.
- The client sends a request to MAA server, which is running all the time and requests the transfer of the messages.
- First point here is Bob cannot by pass the mail serve and use the MTA server directly. To use MTA server directly, bob would need to run the MTA server all the time because he does not know when a message will arrive. This is not feasible today.
- Second point bob needs another pair of client/server programs. Because MTA client/server program is a push program. Bob needs a pull program. Client push the message to the server.

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Figure Fourth scenario in electronic mail



7.4.2 User Agent

- A user agent is normally a program (sometimes called a mail reader) that accepts a variety of commands for composing, receiving, and replying to messages.
- To send an e-mail message, a user must provide the message, the destination address, and possibly some other parameters.
- It will also provide facility to receiver to view the message.
- We can send mail to many recipient it is also facility of user agent
- .

Figure Push versus pull in electronic email

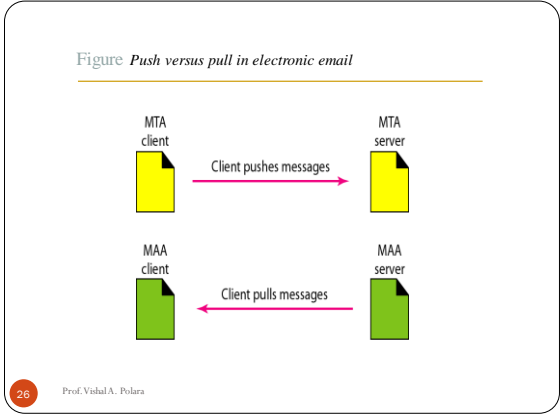
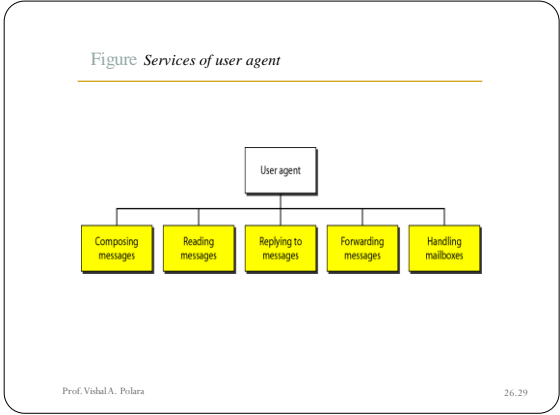


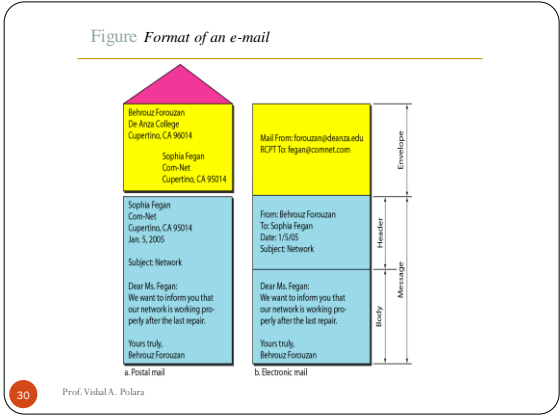
Figure Services of user agent



7.4.1 Architecture and Services

- It normally consists of two subsystems: user agent and message transfer agents.
- User agent is command based, menu based graphical user interface. Message transfer agent will transfer message from source to destination.
- It basically support five functions:
 1. Composition: Creating a message.
 2. Transfer: here it will send the message from source to destination.
 3. Reporting: It will report about message whether it was delivered or not.
 4. Displaying: It will display incoming message.
 5. Disposition: it is the task that recipient do after receiving message, it will delete before reading it, or delete after reading it.

Figure Format of an e-mail



Reading E-mail

An example display of the contents of a mailbox.

#	Flags	Bytes	Sender	Subject
1	K	1030	asw	Changes to MINIX
2	KA	8348	trudy	Not all Trudys are nasty
3	K F	4519	Amy N. Wong	Request for information
4		1236	bal	Bioinformatics
5		104110	kaashoek	Material on peer-to-peer
6		1223	Frank	Re: Will you review a grant proposal
7		3110	guido	Our paper has been accepted
8		1204	dmr	Re: My student's visit

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Message Formats – RFC 822 (2)

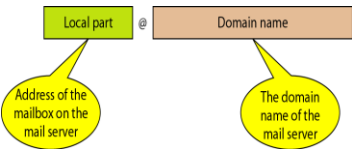
Some fields used in the RFC 822 message header.

Header	Meaning
Date:	The date and time the message was sent
Reply-To:	E-mail address to which replies should be sent
Message-Id:	Unique number for referencing this message later
In-Reply-To:	Message-Id of the message to which this is a reply
References:	Other relevant Message-Ids
Keywords:	User-chosen keywords
Subject:	Short summary of the message for the one-line display

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Figure E-mail address



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MIME – Multipurpose Internet Mail Extensions

The basic idea of MIME is to continue to use the RFC 822 format, but to add structure to the message body and define encoding rules for non-ASCII messages.

Problems with international languages:

- Languages with accents (French, German).
- Languages in non-Latin alphabets (Hebrew, Russian).
- Languages without alphabets (Chinese, Japanese).
- Messages not containing text at all (audio or images).

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7.4.3 Message Formats – RFC 822

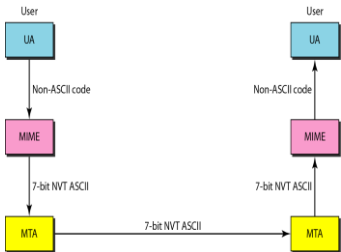
RFC 822 header fields related to message transport.

Header	Meaning
To:	E-mail address(es) of primary recipient(s)
Cc:	E-mail address(es) of secondary recipient(s)
Bcc:	E-mail address(es) for blind carbon copies
From:	Person or people who created the message
Sender:	E-mail address of the actual sender
Received:	Line added by each transfer agent along the route
Return-Path:	Can be used to identify a path back to the sender

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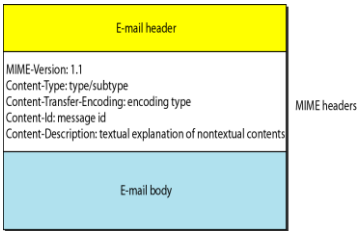
Figure MIME



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Figure *MIME header*



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7.4.4 Message Transfer

- The simplest way to do this is to establish a transport connection from the source machine to the destination machine and then just transfer the message.
- SMTP(Simple mail transfer Protocol) is used to transfer email. e-mail is delivered by having the source machine establish a TCP connection to port 25 of the destination machine.

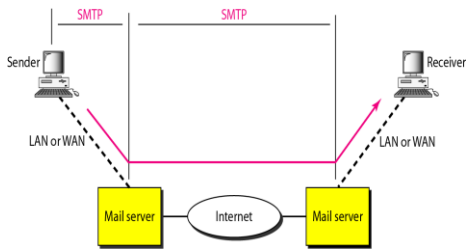
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Table *Data types and subtypes in MIME*

Type	Subtype	Description
Text	Plain	Unformatted
	HTML	HTML format (see Chapter 27)
Multipart	Mixed	Body contains ordered parts of different data types
	Parallel	Same as above, but no order
	Digest	Similar to mixed subtypes, but the default is message/ RFC822
	Alternative	Parts are different versions of the same message
Message	RFC822	Body is an encapsulated message
	Partial	Body is a fragment of a bigger message
	External-Body	Body is a reference to another message
Image	JPEG	Image is in JPEG format
	GIF	Image is in GIF format
Video	MPEG	Video is in MPEG format
Audio	Basic	Single-channel encoding of voice at 8 kHz
Application	PostScript	Adobe PostScript
	Octet-stream	General binary data (8-bit bytes)

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7.4.4 Message Transfer



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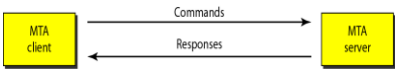
Figure *SMTP range*

Table *Content-transfer-encoding*

Type	Description
7-bit	NVT ASCII characters and short lines
8-bit	Non-ASCII characters and short lines
Binary	Non-ASCII characters with unlimited-length lines
Base-64	6-bit blocks of data encoded into 8-bit ASCII characters
Quoted-printable	Non-ASCII characters encoded as an equals sign followed by an ASCII code

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Figure *Commands and responses*



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Figure Command format



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Table Responses (continued)

Code	Description
Permanent Negative Completion Reply	
500	Syntax error; unrecognized command
501	Syntax error in parameters or arguments
502	Command not implemented
503	Bad sequence of commands
504	Command temporarily not implemented
550	Command is not executed; mailbox unavailable
551	User not local
552	Requested action aborted; exceeded storage location
553	Requested action not taken; mailbox name not allowed
554	Transaction failed

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Table 14 Commands from client to server

Keyword	Argument(s)
HELO	Sender's host name
MAIL FROM	Sender of the message
RCPT TO	Intended recipient of the message
DATA	Body of the mail
QUIT	
RSET	
VRFY	Name of recipient to be verified
NOOP	
TURN	
EXPN	Mailing list to be expanded
HELP	Command name
SEND FROM	Intended recipient of the message
SMOL FROM	Intended recipient of the message
SMAL FROM	Intended recipient of the message

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7.4.5 Final Delivery

- we have assumed that all users work on machines that are capable of sending and receiving e-mail.
- what happens when Elinor wants to send Carolyn e-mail and Carolyn is not currently on-line? Elinor cannot establish a TCP connection to Carolyn and thus cannot run the SMTP protocol.
- One solution is to have a message transfer agent on an ISP machine accept e-mail for its customers and store it in their mailboxes on an ISP machine. Since this agent can be on-line all the time, e-mail can be sent to it 24 hours a day.
- The solution to this problem is to create another protocol that allows user transfer agents (on client PCs) to contact the message transfer agent (on the ISP's machine) and allow e-mail to be copied from the ISP to the user. One such protocol is POP3 (Post Office Protocol Version 3)

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Table Responses from server to client

Code	Description
Positive Completion Reply	
211	System status or help reply
214	Help message
220	Service ready
221	Service closing transmission channel
250	Request command completed
251	User not local; the message will be forwarded
Positive Intermediate Reply	
354	Start mail input
Transient Negative Completion Reply	
421	Service not available
450	Mailbox not available
451	Command aborted: local error
452	Command aborted: insufficient storage

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Final Delivery

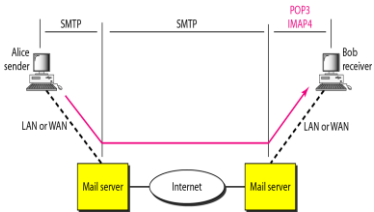


Figure POP3 and IMAP4

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7.4.5 Final Delivery

- The first and the second stages of mail delivery use SMTP. However, SMTP is not involved in the third stage because SMTP is a push protocol.
- It pushes the message from the client to the server. Direction of the bulk data from client to the server.
- The third stage needs a pull protocol. The client must pull messages from the server. The direction of bulk data is from the server to the client. the third stage uses a message access agent.
- Currently two message access protocol are available: Post office Protocol , version 3 and Internet mail access protocol, version 4.

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IMAP

- IMAP (Internet Message Access Protocol), which is defined in RFC 2060. Unlike POP3, which basically assumes that the user will clear out the mailbox on every contact and work off-line after that, IMAP assumes that all the e-mail will remain on the server indefinitely in multiple mailboxes.
- IMAP provides extensive mechanisms for reading messages or even parts of messages, a feature useful when using a slow modem to read the text part of a multipart message with large audio and video attachments.
- Since the working assumption is that messages will not be transferred to the user's computer for permanent storage, IMAP provides mechanisms for creating, destroying, and manipulating multiple mailboxes on the server. In this way a user can maintain a mailbox for each correspondent and move messages there from the inbox after they have been read.

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7.4.5 Final Delivery (POP3)

- POP3 begins when the user starts the mail reader. The mail reader calls up the ISP (unless there is already a connection) and establishes a TCP connection with the message transfer agent at port 110. Once the connection has been established, the POP3 protocol goes through three states in sequence:
- Authorization: deals with having the user log in
- Transactions: deals with the user collecting the e-mails and marking them for deletion from the mailbox
- Update: actually causes the e-mails to be deleted.
- It has two mode delete mode and the keep mode. In the delete mode the mail is deleted from the mailbox after each retrieval. In the keep mode, the mail remains in the mailbox after retrieval. The delete mode is used when user is on his computer. Keep mode is used when user accessing from others computer.

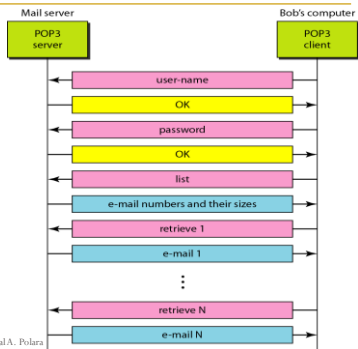
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IMAP

- IMAP4 is more powerful and more complex.
- POP3 does not allow the user to organize his mail on the server the user cannot have different folders on the server.
- POP3 does not allow the user to partially check the contents of the email before downloading.
- IMAP4 provides the following extra functions:
 1. A user can check the email header prior to downloading.
 2. A user can search the contents of the email for a specific string of characters prior to downloading.
 3. A user can partially download email.
 4. A user can create, delete, or rename mailboxes on the mail server.
 5. A user can create a hierarchy of mailboxes in a folder for email storage.

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Figure The exchange of commands and responses in POP3



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A comparison of POP3 and IMAP

Feature	POP3	IMAP
Where is protocol defined?	RFC 1939	RFC 2060
Which TCP port is used?	110	143
Where is e-mail stored?	User's PC	Server
Where is e-mail read?	Off-line	On-line
Connect time required?	Little	Much
Use of server resources?	Minimal	Extensive
Multiple mailboxes?	No	Yes
Who backs up mailboxes?	User	ISP
Good for mobile users?	No	Yes
User control over downloading?	Little	Great
Partial message downloads?	No	Yes
Are disk quotas a problem?	No	Could be in time
Simple to implement?	Yes	No
Widespread support?	Yes	Growing

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7.5 World Wide Web (WWW)

The **WWW** today is a distributed client/server service, in which a client using a browser can access a service using a server. However, the service provided is distributed over many locations called sites.

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Browser(client)

- Each browser consists of three part: a controller, client protocol and interpreters.
- The controller receives input from the keyboard or the mouse and uses the client programs to access the document.
- After accessing document the controller uses one of the interpreters to display the document on screen.

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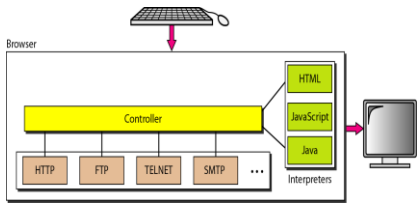
7.5 WWW

- It is a repository of information linked together from points all over the world.
- WWW has a unique combination of flexibility , portability and user–friendly feature.
- It is a distributed client/server service, in which a client using a browser can access a service using a server.
- The service provided is distributed over many locations called sites. Each sites holds one or more documents, referred to as web pages. Each web page can contain a link to other pages in the same site or at other sites. Page can be view using browsers.

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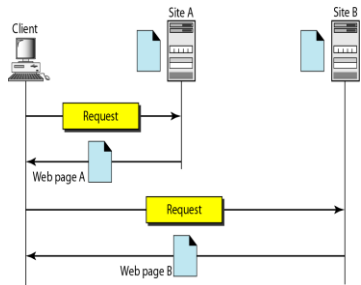
Figure Browser



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Figure Architecture of WWW



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Server and Uniform Resource Locator

- Server is used to send document to client on request.
- A client that wants to access a web page needs the address.
- The uniform resource locator is a standard for specifying any kind of information on the internet.
- The protocol is the client/server program used to retrieve the document.
- The host is the computer on which the information is located.
- The port is port available on computer.
- The path is the pathname of the file where the information is located.

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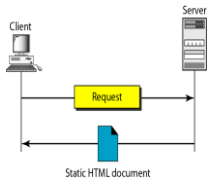
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Figure URL



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Figure Static document



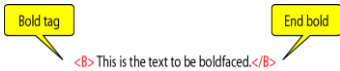
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7.5.1 Web Documents

- There are three types of documents: static, dynamic and active.
- **Static Documents:** It is fixed content documents that are created and store in a server.
- The client can get only a copy of the document. It can not change when it is used.
- Ex. HTTP language is used to create static doc.
- **Dynamic documents:** It is created by a web sever whenever requests the document.
- When an application arrives application program or a script that create the dynamic document.
- Ex. Common gateway interface(CGI) used to create dynamic documents.

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Figure Boldface tags

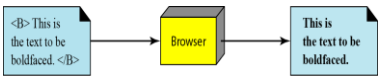


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- **Active documents:** the program or script which is require to run some program at client side is called active documents.
- It is also known as client side dynamic documents.
- for example a program that creates animated graphics on the screen or a program that interacts with the user. This types of program needs to be run at the client site where the animation or interaction take place.
- For example. Java applet is used to create active documents.

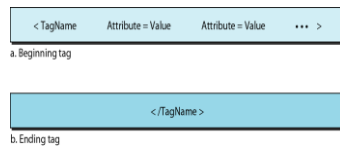
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Figure Effect of boldface tags



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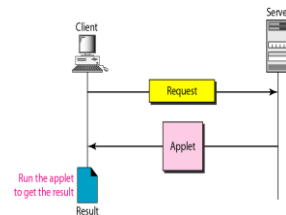
Figure Beginning and ending tags



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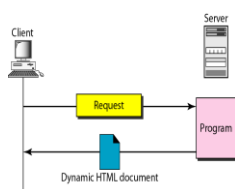
Figure Active document using Java applet



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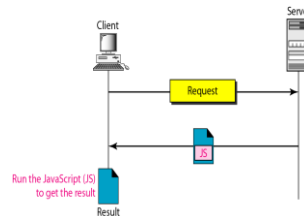
Figure Dynamic document using CGI



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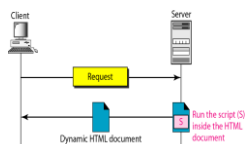
Figure Active document using client-site script



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Figure Dynamic document using server-site script



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7.5.2 HTTP

- It is a Hyper text transfer protocol (HTTP) used mainly to access data on the world wide web. It is a **stateless** protocol.
- It function as a combination of FTP and SMTP. It is similar to FTP because it transfers files and uses the services of TCP. It is simpler than FTP because it uses only one TCP connection. No separate control connection only data transfer take place.
- HTTP is like SMTP because the data transferred between the client and the sever look like SMTP messages.
- SMTP messages are stored and forward but HTTP messages are delivered immediately.
- HTTP uses the services of TCP on well-known port 80.

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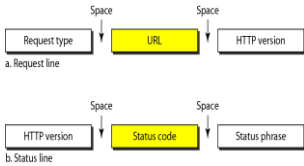
HTTP transaction

- The client initializes the transaction by sending a request message. The server replies by sending response.
- The format of the request and response messages are similar. A request message consists of a request line, a header and sometimes a body. A response message consists of a status line, a header and sometimes a body.
- **Request and Status line:** The first line in a request message is called a request line, the first line in the response message is called the **status line**.
- **Request type:** It is defined as per the format.
- **URL:** as per the previous topic.
- **Version:** The most current version of HTTP is 1.1.
- **Status code:** It consists of three digits.
- **Status phrase:** this field is used in the response message. It explains the status code in text form.

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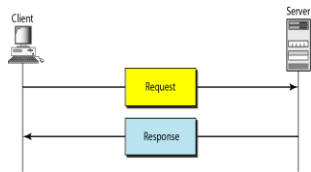
Figure Request and status lines



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Figure HTTP transaction



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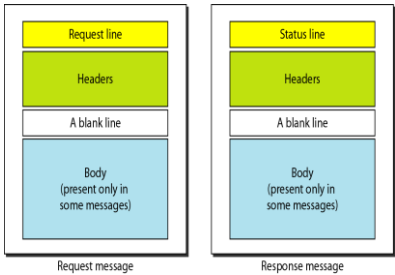
Table Methods of Request type

Method	Action
GET	Requests a document from the server
HEAD	Requests information about a document but not the document itself
POST	Sends some information from the client to the server
PUT	Sends a document from the server to the client
TRACE	Echoes the incoming request
CONNECT	Reserved
OPTION	Inquires about available options

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Figure Request and response messages



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Table Status codes

Code	Phrase	Description
Informational		
100	Continue	The initial part of the request has been received, and the client may continue with its request.
101	Switching	The server is complying with a client request to switch protocols defined in the upgrade header.
Success		
200	OK	The request is successful.
201	Created	A new URL is created.
202	Accepted	The request is accepted, but it is not immediately acted upon.
204	No content	There is no content in the body.

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Table *Status codes (continued)*

Code	Phrase	Description
Redirection		
301	Moved permanently	The requested URL is no longer used by the server.
302	Moved temporarily	The requested URL has moved temporarily.
304	Not modified	The document has not been modified.
Client Error		
400	Bad request	There is a syntax error in the request.
401	Unauthorized	The request lacks proper authorization.
403	Forbidden	Service is denied.
404	Not found	The document is not found.
405	Method not allowed	The method is not supported in this URL.
406	Not acceptable	The format requested is not acceptable.
Server Error		
500	Internal server error	There is an error, such as a crash, at the server site.
501	Not implemented	The action requested cannot be performed.
503	Service unavailable	The service is temporarily unavailable, but may be requested in the future.

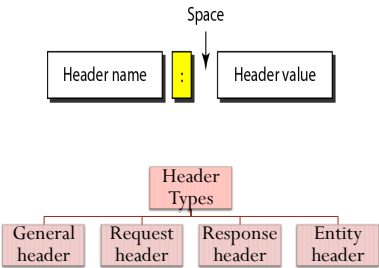
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HTTP header

- **Response header:** It specifies the server's configuration and special information about the request.
- **Entity header:** It gives information about the body of the document.
- **Body:** It can be present in a request or response message. It contains the document to be sent or received.

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Figure *Header format*



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Table *General headers*

Header	Description
Cache-control	Specifies information about caching
Connection	Shows whether the connection should be closed or not
Date	Shows the current date
MIME-version	Shows the MIME version used
Upgrade	Specifies the preferred communication protocol

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HTTP header

- It is used to exchange additional information between client and server. The header can consists of one or more header lines. Each header line has a header name, a colon, a space, and a header value.
- A header line belongs to one of four categories: General header, request header, response header and entity header.
- A request message contain only general, request and entity headers. A response message contain general, response and entity headers.
- **General Header:** It gives general information about the message and can be present in both a request and a response.
- **Request header:** It specifies the client's configuration and the client's preferred document format.
- **Response header:** It specifies the server's configuration and special information about the request.
- **Entity header:** It gives information about the body of the document.

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Table *Request headers*

Header	Description
Accept	Shows the medium format the client can accept
Accept-charset	Shows the character set the client can handle
Accept-encoding	Shows the encoding scheme the client can handle
Accept-language	Shows the language the client can accept
Authorization	Shows what permissions the client has
From	Shows the e-mail address of the user
Host	Shows the host and port number of the server
If-modified-since	Sends the document if newer than specified date
If-match	Sends the document only if it matches given tag
If-non-match	Sends the document only if it does not match given tag
If-range	Sends only the portion of the document that is missing
If-unmodified-since	Sends the document if not changed since specified date
Referer	Specifies the URL. of the linked document
User-agent	Identifies the client program

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Table *Response headers*

Header	Description
Accept-range	Shows if server accepts the range requested by client
Age	Shows the age of the document
Public	Shows the supported list of methods
Retry-after	Specifies the date after which the server is available
Server	Shows the server name and version number

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Proxy Server

- HTTP supports proxy servers.
- A proxy server is a computer that keeps copies of responses to recent requests.
- The HTTP client sends a request to the proxy server. The proxy server checks its cache.
- If the response is not stored in the cache, the proxy server sends the request to the corresponding server. Incoming responses are sent to the proxy server and stored for future requests from other clients.
- The proxy server reduces the load on the original server, decreases traffic, and improves latency.
- To use the proxy server, the client must be configured to access the proxy instead of the target server.

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Table *Entity headers*

Header	Description
Allow	Lists valid methods that can be used with a URL
Content-encoding	Specifies the encoding scheme
Content-language	Specifies the language
Content-length	Shows the length of the document
Content-range	Specifies the range of the document
Content-type	Specifies the medium type
Etag	Gives an entity tag
Expires	Gives the date and time when contents may change
Last-modified	Gives the date and time of the last change
Location	Specifies the location of the created or moved document

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Thank You

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Persistent Versus Nonpersistent Connection

- In a nonpersistent connection, one TCP connection is made for each request/response.
- The following lists the steps in this strategy:
 1. The client opens a TCP connection and sends a request.
 2. The server sends the response and closes the connection.
 3. The client reads the data until it encounters an end-of-file marker; it then closes the connection.
- In a persistent connection, the server leaves the connection open for more requests after sending a response.
- The server can close the connection at the request of a client or if a time-out has been reached.
- HTTP version 1.1 specifies a persistent connection by default.

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